FutureDEAL
Digital Education And Learning

Pädagogische Hochschule Steiermark

TU Graz

ARISHNA

Workshop

Next-Gen IoT Teaching and Learning Platform with AIoT Development Kit and IoT Cloud

SFSCON

13:00
40 mins
08/11/2025

COHESION ITALY 21-27
ALTO ADIGE SÜDTIROL

Co-funded by the European Union

AUTONOME PROVINZ BOZEN SÜDTIROL
PROVINCIA AUTONOMA DI BOLZANO ALTO ADIGE
PROVINZIA AUTONOMA DE BULSAN SÜDTIROL

Krishan Mohan Patel

Founder/CEO- Arishna IoT Solutions

Experience

Founder of Arishna IoT Solutions

8+ years in Industry

Lecturer, Institute for Digital media Education (PHSt)

Member of MareMundi Consortium Project Group

Interests

IoT/IIoT(Internet of Things)

AI/ML (Artificial Intelligence / Machine Learning)

Augmented Reality

Cyber Security

Roles

Supervising and Trainer, Industry Professionals, Academics, and IoT Enthusiasts

Technical Speaker at Tech Conferences

More Details

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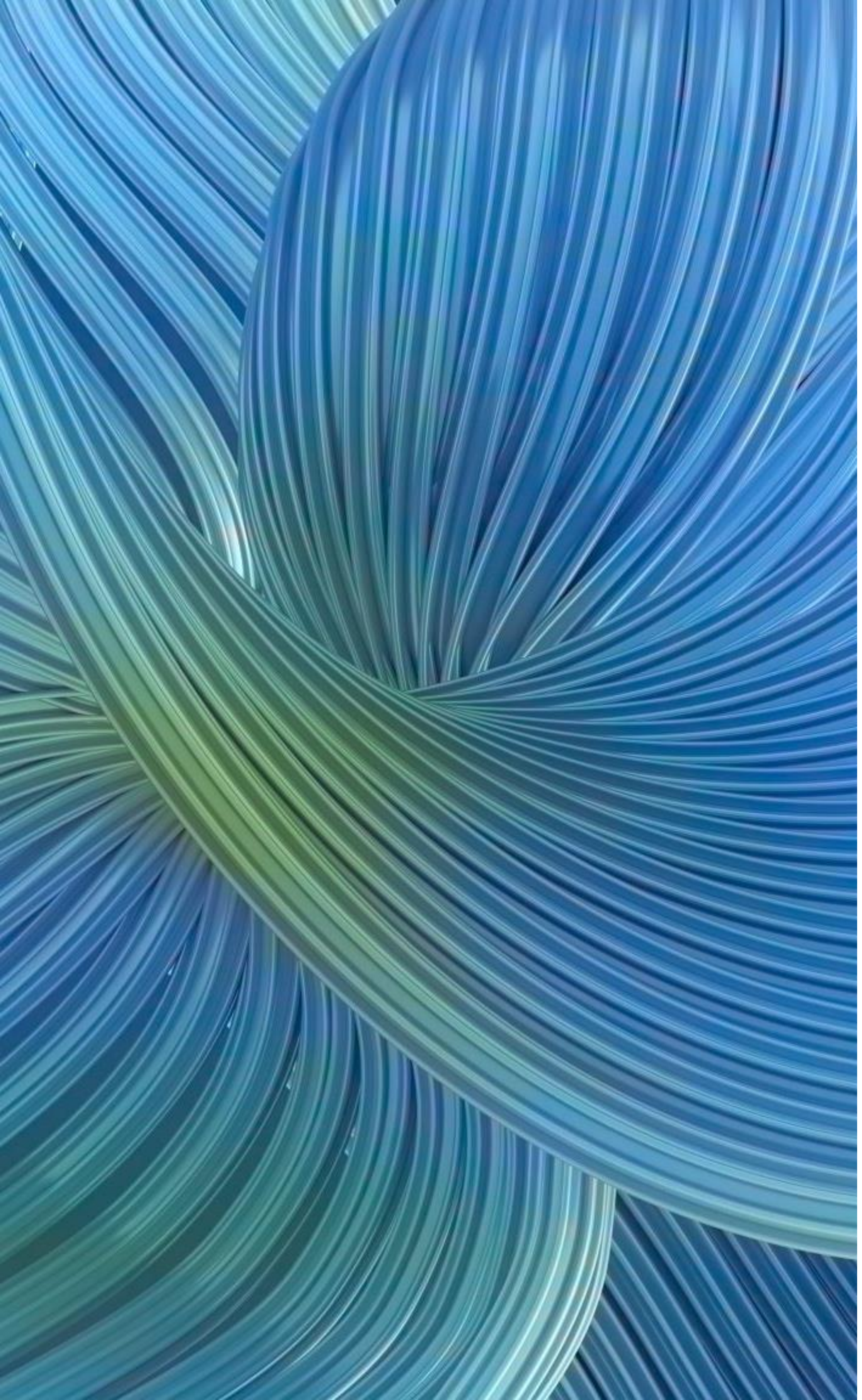
Email: info@arishnaiotsolutions.com



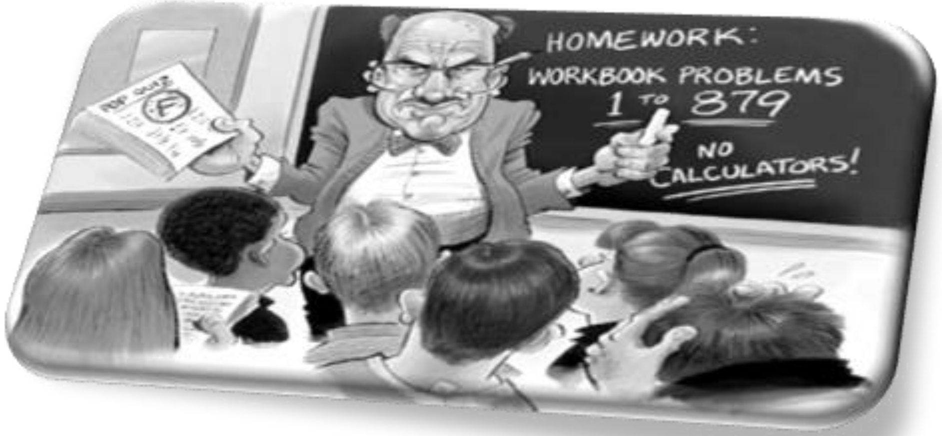
Overview

Introduction

Rapid Technological Advancements Outpace Traditional Curricula.

Need for Integrating AI, IoT, and AR into education.

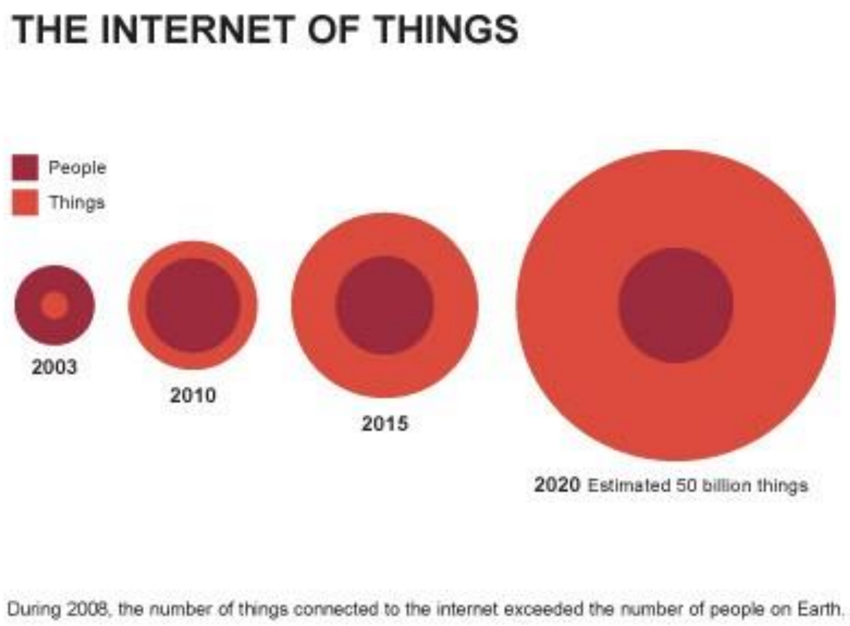
Aim: Bridge Theoretical Knowledge with Practical Application

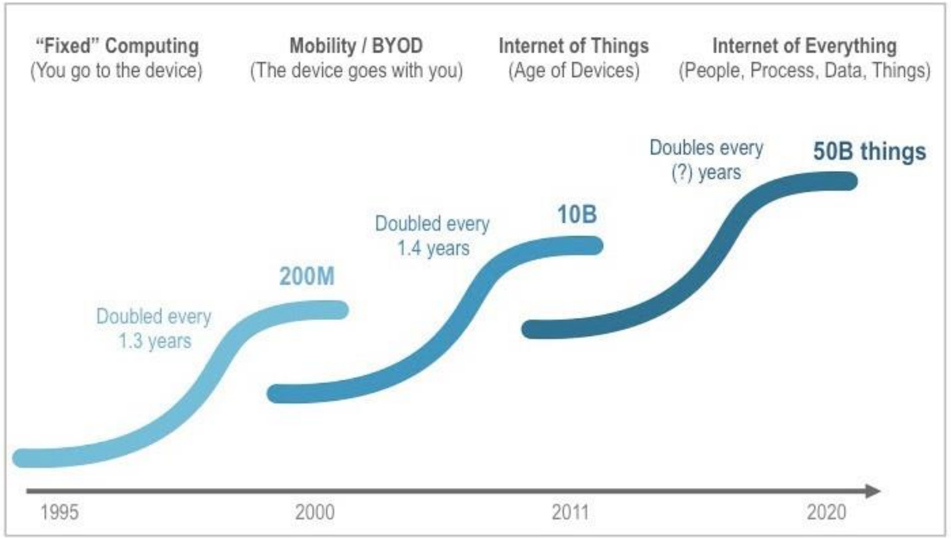


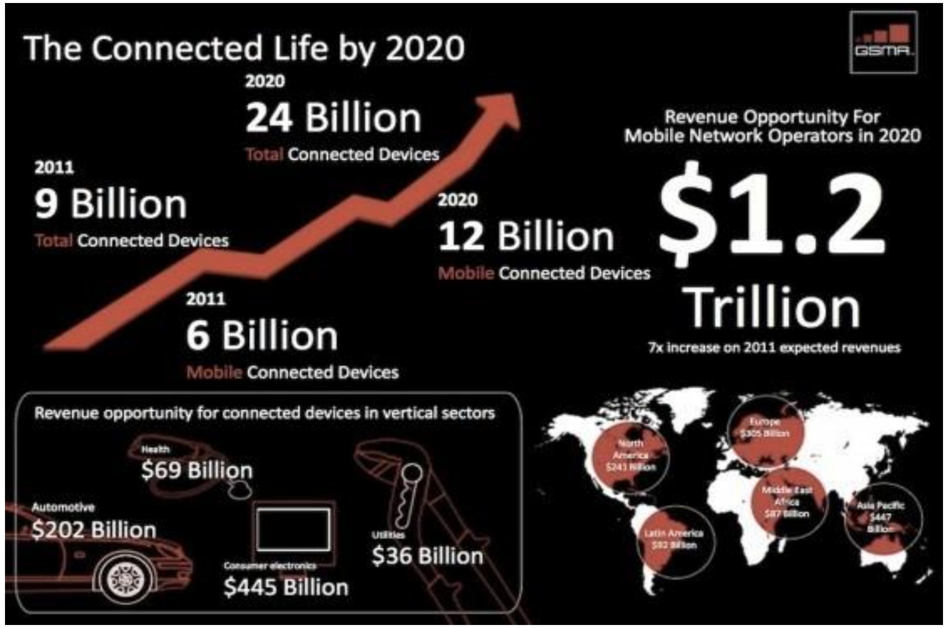
What is IoT

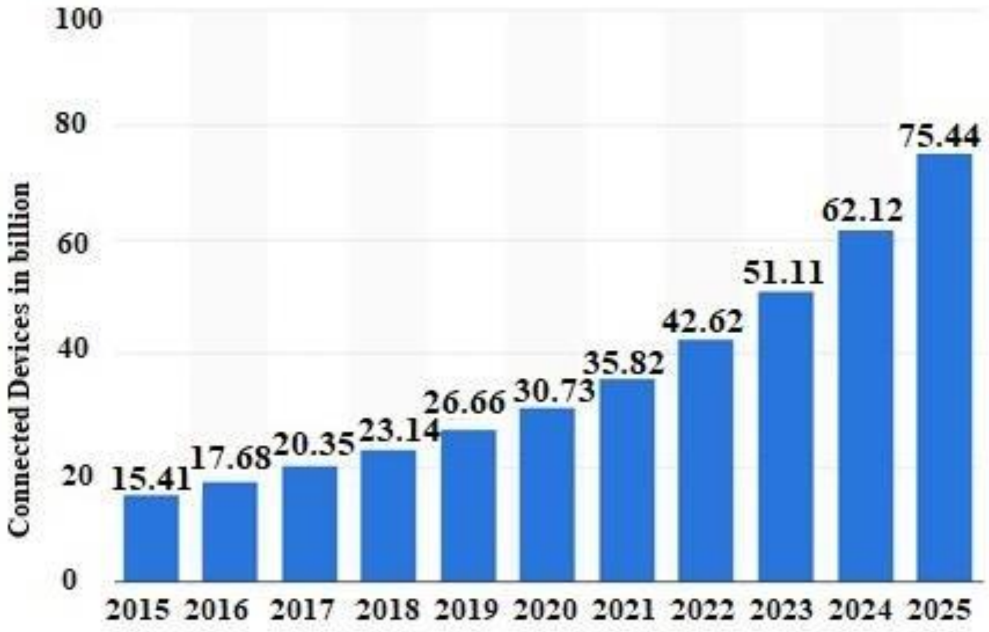
- The Internet of Things (IoT) envisions a self-configuring, adaptive, complex network that interconnects ‘things’ to the Internet through the use of standard communication protocols. The interconnected things have physical or virtual representation in the digital world, sensing/actuation capability, a programmability feature, and are uniquely identifiable.

A commonly cited version from IEEE

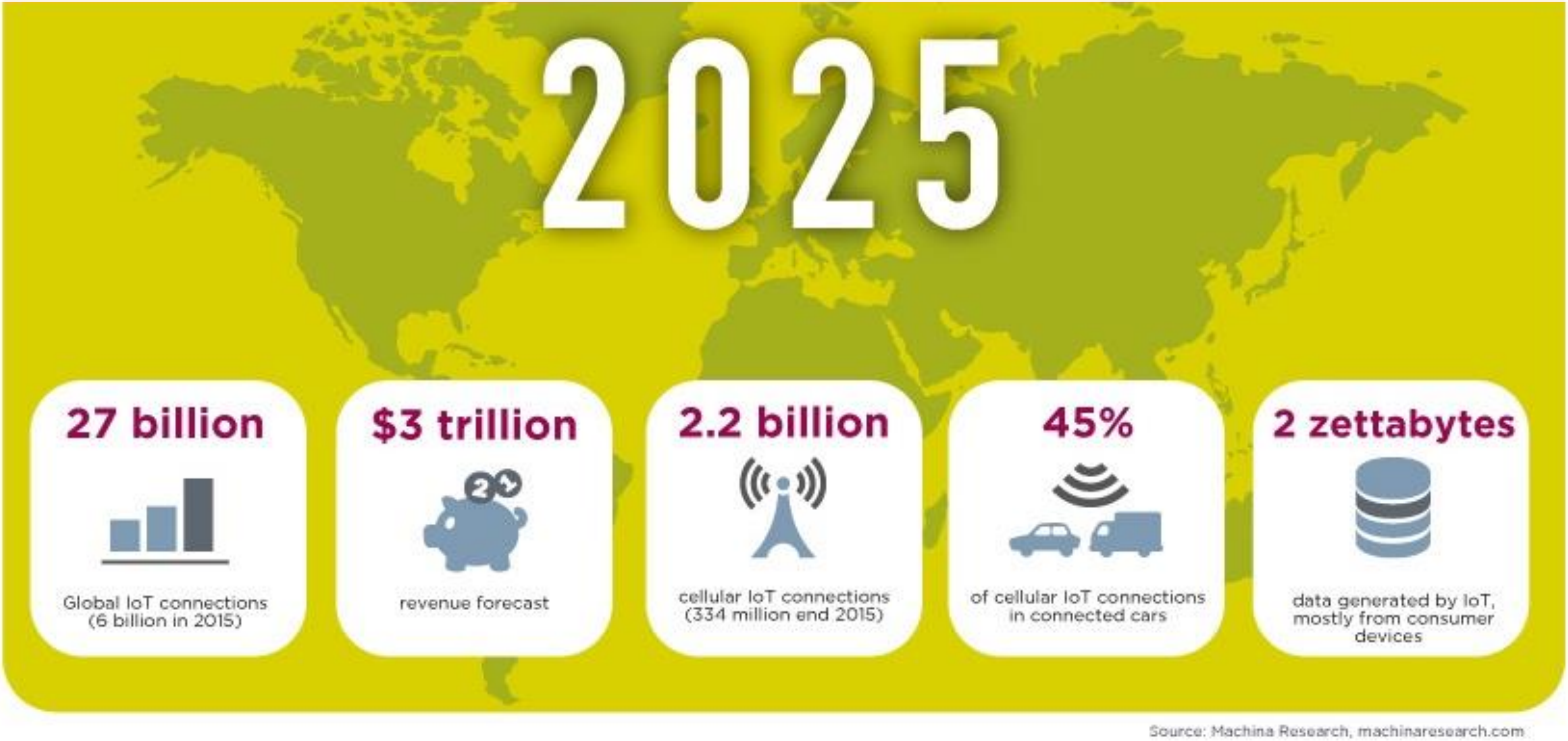

THE INTERNET OF THINGS
People
Things
2003
2010
2015
2020 Estimated 50 billion things
During 2008, the number of things connected to the internet exceeded the number of people on Earth.

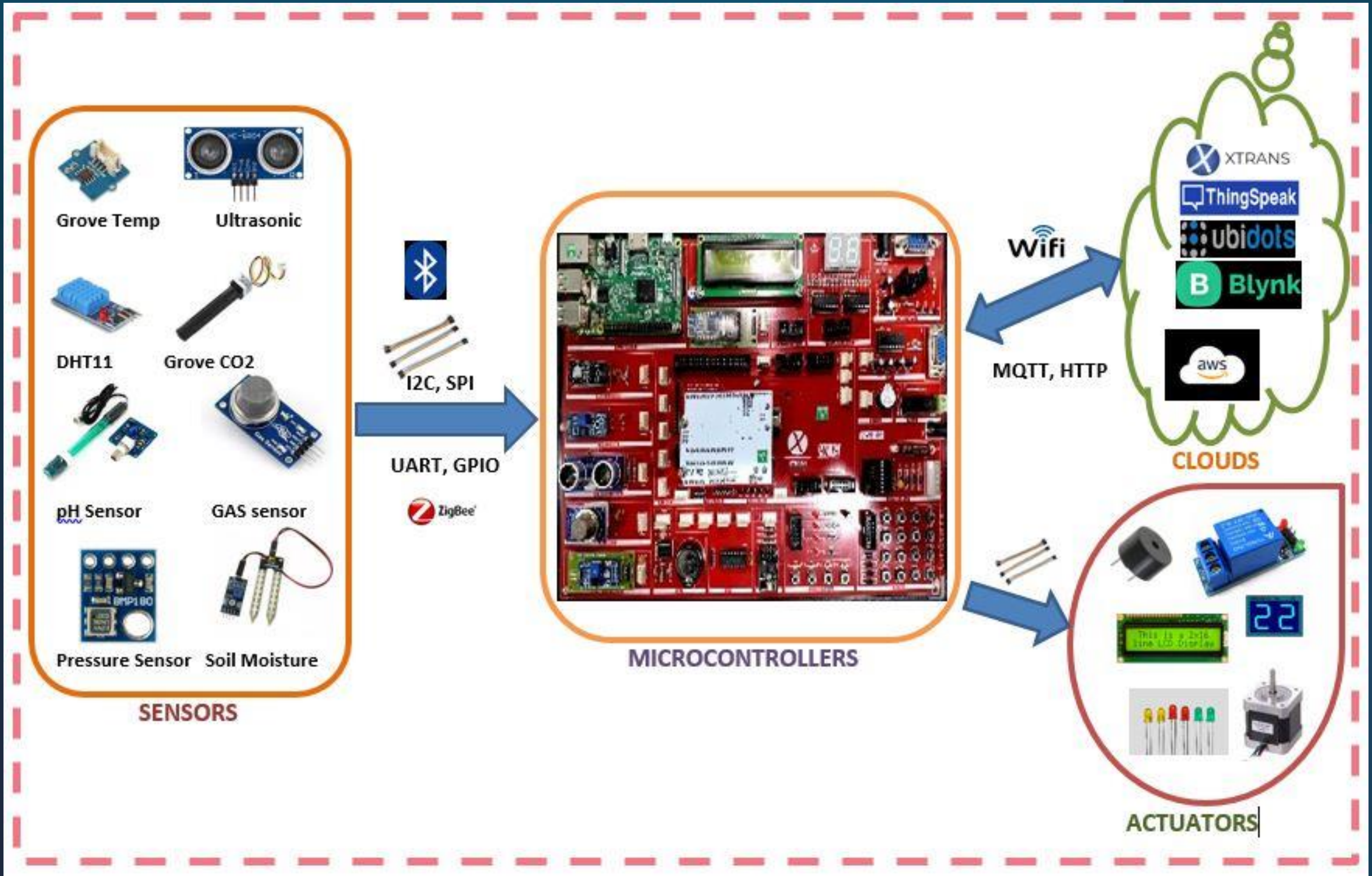

"Fixed" Computing
(You go to the device)
Mobility / BYOD
(The device goes with you)
Internet of Things
(Age of Devices)
Internet of Everything
(People, Process, Data, Things)
Doubled every
1.3 years
200M
Doubled every
1.4 years
10B
Doubles every
(?) years
50B things
1995
2000
2011
2020


The Connected Life by 2020
GSMA
2020
24 Billion
Total Connected Devices
2011
9 Billion
Total Connected Devices
2020
12 Billion
Mobile Connected Devices
2011
6 Billion
Mobile Connected Devices
Revenue Opportunity For
Mobile Network Operators in 2020
$1.2
Trillion
7x increase on 2011 expected revenues
Revenue opportunity for connected devices in vertical sectors
Health
$69 Billion
Automotive
$202 Billion
Consumer electronics
$445 Billion
Utilities
$36 Billion


Connected Devices in billion
100
80
60
40
20
0
15.41
17.68
20.35
23.14
26.66
30.73
35.82
42.62
51.11
62.12
75.44
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

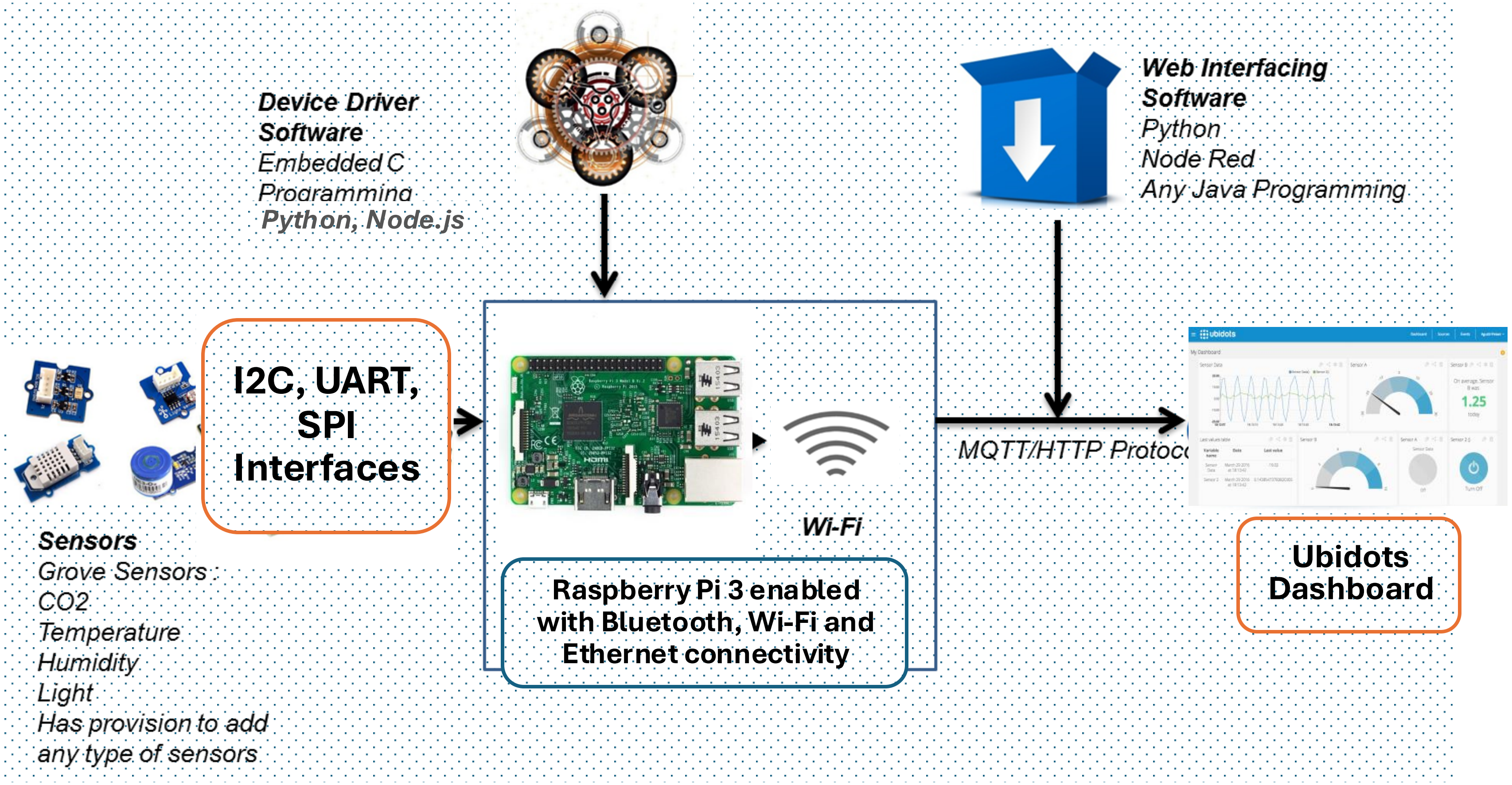
5 IoT predictions for IoT in



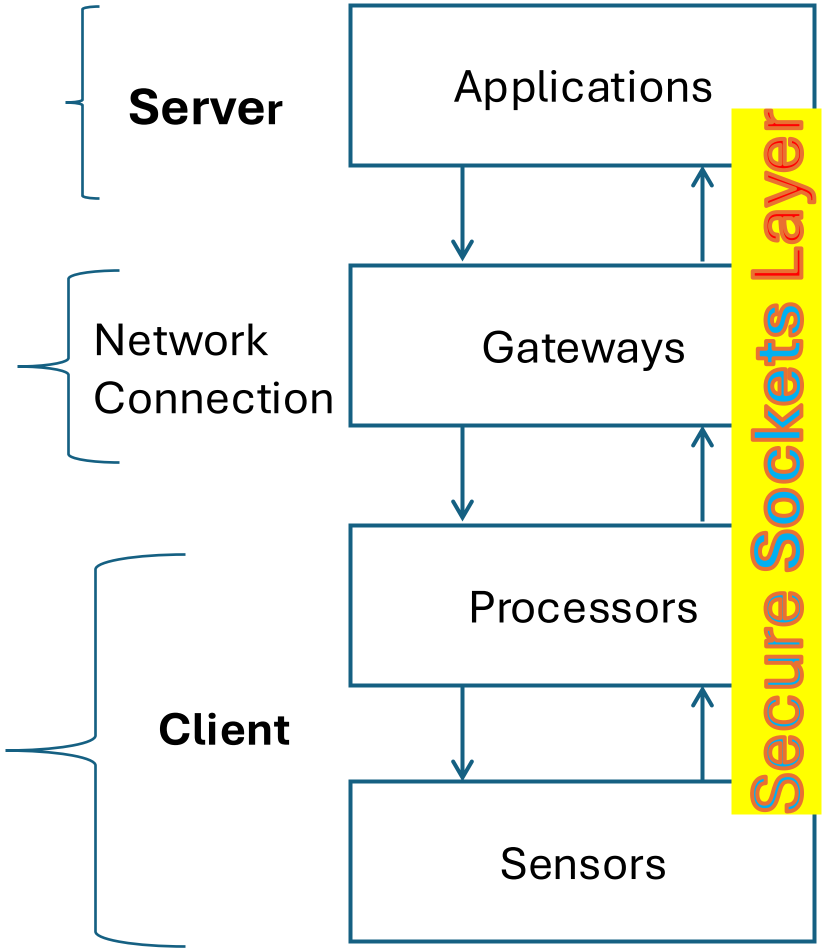


Grove Temp
Ultrasonic
DHT11
Grove CO2
pH Sensor
GAS sensor
Pressure Sensor
Soil Moisture
SENSORS
I2C, SPI
UART, GPIO
ZigBee
MICROCONTROLLERS
Wifi
MQTT, HTTP
XTRANS
ThingSpeak
ubidots
Blynk
aws
CLOUDS
ACTUATORS

IoT Schematic Diagram



Why Blockchain in IoT applications



Challenges :

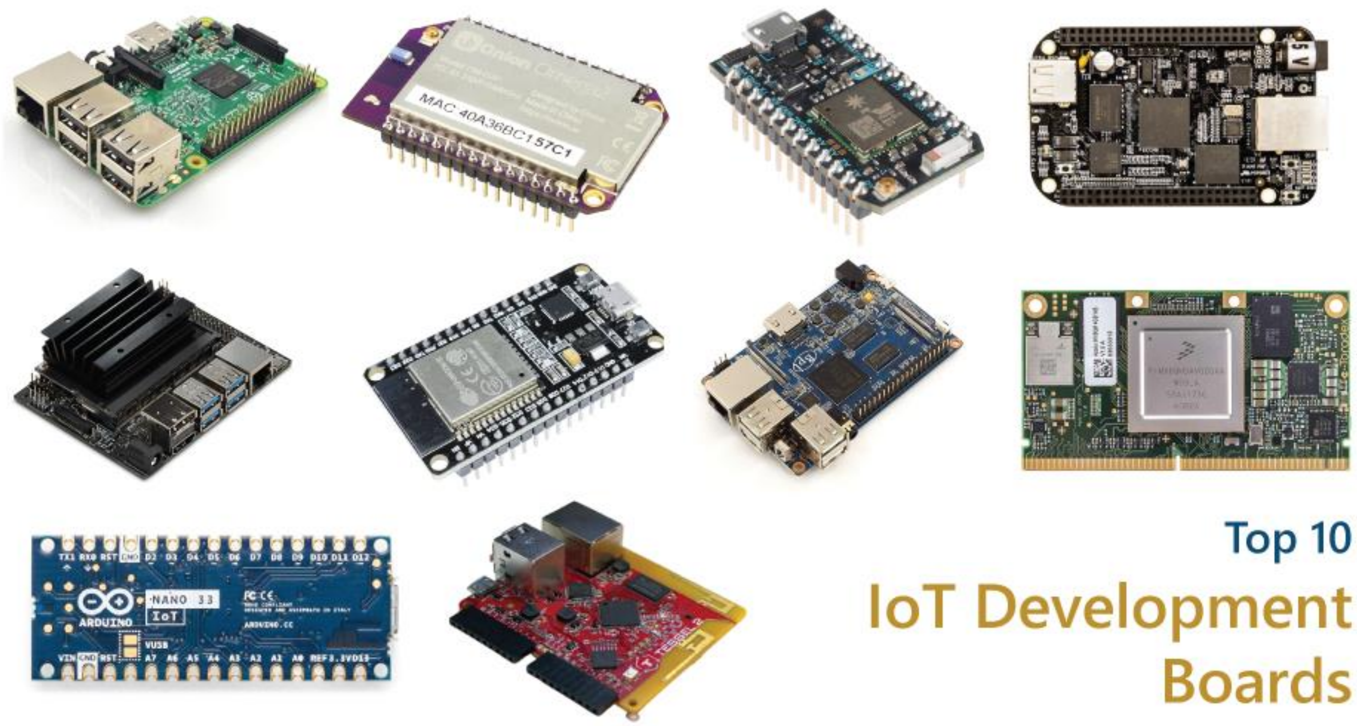
Devices are growing with respect to time, Can SSL handle the situations?

If you take Moore's law (growth of semiconductors) as reference, SSL may not be sufficient to address security for billions of connected devices

Of course, one can invest on embedded encryption/decryption within hardware, but this will be a very costly proposition and scaling up be more challenging.

IoT Development Boards

- Raspberry Pi
- Omega 2
- Particle Photon
- Beagle bone –
- Jetson Nano
- ESP 32
- Banana Pi
- Arduino Nano 33 IoT
- Tessel 2
- i.MX 8



Sensor Technology

Sensor technology

1 language

Article discussion To read Edit Edit source code Version history Tools

In engineering, sensor technology refers to the science and application of sensors for measuring and controlling changes in various measured quantities from different fields, e.g. physics (see measurement principle), chemistry or the environment.

Modern sensor technology evolved from analog measurement technology . It encompasses both academic and application-specific aspects of sensor development and physics/technology, accuracy , design and manufacturing of sensor elements as components, and measurement technology . In the simplest case, analog measured quantities are converted into electrical signals (see digital electronics) using analog-to-digital converters (ADCs) for further use. Sensor technology enables, among other things, a high degree of automation . In the latter case, so-called standard signals or fieldbuses are used.

Today there are thousands of different sensors, ranging from relatively simple temperature sensors to sensors for measuring nuclear radiation , pressure, humidity, force, electromagnetic quantities, gases, motion sensors , position sensors, or optical sensors . Some sensors are integrated with actuators in microsystems .

Sensor technology is not a closed field. Besides the sensor technology mentioned above, it also includes switching systems (e.g., light barriers) and laboratory and industrial measurement systems for automation.

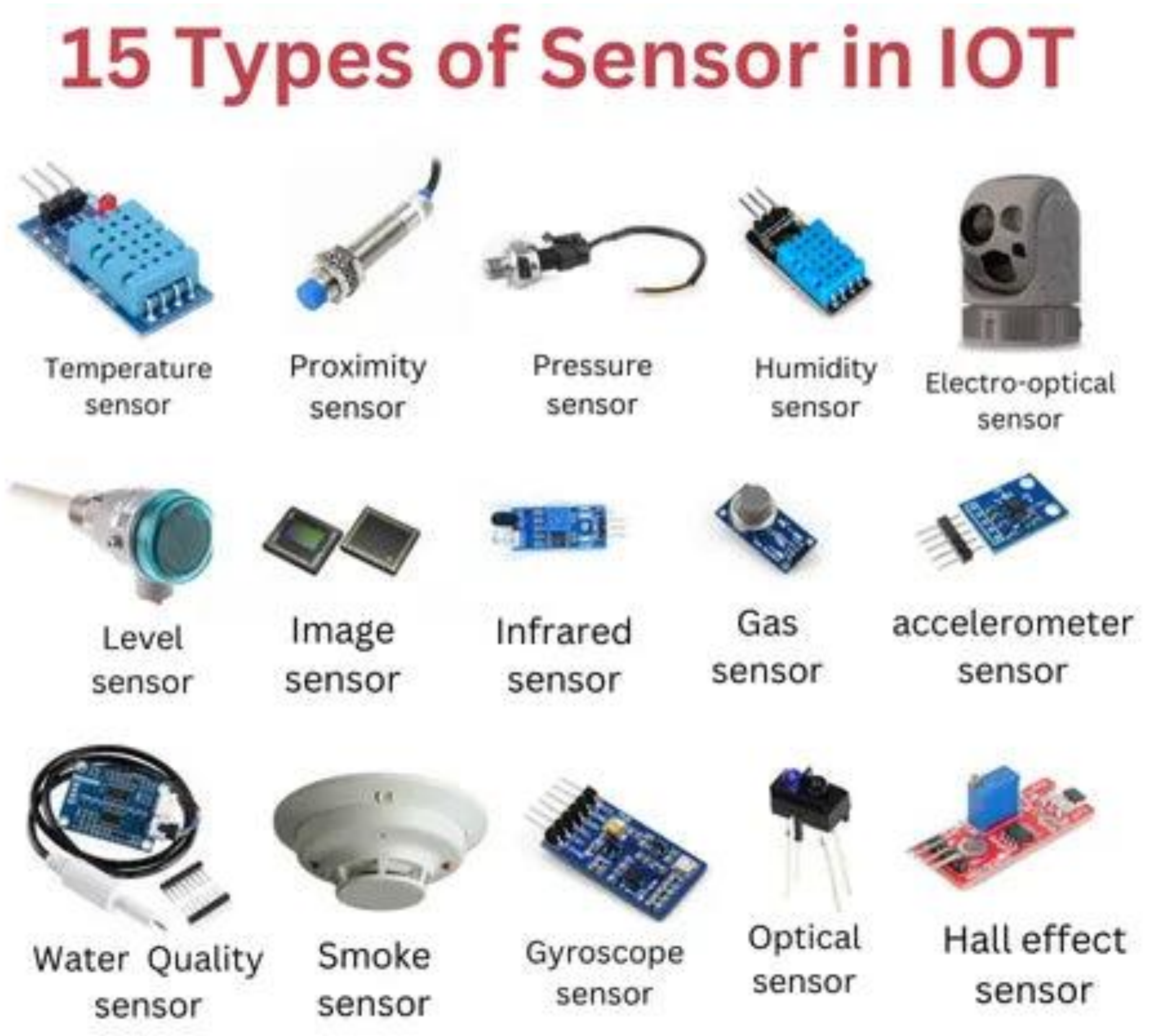
appearance Hide

text
Small
standard
Large

Width
standard
Broad

Color (Beta)
Automatically
Bright
Dark

IoT Sensors


15 Types of Sensor in IOT
Temperature sensor
Proximity sensor
Pressure sensor
Humidity sensor
Electro-optical sensor
Level sensor
Image sensor
Infrared sensor
Gas sensor
accelerometer sensor
Water Quality sensor
Smoke sensor
Gyroscope sensor
Optical sensor
Hall effect sensor

IoT Protocols

Hardware Protocols I2C, UART, SPI and GPIO

Inter Integrated Circuit I2C

- Protocol introduced by Philips Semiconductor in 1982.
- Lower speed devices:
  - Standard mode: 100 Kbit/s,
  - Full speed: 400 Kbit/s ,
  - Fast mode: 1 Mbit/s.
  - High speed: 3.2 Mbit/s.
- Master/Slave communication.
- Slave has unique address bits.

Universal Asynchronous Receiver/Transmitter UART

Translates data from Parallel into Serial format.

Also known as RS 232.

Transmits bits serially at a mutually agreed speed without providing a clock.

The speed is known as thebaud rate such as: 9600 baud, 115200 baud, or 10 Mbaud.

Has single wire in each direction (VCC and Ground).

Asynchronous, as there is no clock signal.

UART SPECS

01

The number of start bits is typically 1 or sometimes 1.5.

02

The number of data bits is typically 7 or 8.

03

It has a parity bit which can be an even parity or an odd parity.

04

The number of stop bits is typically 1 or sometimes 2.

Serial Peripheral Interface (SPI)

SPI busis asynchronousserial communicationinterface specification used for short distance communication.

The interface was developed byMotorola.

SPI devices communicate infull duplexmode using amaster-slavearchitecture with a single master.

The master device originates theframefor reading and writing.

Multiple slave devices are supported through selection with individualslave select(SS) lines.

Typical applications includeSecure Digitalcards andliquid crystal displays (LCD).

General Purpose Input Output GPIO

01

Both input and output are controllable by the user at a runtime.

02

No pre-defined pins. They go unused by default.

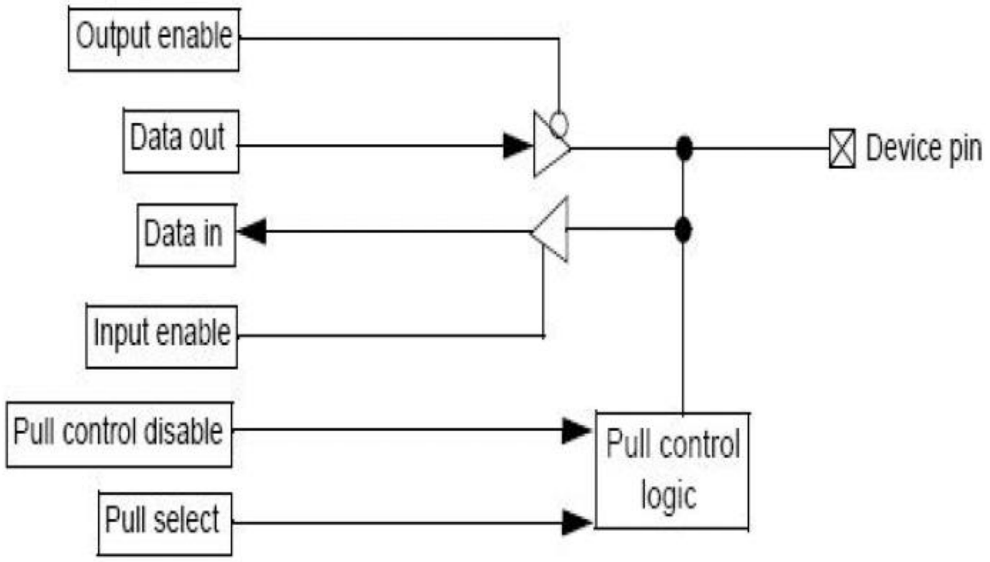
03

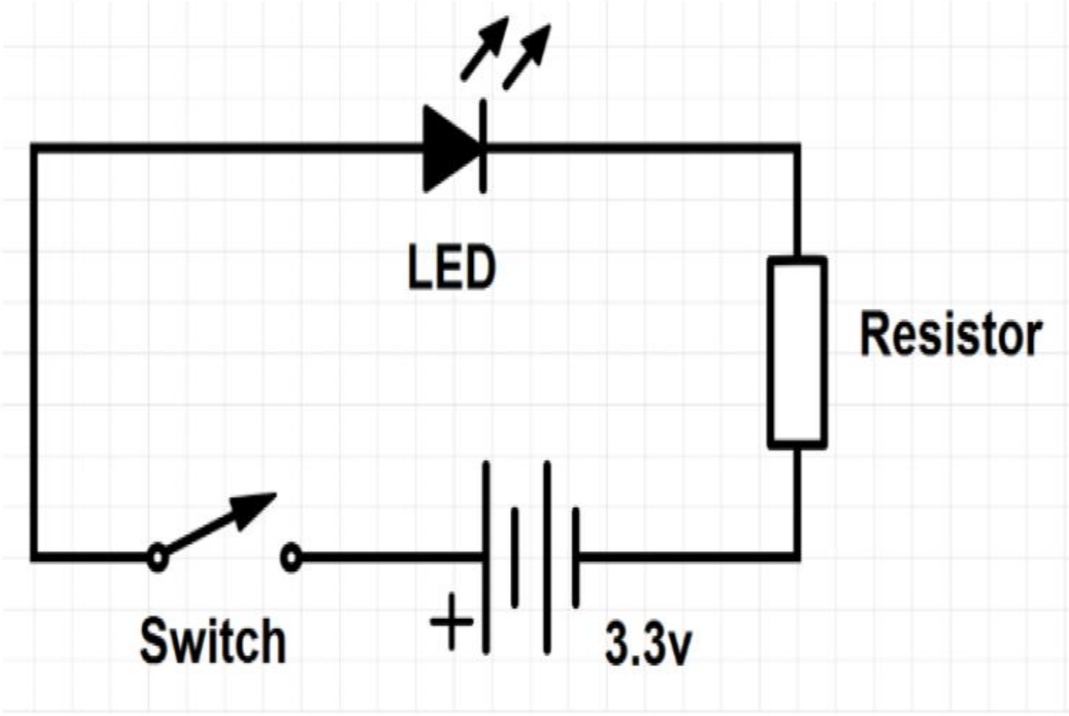
GPIO Pins can be enabled or disabled.

04

May be exposed to the developer for configuring or state set up.

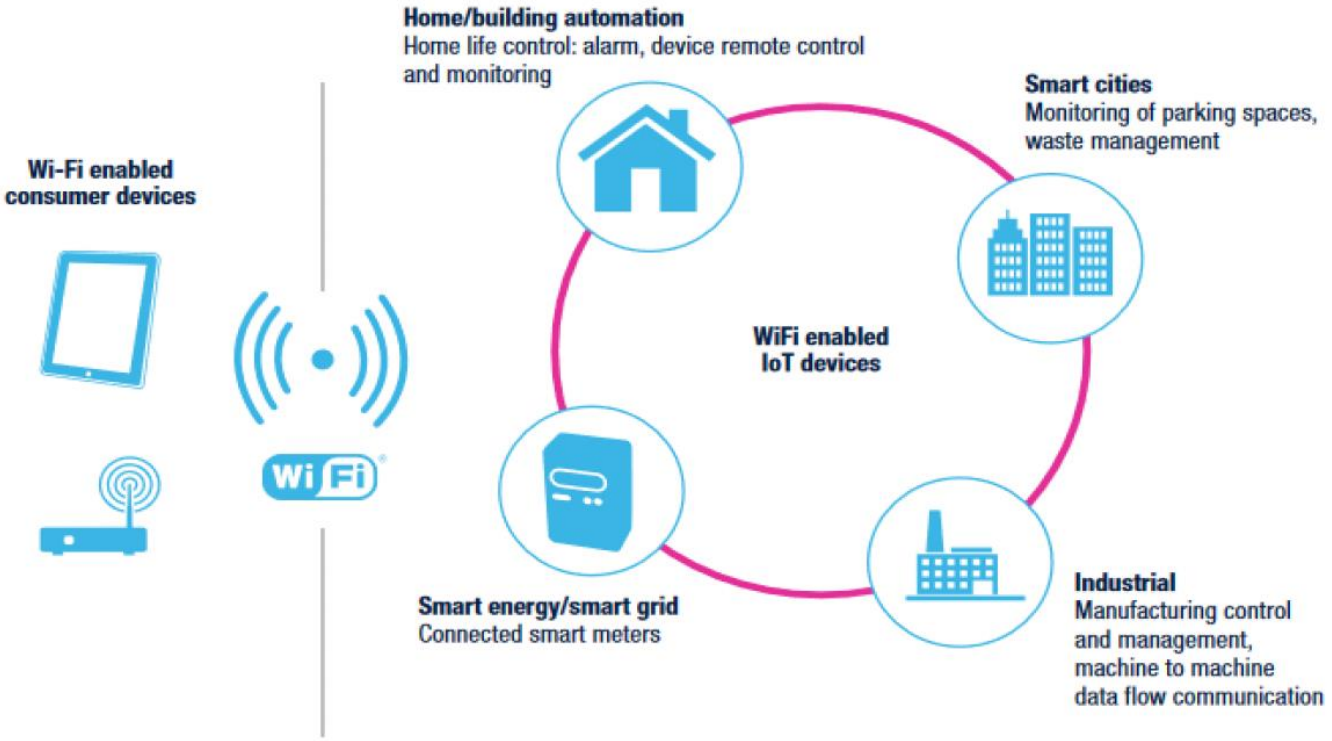
Block Diagram of GPIO





Wireless protocols Wifi, BLE, ZigBee, LoRa, LTE, Sigfox

Wi-Fi


Wi-Fi enabled consumer devices
Wi Fi
Home/building automation
Home life control: alarm, device remote control and monitoring
Smart cities
Monitoring of parking spaces, waste management
WiFi enabled IoT devices
Smart energy/smart grid
Connected smart meters
Industrial
Manufacturing control and management, machine to machine data flow communication

Wi-Fi

Well-configured access points are essential for the growth of the **Internet of Things (IoT)** over **Wi-Fi**.

The **IoT model** connects headless sensors over wireless connections to a **cloud service** that manages them and collects traffic.

This **cloud service** provides a **portal** for analytics and smartphone-based user control.

The sensor later needs to **authenticate** to its cloud service, but only after it has a valid **path through the WLAN (Wireless Local Area Network)**.

Wi-Fi is a **uniform standard**, but security is implemented **per network**.

An **IoT sensor** must be configured to connect to the WLAN using three parameters:

- **Network discovery**
- **Authentication credentials**
- **Device identity**

Wi-Fi Technology

Wi-Fi technology was designed to connect electronic devices within a **Wireless Local Area Network (WLAN)**, enabling them to exchange data or connect to the Internet at speeds of **54 Mbit/s or more**.

It is based on the **IEEE 802.11 family of standards**, operating in the **2.4 GHz (802.11 b/g/n)** and **5 GHz (802.11 a/n/ac)** unlicensed frequency bands available worldwide.

IoT applications have diverse connectivity needs in terms of **range, data throughput, energy efficiency,** and **device cost**.

Data transfer requirements in IoT vary widely — from **small, intermittent data packets** (e.g., utility meters) to **large, continuous streams** (e.g., real-time video surveillance).

Range requirements also differ, spanning **short distances** for wearables to **several kilometers** for environmental, weather, and agricultural applications.

Introduction to Bluetooth Technologies

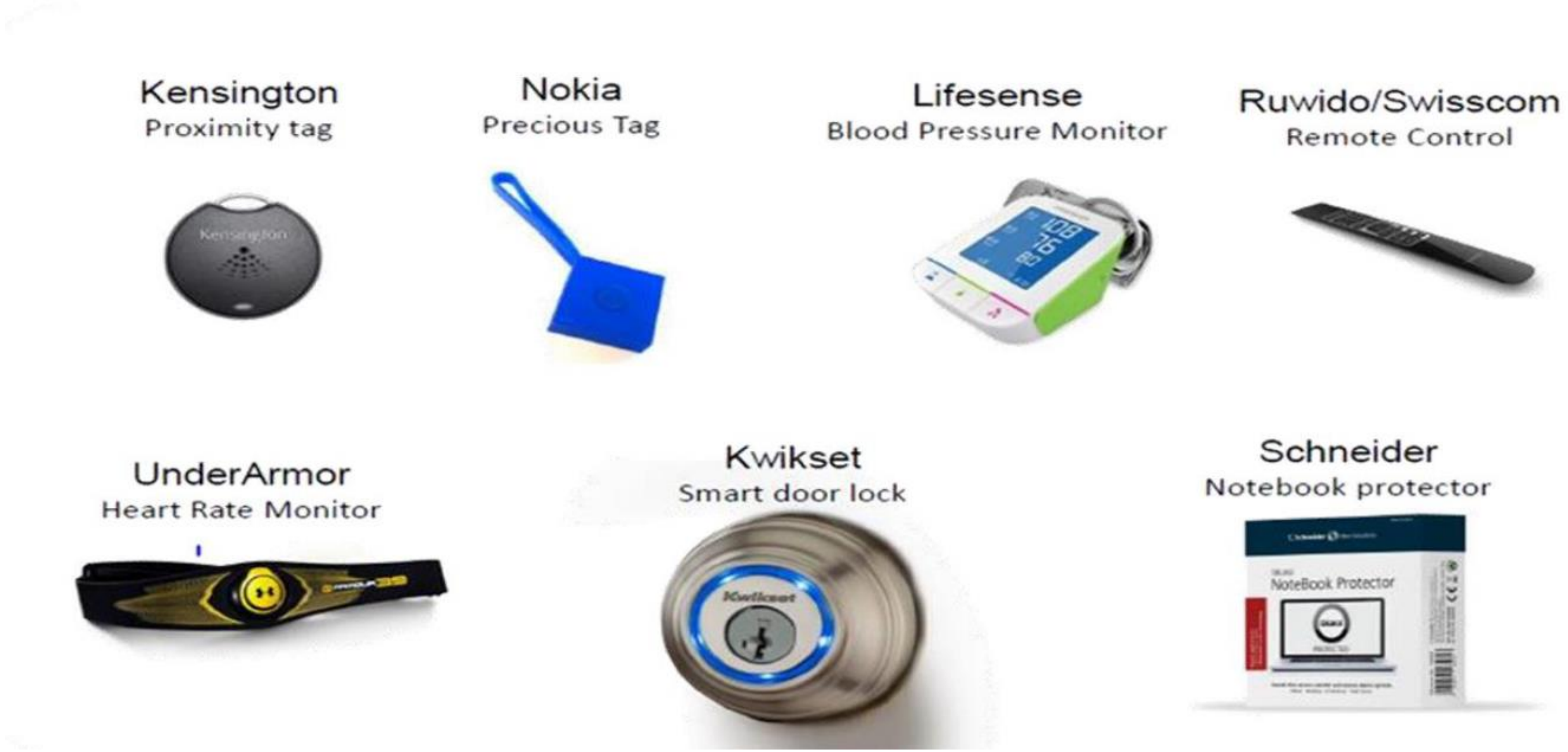
Invented by telecom vendor Ericsson in 1994.

Bluetooth is a wireless technology standard for exchanging data over short distances.

Short -wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz[4]).

Originally conceived as a wireless alternative to RS-232 data cables. It can connect several devices, overcoming problems of synchronization.

Bluetooth 4.0: Example of products



ZigBee

01

ZigBee is the wireless protocol that everyday devices use to connect to one another.

02

ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios.

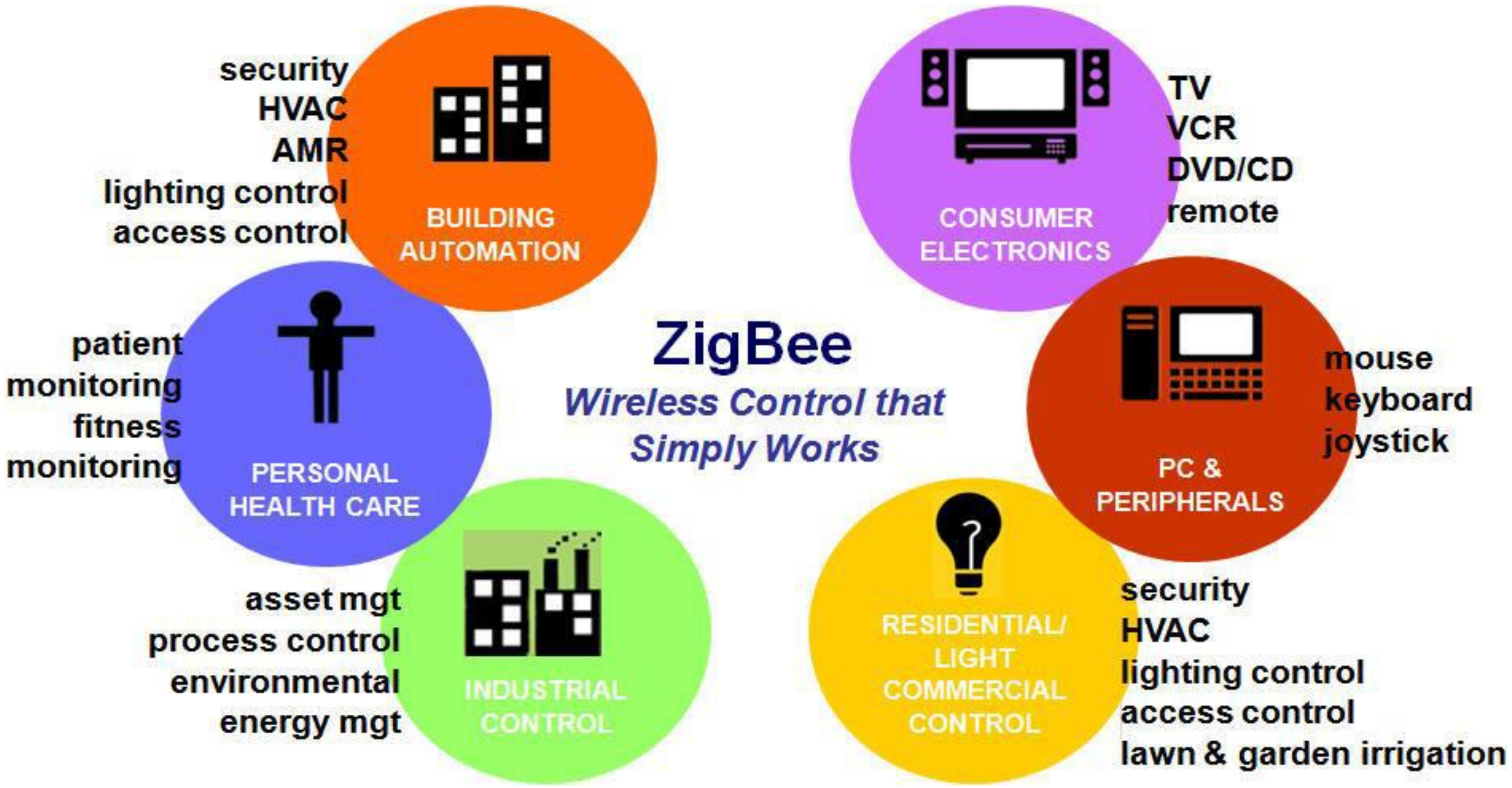
03

The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi.

04

Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics.

ZigBee



security
HVAC
AMR
lighting control
access control
BUILDING AUTOMATION
CONSUMER ELECTRONICS
TV
VCR
DVD/CD
remote
patient monitoring
fitness monitoring
PERSONAL HEALTH CARE
ZigBee
Wireless Control that Simply Works
PC & PERIPHERALS
mouse
keyboard
joystick
asset mgt
process control
environmental
energy mgt
INDUSTRIAL CONTROL
RESIDENTIAL/ LIGHT COMMERCIAL CONTROL
security
HVAC
lighting control
access control
lawn & garden irrigation

LoRa

LoRa technology was developed by the **LoRa Alliance** to support long-range, low-power IoT communication.

Data rates range from **0.3 kbps to 50 kbps**, depending on the network configuration and application.

Security: Features **end-to-end AES-128 encryption**, ensuring secure data transmission between devices and networks.

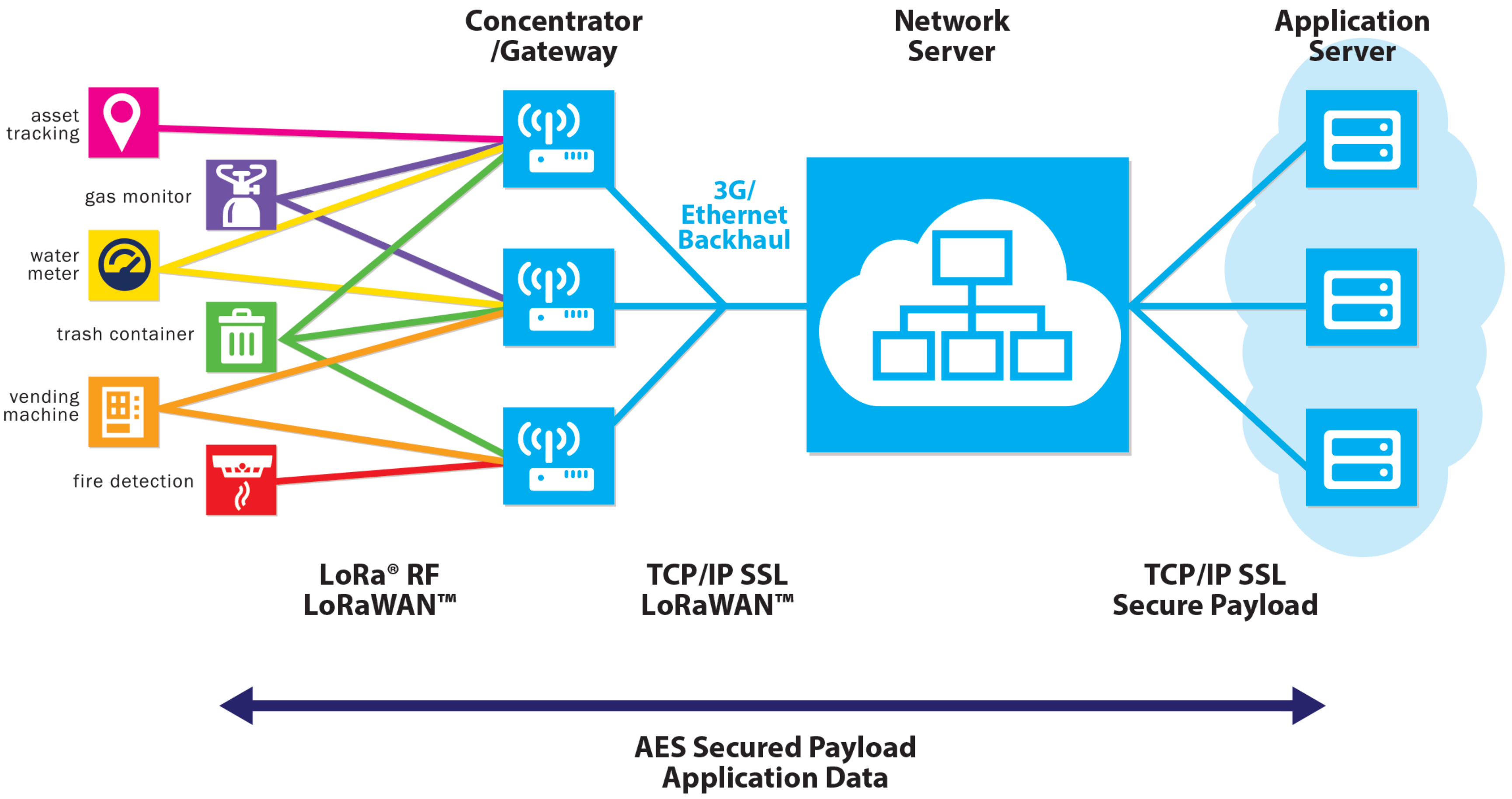
Low Cost: Reduces expenses through minimal **infrastructure investment**, **lower operating costs**, and **affordable end-node sensors**.

Spectrum Use: Operates on **unlicensed ISM (Industrial, Scientific, and Medical)** radio bands.

Low Power: Specifically designed for **energy efficiency**, enabling **battery lifetimes of up to 20 years**.

Long Range: A single **base station** can cover **up to 30 miles (48 km)** in rural areas, making it ideal for wide-area IoT deployments.

LoRa Architecture



MQTT

1. **MQTT (Message Queue Telemetry Transport)** is a lightweight messaging protocol for IoT communication.
2. **Developed by:** IBM and Eurotech.
3. **Open Source:** Donated to the **Eclipse "Paho" M2M project**.
4. **Lightweight Design:** Minimizes client footprint with a **smallest packet size of just 2 bytes**.
5. **Reliability:** Supports **three Quality of Service (QoS) levels** to ensure message delivery and prevent packet loss during disconnections.
6. **Transport Layer:** Operates over **TCP**, providing reliable data transfer.
7. **Asynchronous Communication:** Enables efficient, non-blocking message exchange.
8. **Publish/Subscribe Model:** Ideal for IoT networks requiring scalable, event-driven communication between devices and servers.

What is CoAP?

CoAP (Constrained Application Protocol) is an **embedded web transfer protocol** designed for IoT and M2M communication.

Defined in: RFC 7252.

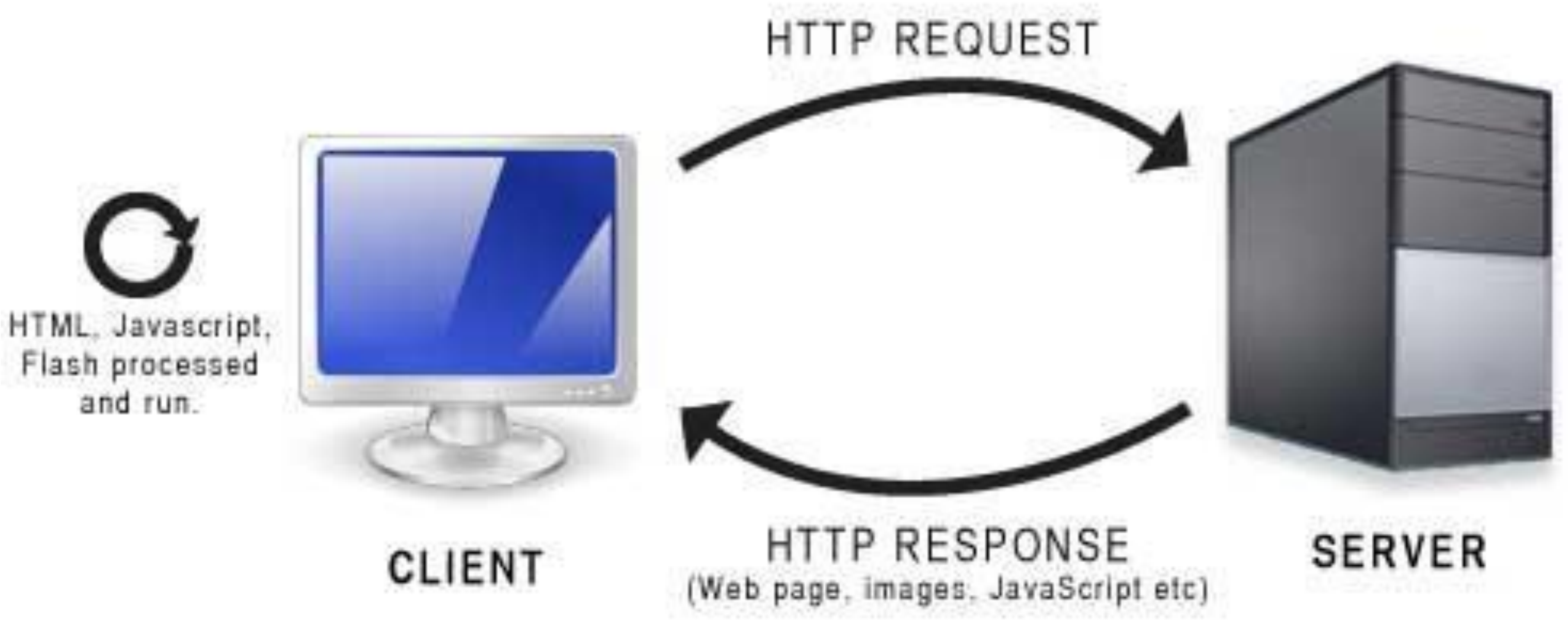
Purpose: Specifically created for **constrained devices** (e.g., microcontrollers) and **low-power, low-bandwidth networks**.

Lightweight Design: Offers **low overhead** and simple implementation suitable for embedded systems.

Use Case: Commonly used for **Machine-to-Machine (M2M)** data exchange.

Similarity to HTTP: Operates in a similar request/response model as HTTP but optimized for constrained environments.

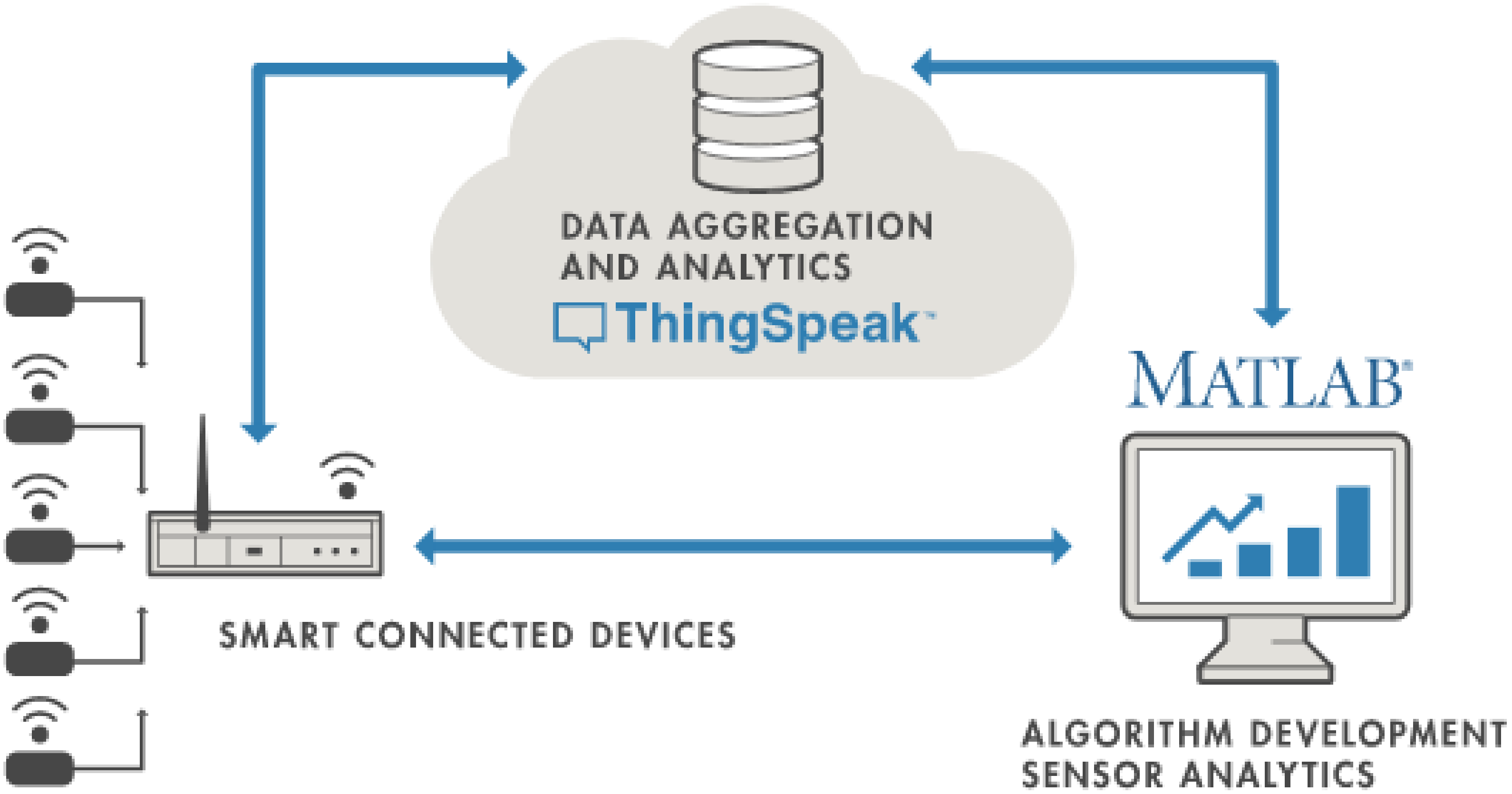
HTTP


HTTP REQUEST
HTML, Javascript,
Flash processed
and run.
CLIENT
HTTP RESPONSE
(Web page, images, JavaScript etc)
SERVER

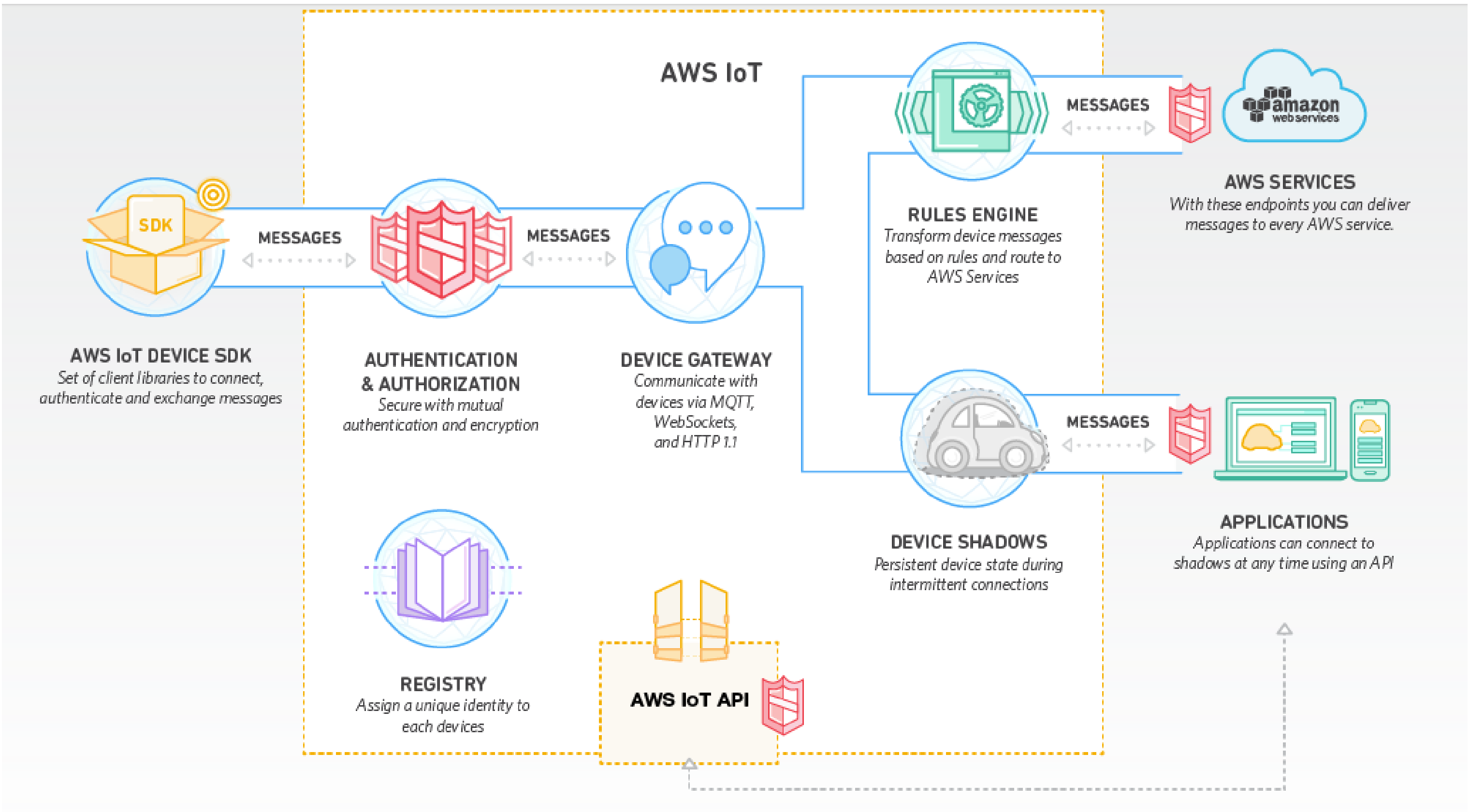
IoT Cloud Platforms

- AWS IoT
- Bluemix –IBM
- Azure -Microsoft
- ARTIK –Samsung
- Open IoT - National University of Ireland
- Exosite –Texas Instruments
- Predix –GE
- Ubidots
- ThingSpeak
- Xtrans IoT Cloud

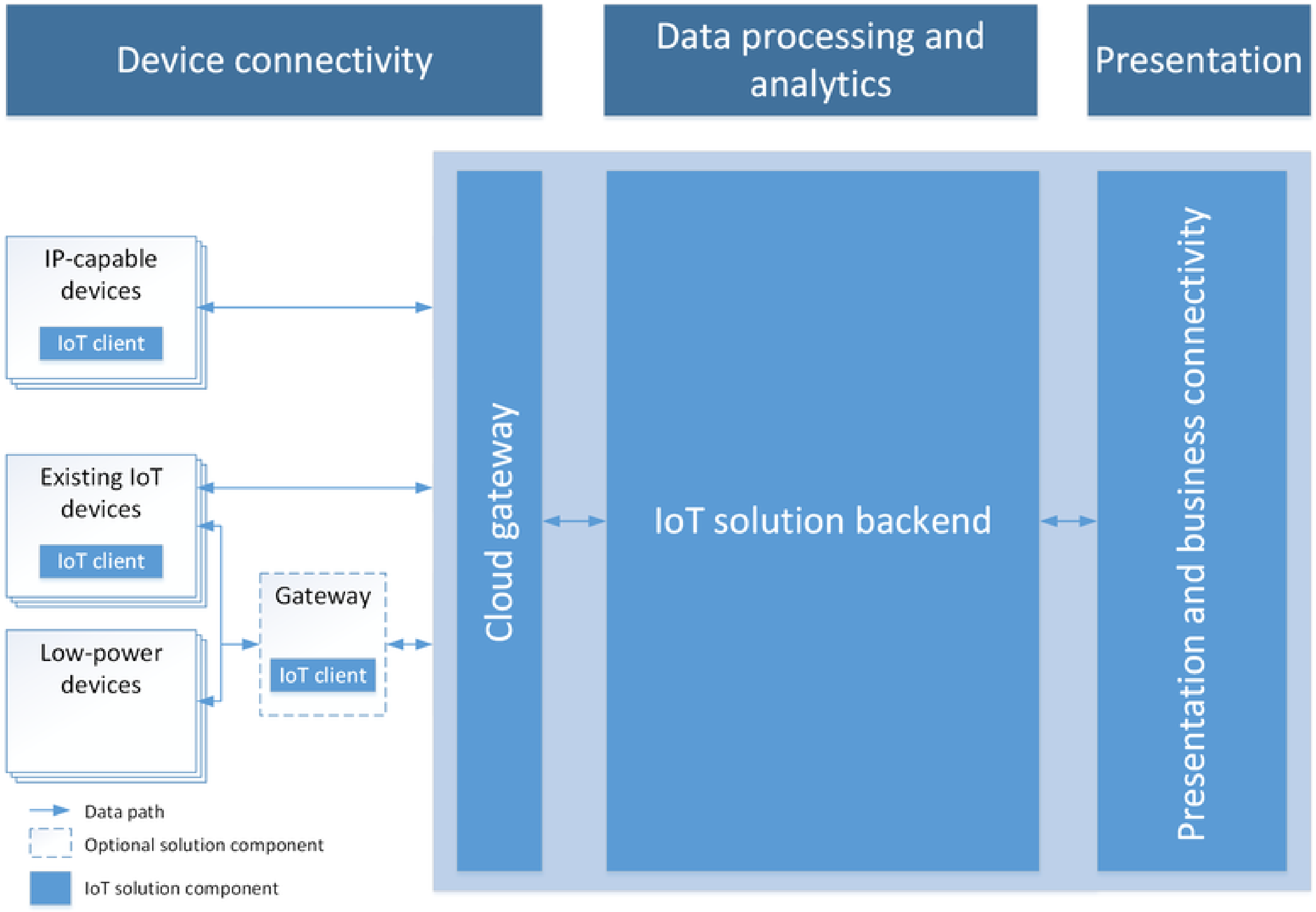
ThingSpeak

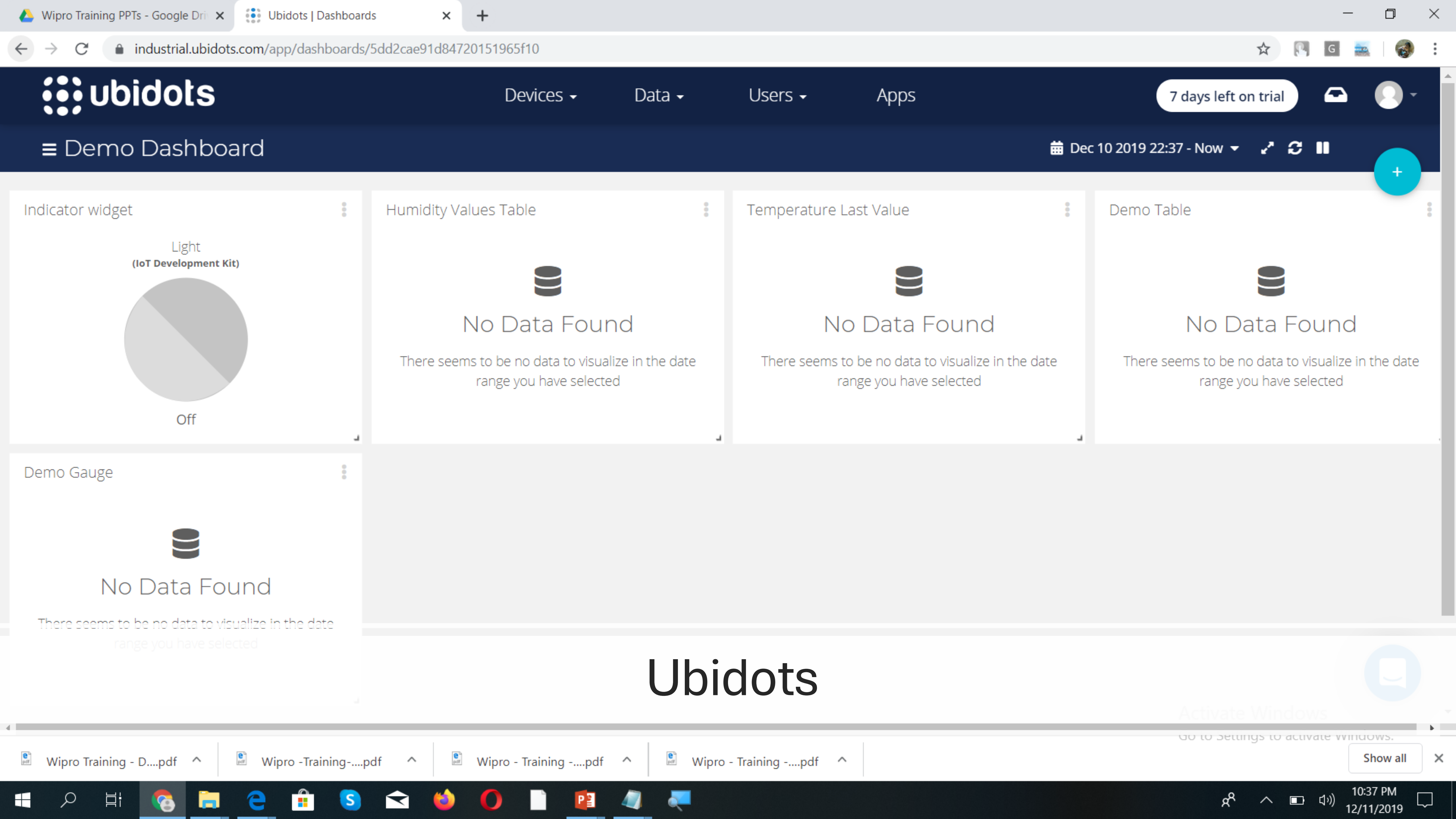

DATA AGGREGATION
AND ANALYTICS
ThingSpeak
MATLAB
SMART CONNECTED DEVICES
ALGORITHM DEVELOPMENT
SENSOR ANALYTICS

Amazon - AWS IoT



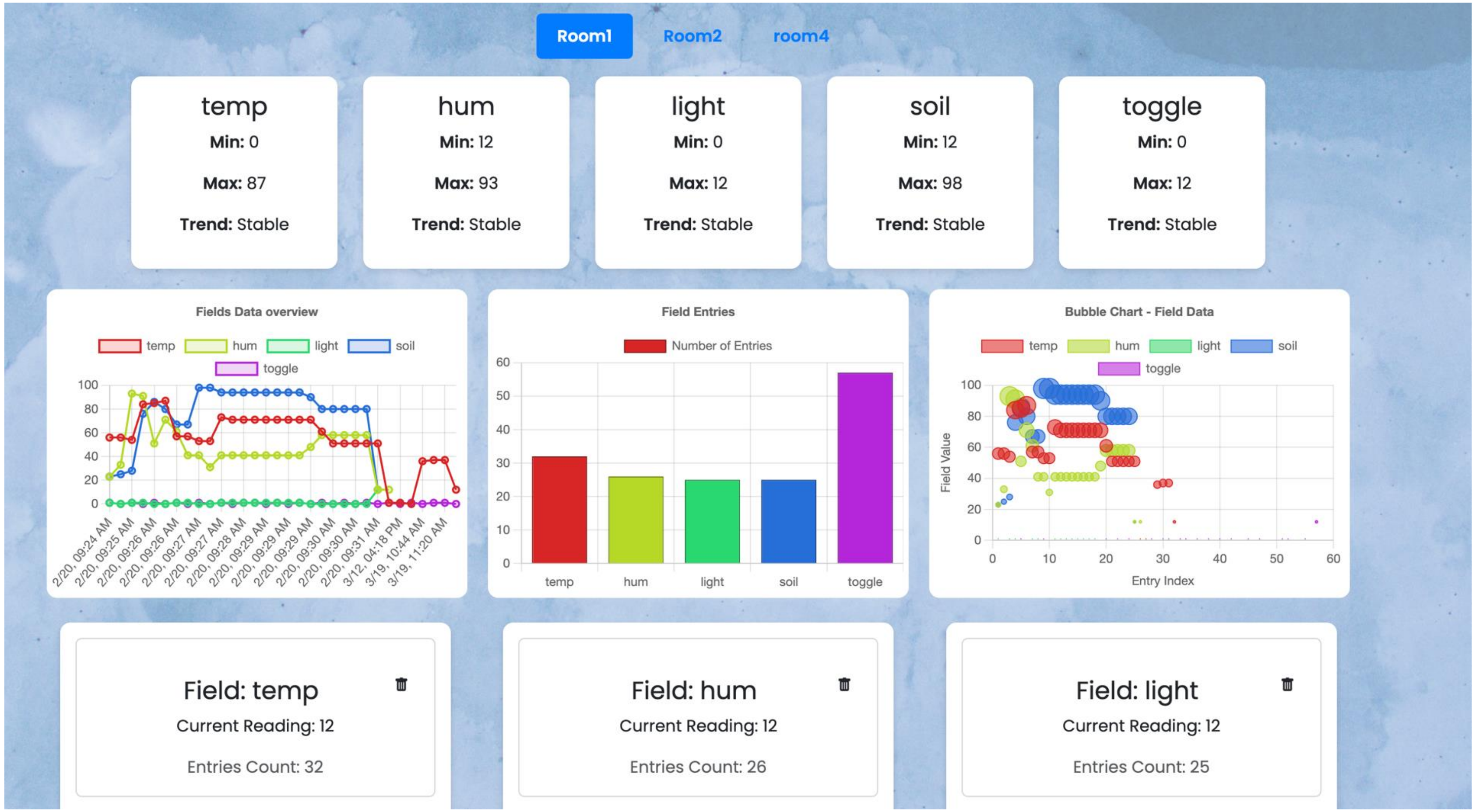
Microsoft Azure




Wipro Training PPTs - Google Dri
Ubidots | Dashboards
industrial.ubidots.com/app/dashboards/5dd2cae91d84720151965f10
ubidots
Devices
Data
Users
Apps
7 days left on trial
Demo Dashboard
Dec 10 2019 22:37 - Now
Indicator widget
Light
(IoT Development Kit)
Off
Humidity Values Table
No Data Found
There seems to be no data to visualize in the date range you have selected
Temperature Last Value
No Data Found
There seems to be no data to visualize in the date range you have selected
Demo Table
No Data Found
There seems to be no data to visualize in the date range you have selected
Demo Gauge
No Data Found
Wipro Training - D....pdf
Wipro -Training-....pdf
Wipro - Training -....pdf
Wipro - Training -....pdf
Show all
10:37 PM
12/11/2019

Ubidots

XTRANS

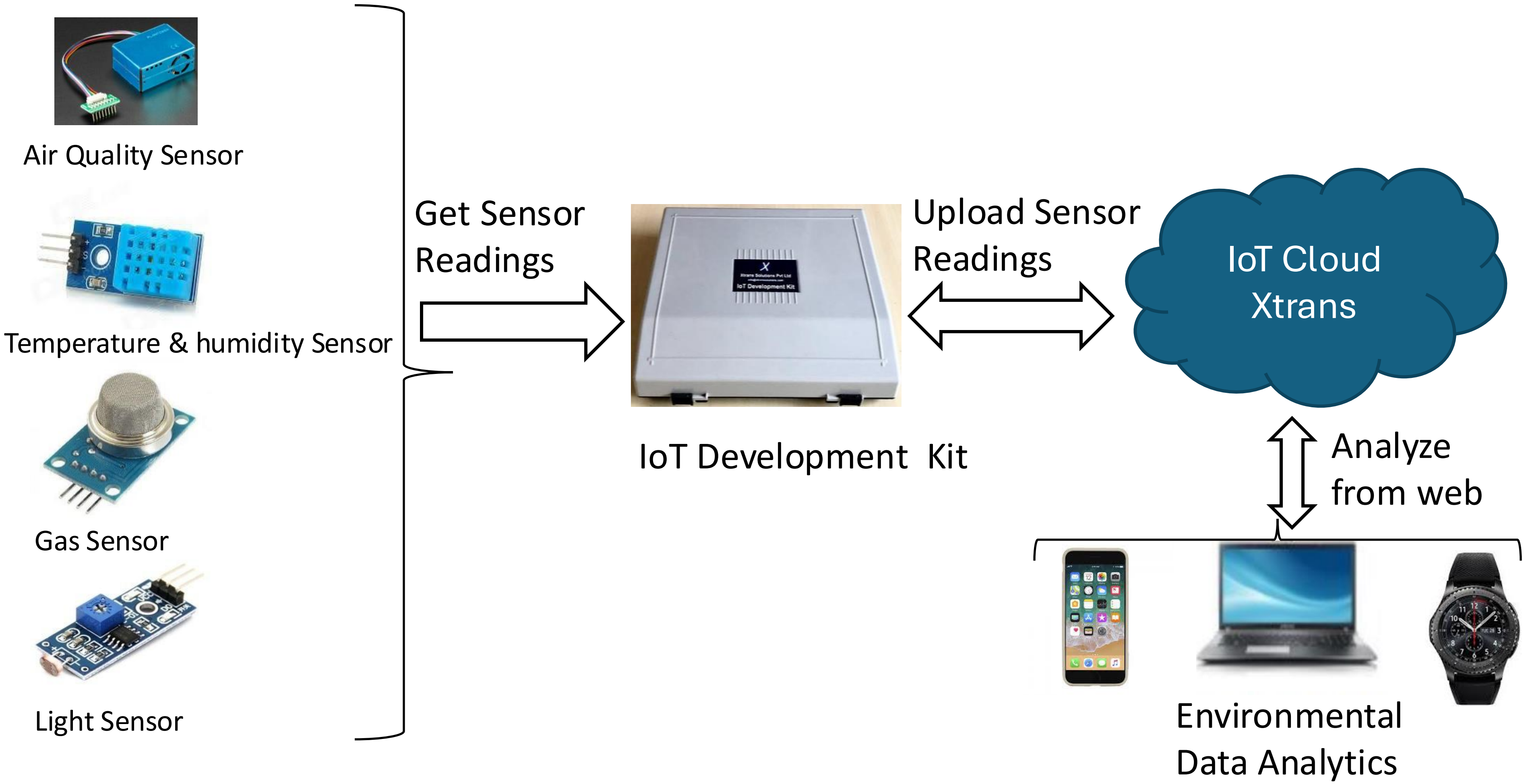


Room1
Room2
room4
temp
Min: 0
Max: 87
Trend: Stable
hum
Min: 12
Max: 93
Trend: Stable
light
Min: 0
Max: 12
Trend: Stable
soil
Min: 12
Max: 98
Trend: Stable
toggle
Min: 0
Max: 12
Trend: Stable
Fields Data overview
temp hum light soil toggle
Field Entries
Number of Entries
temp hum light soil toggle
Bubble Chart - Field Data
temp hum light soil toggle
Field Value
Entry Index
Field: temp
Current Reading: 12
Entries Count: 32
Field: hum
Current Reading: 12
Entries Count: 26
Field: light
Current Reading: 12
Entries Count: 25

IoT- Use cases


smarter and efficient
more
faster response
Industry 4.0
Tools and parts inventory conrol
Remote maintenance (video streaming)
Collaborative autonomous robots
Utilities
Gas and electricity meters
Smart buildings
Smart Grid
Smart cities Massive IoT
Fast autonomous and intelligent grid
Transport & logistics
Telemetrics
emergency calll
Asset tracking
Intelligent transport
Autonomous vehicles
Consumer focused IoT
Smart Home
Massive Mobile Broadband
Massive Video Streaming
Live Event Broadcasting
Innovative use cases
Now
Soon
future

Smart Environmental Monitoring



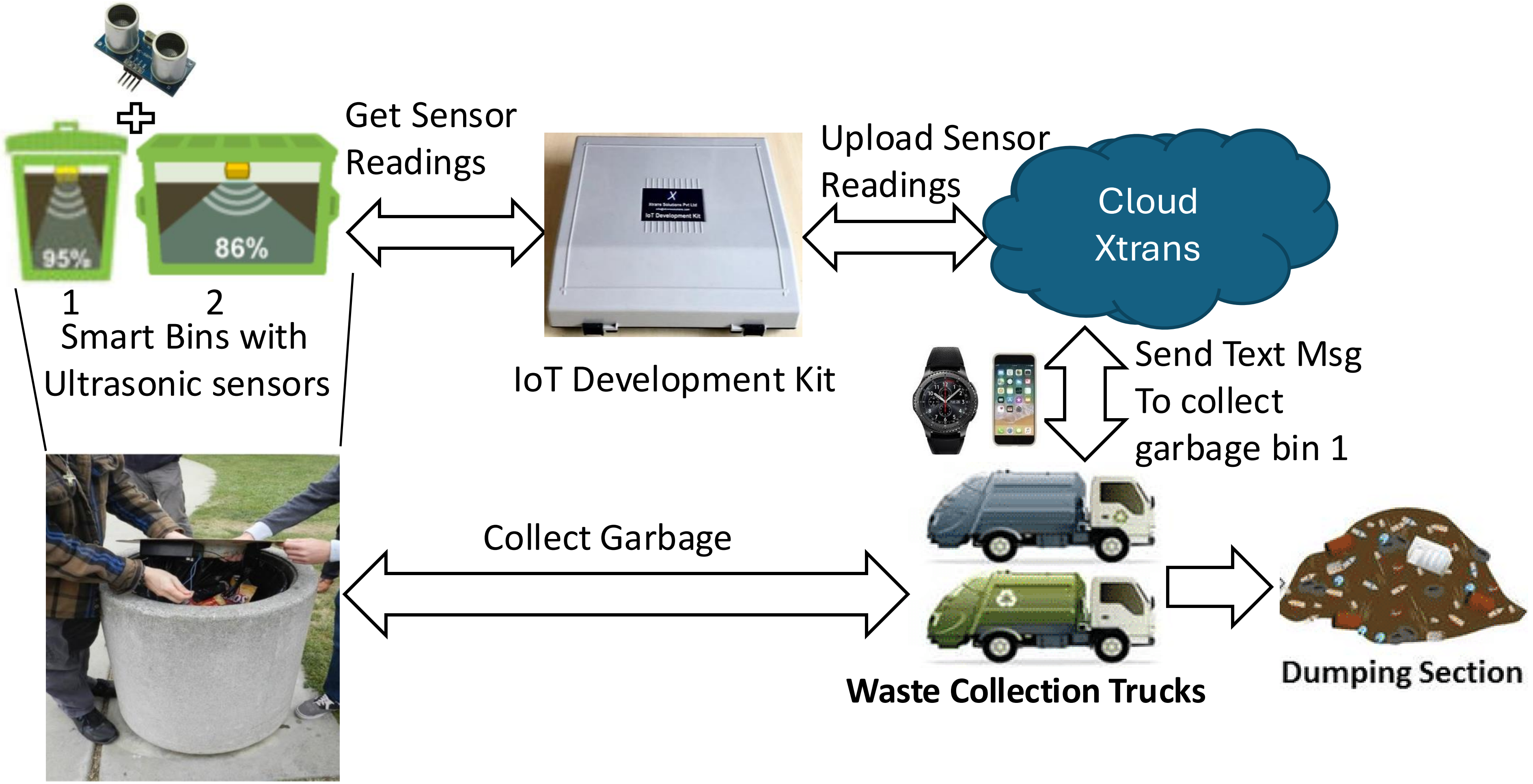
NIST

GLOBAL CITY TEAMS CHALLENGE

Rohnert Park

SONOMA STATE UNIVERSITY

Smart Waste Management System



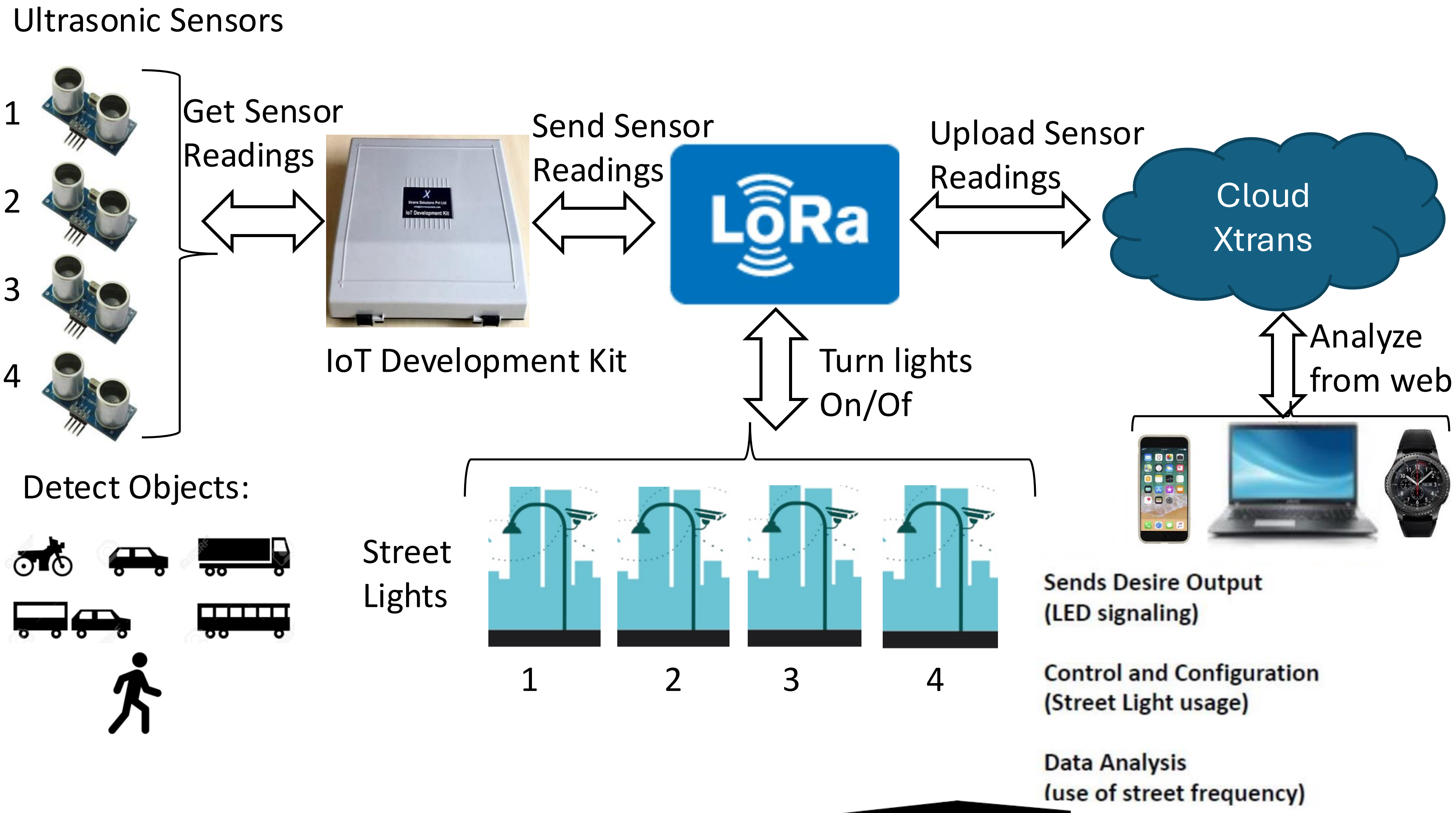
NIST

GLOBAL CITY TEAMS CHALLENGE

Rohnert Park

SONOMA STATE UNIVERSITY

Smart Street Lighting



NIST

GLOBAL CITY TEAMS CHALLENGE

Rohnert Park

SONOMA STATE UNIVERSITY

Next Gen- IoT

Automotive industry

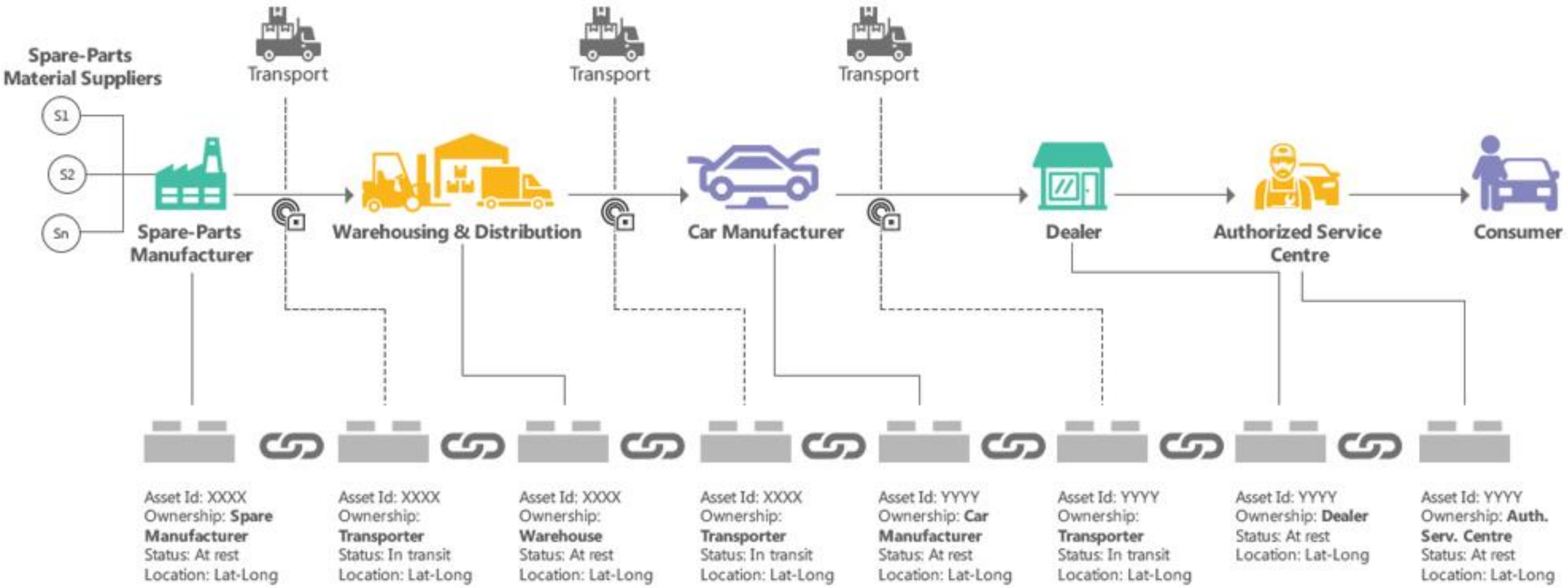
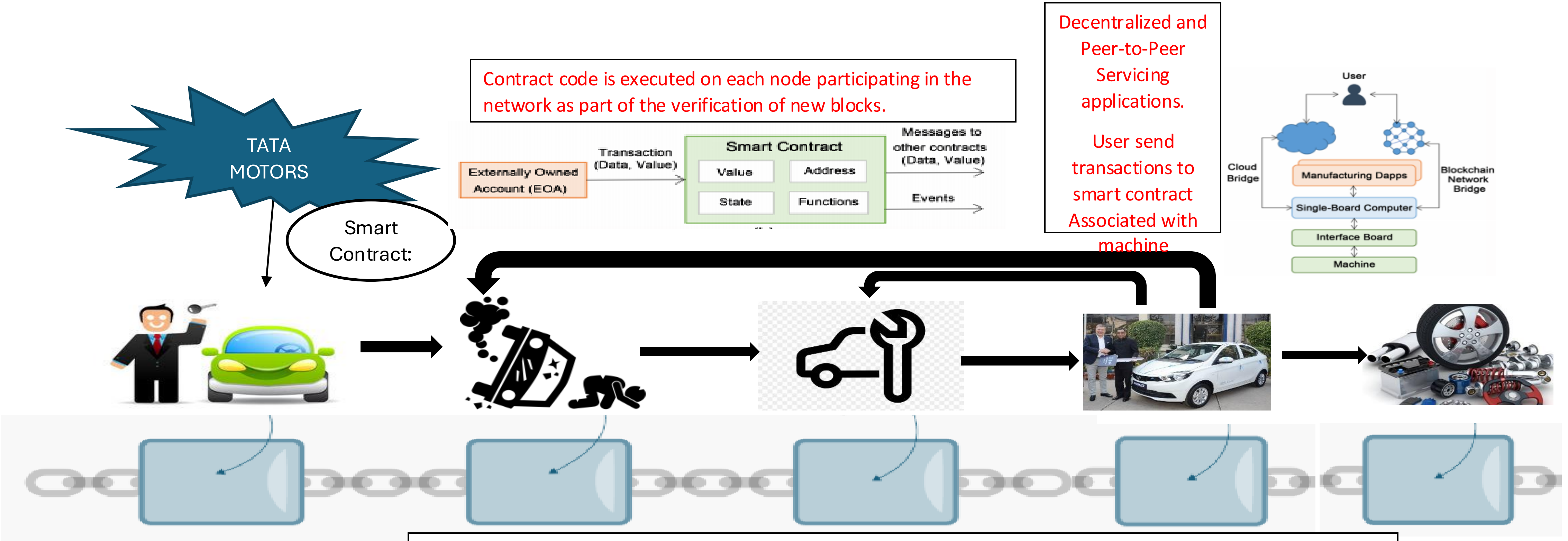
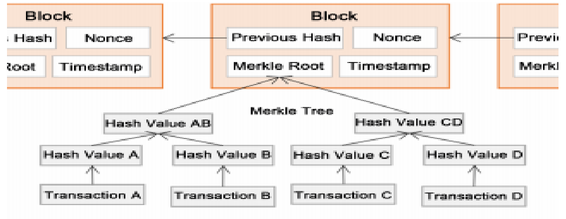


Image Source: https://www.mobiliya.com/mobiliya-labs/Blockchain

Smart Vehicle Monitoring System





Features of the Smart vehicle Servicing System:

1) Enabling consumer-to-machine and machine-to-machine transactions without a trusted intermediary;

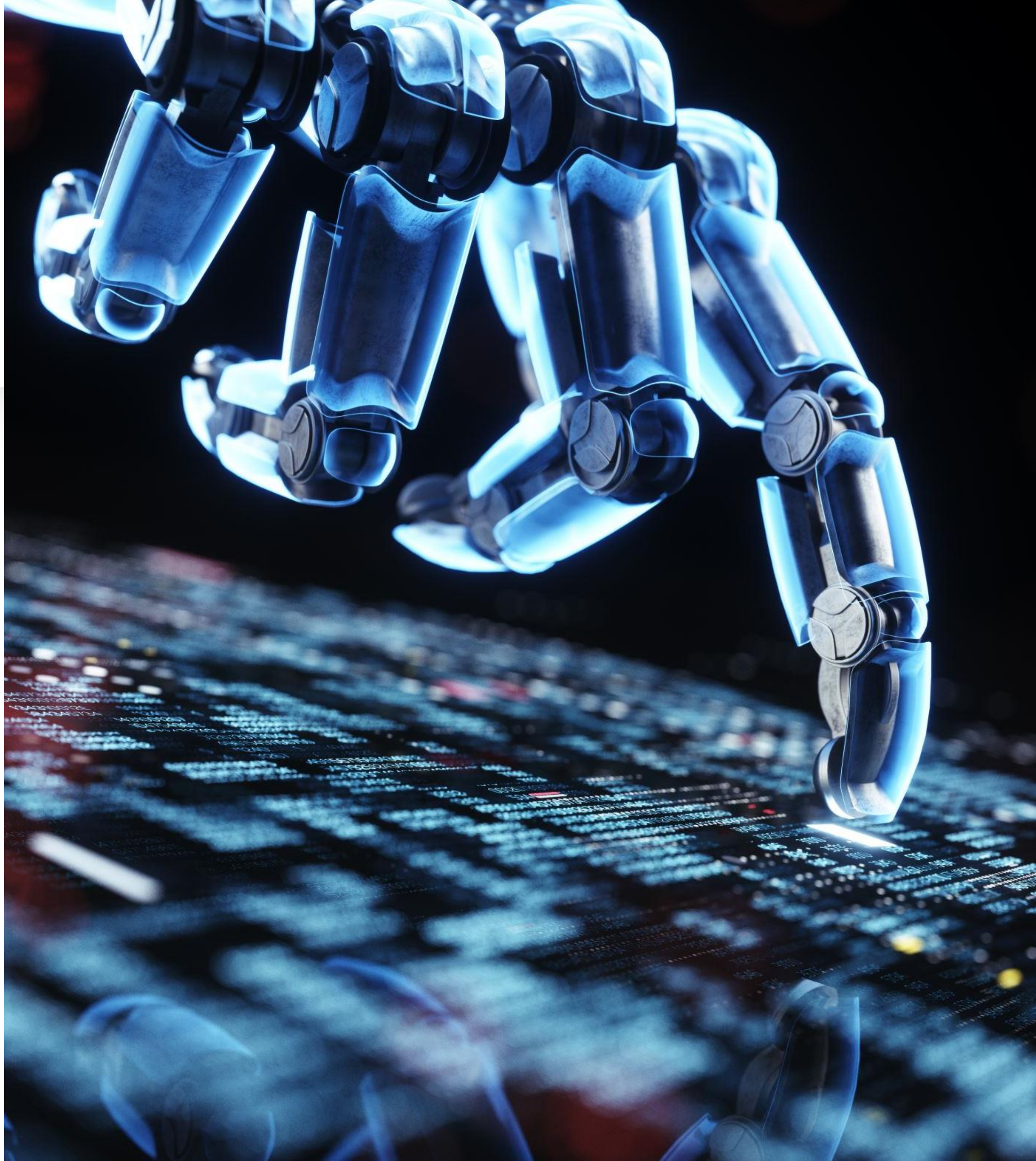
2) Integrating Authorized Servicing shop equipment into the cloud environment;

3) Automating or manually machine maintenance and diagnostics tasks.

4) Providing a distributed, secure and shared ledger of all transactions, assets and inventory records.

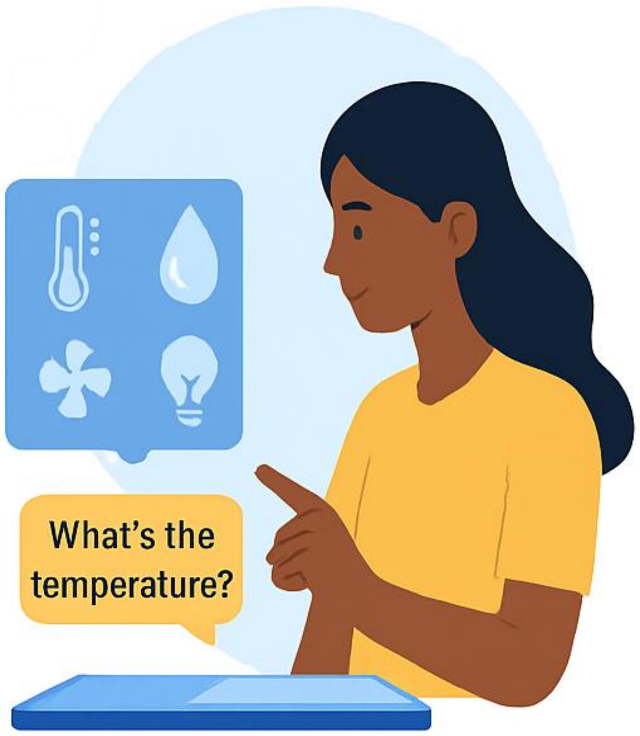
Key Applications of AI in Education

- Personalized Learning (e.g., adaptive platforms)
- AI Tutors & Chatbots
- Automated Grading & Feedback
- Content Generation
- Predictive Analytics



AR-Enabled IoT with AI Voice Interaction for Smart Environment Monitoring and Control

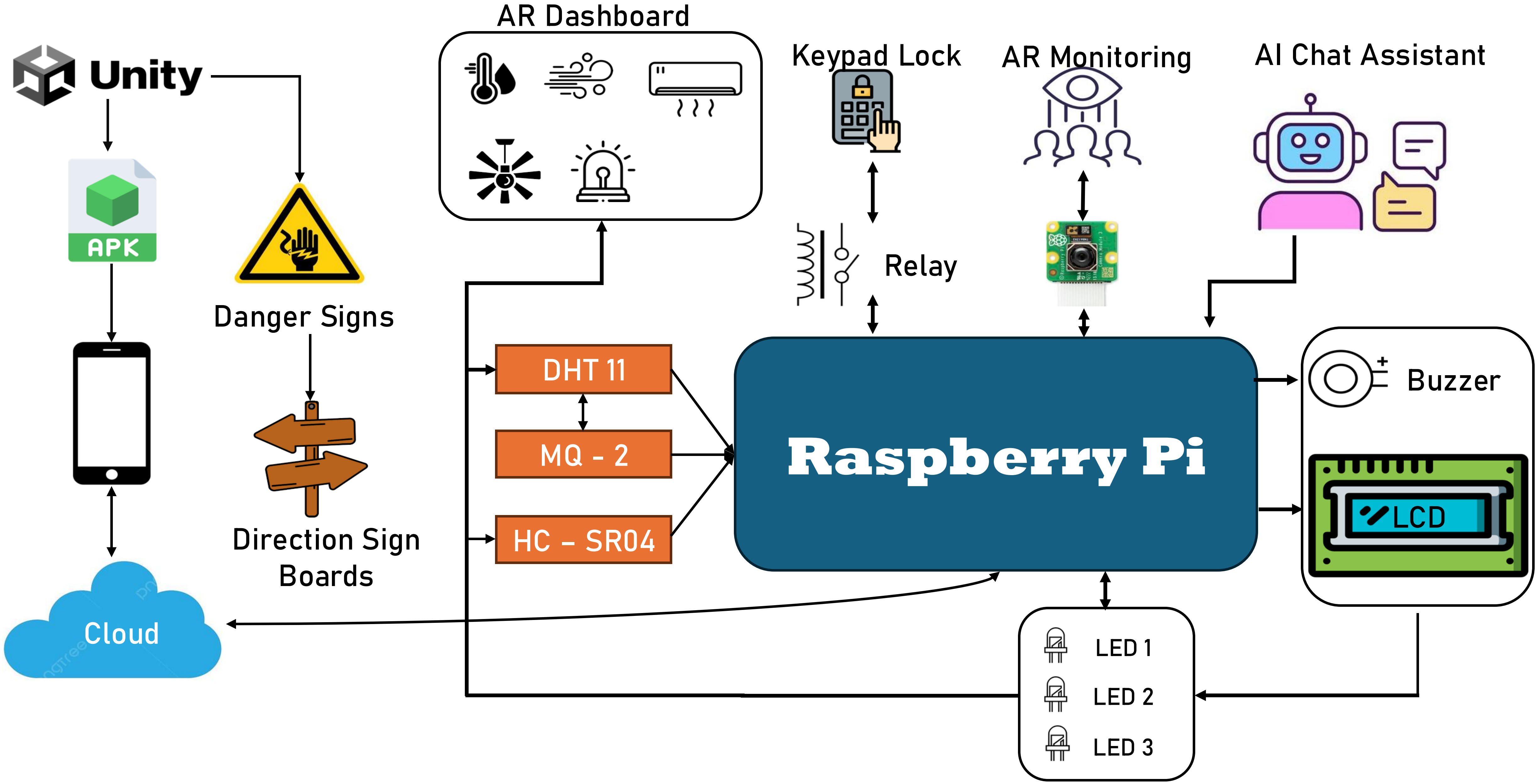
- *AI + AR-IoT for Smart Environments*



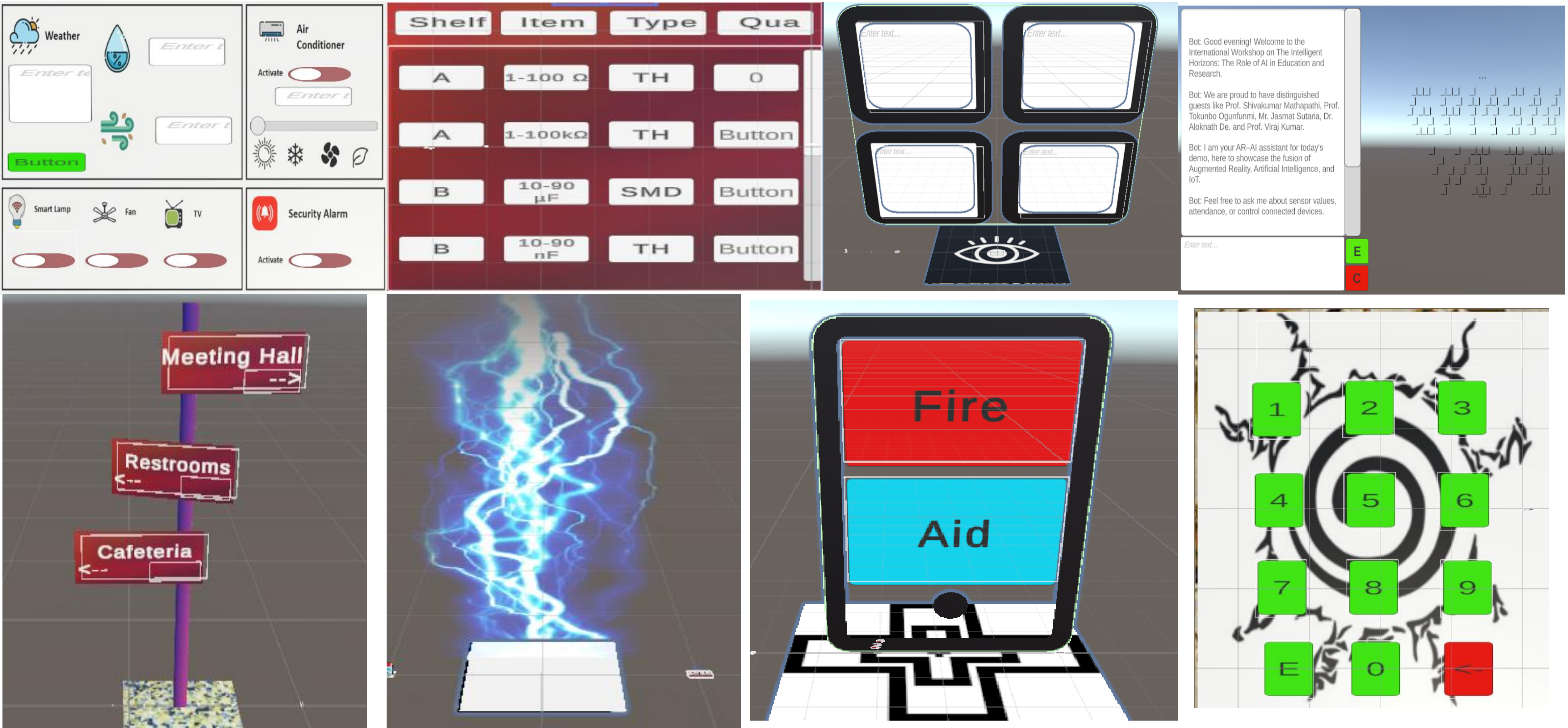
Introduction

- Artificial Intelligence (AI) and the Internet of Things (IoT) are reshaping how we interact with and manage our surroundings. We present a low-cost, AR-enabled IoT platform using Xtrans IoT kit , multiple sensors, a camera module, and actuators for real-time smart environment monitoring and control. Developed in Unity 3D with Vuforia and integrated with Blynk cloud, it overlays live sensor data onto physical objects while enabling remote access and analytics. A Gemini-powered conversational AI assistant supports both text and voice commands, offering an intuitive, scalable solution for smart homes, safety systems, and educational applications.

Block diagram



AR Models


Weather
Button
Air Conditioner
Activate
Smart Lamp
Fan
TV
Security Alarm
Activate
Shelf
Item
Type
Qua
A
1-100 Ω
TH
0
A
1-100kΩ
TH
Button
B
10-90 µF
SMD
Button
B
10-90 nF
TH
Button
Enter text...
Bot: Good evening! Welcome to the International Workshop on The Intelligent Horizons: The Role of AI in Education and Research.
Bot: We are proud to have distinguished guests like Prof. Shivakumar Mathapathi, Prof. Tokunbo Ogunfunmi, Mr. Jasmat Sutaria, Dr. Aloknath De, and Prof. Viraj Kumar.
Bot: I am your AR–AI assistant for today's demo, here to showcase the fusion of Augmented Reality, Artificial Intelligence, and IoT.
Bot: Feel free to ask me about sensor values, attendance, or control connected devices.
Enter text...
E
C
Meeting Hall
-->
Restrooms
<--
Cafeteria
<--
Fire
Aid
1
2
3
4
5
6
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E
0
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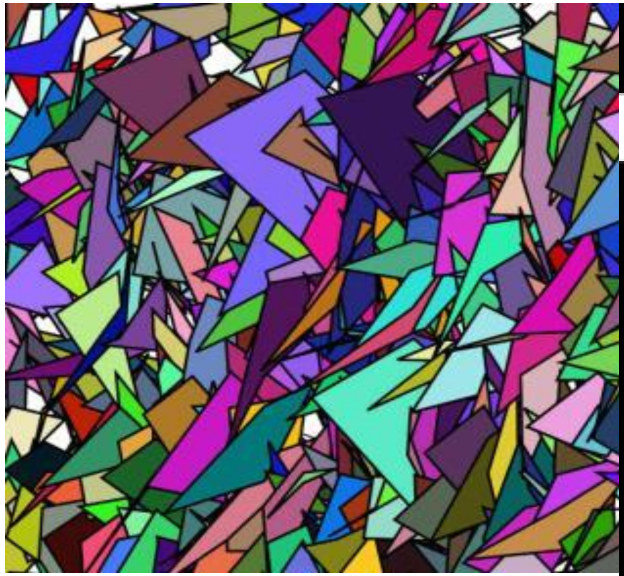
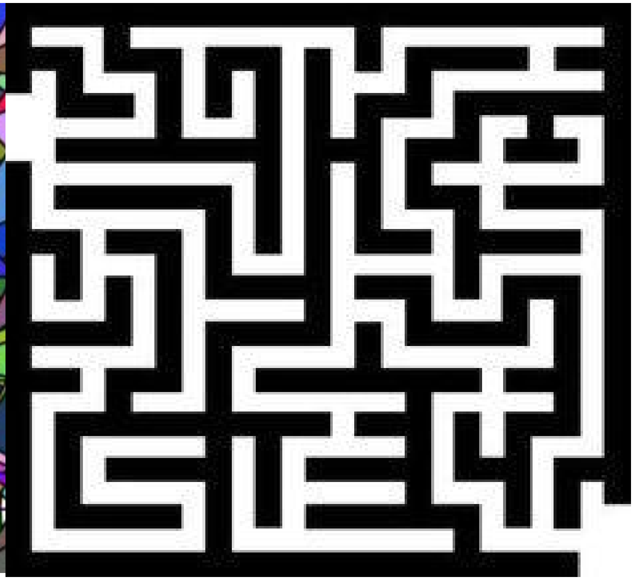
Target Images





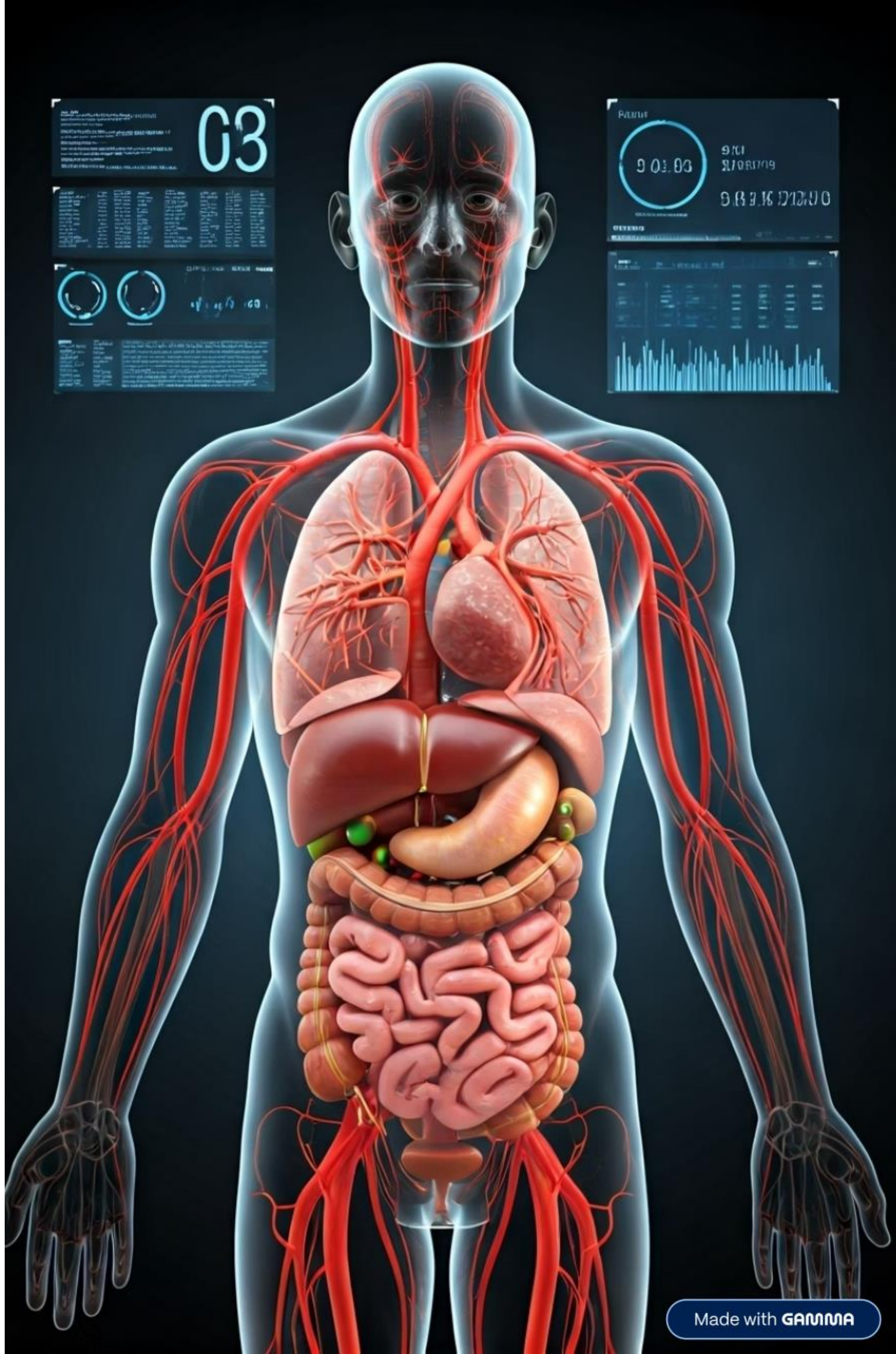



Concept of Digital Twin in Healthcare and Blockchain

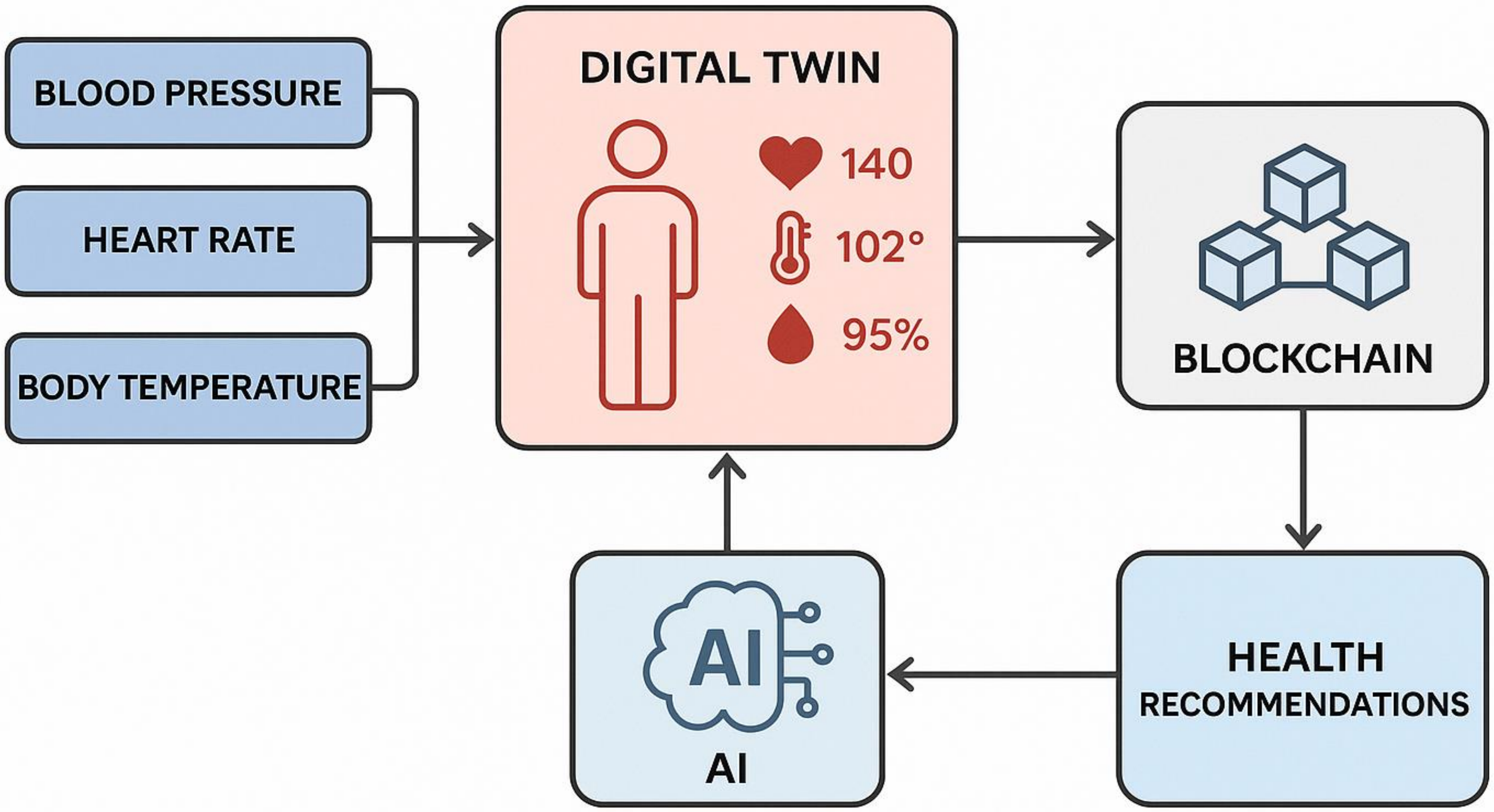
- **Virtual Representation**
- A digital twin is a virtual model that mirrors a physical object, process or person, allowing for real-time monitoring and analysis.

- **Personalized Healthcare**
- In healthcare, a digital twin of a patient can be used to track health data, predict outcomes and optimize treatments.

- **Secure Patient Data and Continuous Monitoring**
- The digital twin enables ongoing monitoring of a patient's vitals, behaviors and environmental factors to proactively manage their wellbeing, and also save data to Ethereum based Blockchain for Encryption, Access Control, Transparency.

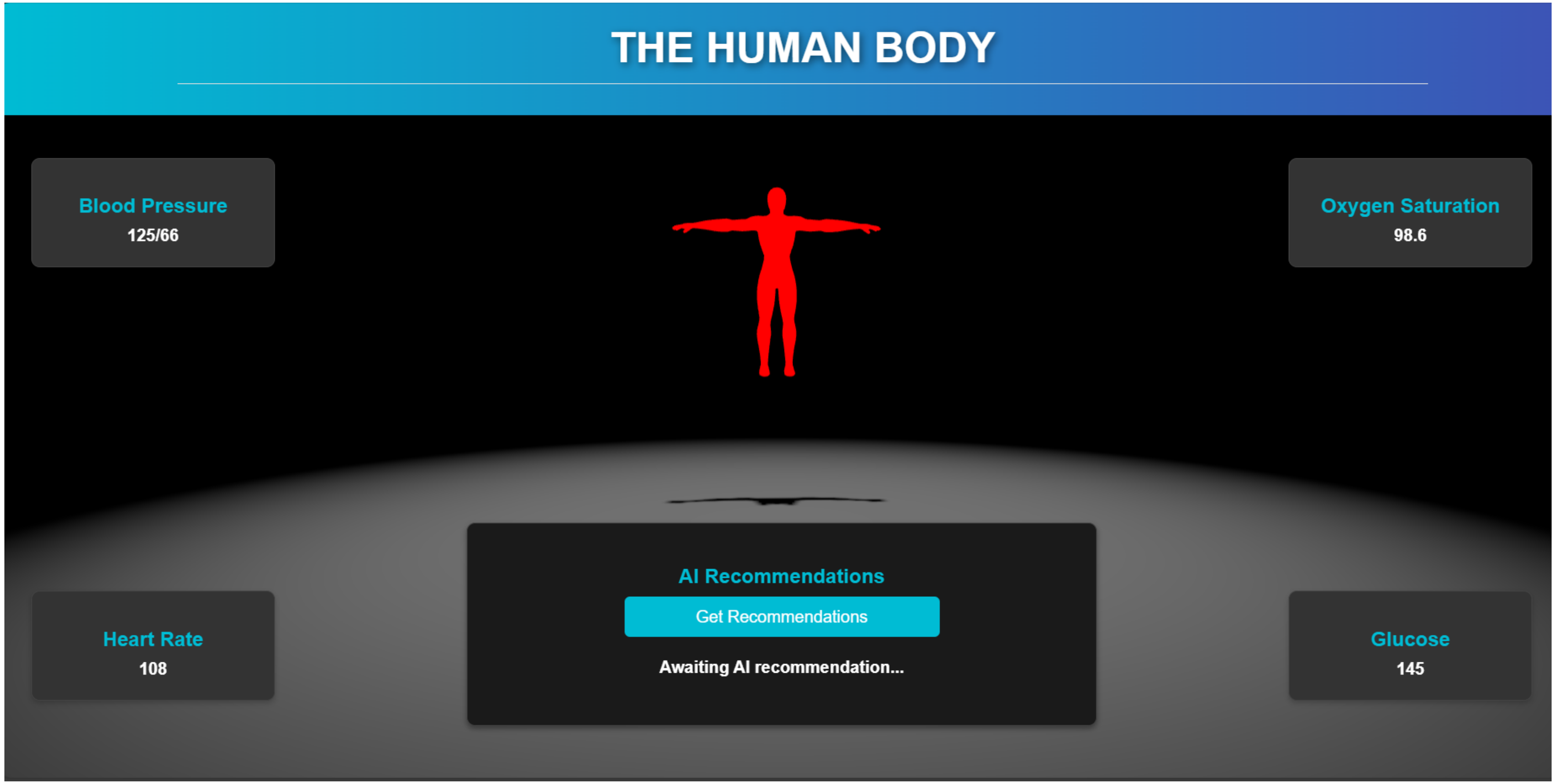


Block Diagram



Outcomes Cont....

- Step4: Start Our Digital Twin Website By Starting Live-Server.



Demo

Thank You

Designing Smart and Secure Systems for the Future…

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info@arishnaiotsolutions.com

Krishna Mohan Patel
(Founder/CEO)