A
Presentation
on

Internet of Things

(IoT)

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OUTLINE

- Introduction: Internet of Things (IoT)
- IoT: Characteristic, Features, Advantages, Disadvantages
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- IoT: Hardware, Middleware and Software
- IoT: Conceptual Framework
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Introduction: Internet of Things (IoT)

- The **Internet of Things** is the network of physical objects—devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity—that enables these objects to collect and exchange data.
- IoT is connecting every physical object in the world using wireless.
- **Internet of Things** are able to collect and exchange data using embedded sensors.

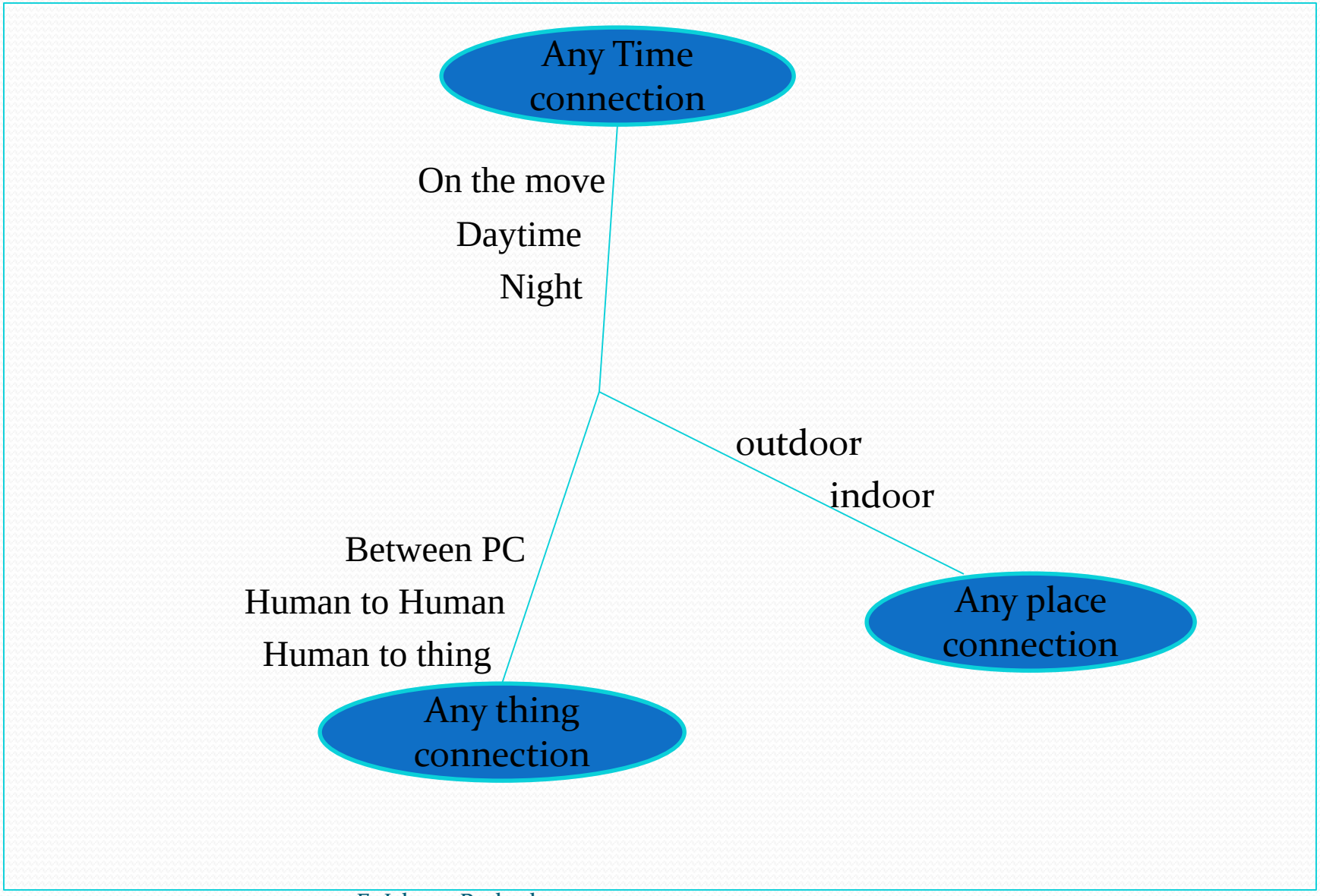
Internet of Things (Contd…)

Physical Object + Controller, Sensor and Actuators + Internet = IoT

Gather + Enrich + Stream + Manage + Acquire + Organise and Analyse = IoT with connectivity to Data Centre, Enterprise or Cloud Server

Gather + Consolidate + Connect + Collect + Assemble + Manage and Analyse = IoT

Internet of Things (contd…)



IoT: Characteristics, Features, Advantages, Disadvantages

Characteristics	Features	Advantages	Disadvantages
Intelligence	Device Virtualisation	Integration of Devices	Security
Connectivity	High Speed	Reliable, Secure Bi-Directional Communication	Privacy
Sensing	End Point Management	Enhanced Data Collection	Complexity
Expressing	Small Devices	Reduce Waste	Flexibility
Energy	Stream Processing	Real Time Analysis Improved Engagement	Compliance
Safety	Data Enrichment	Automation and Technology Optimization	Tier Management

IoT: Growth

Year	Number of Connected Devices
1990	0.3 Million
2000	90 Million
2010	5 Billion
2015	9 billion
2025	1 trillion (EXPECTED)

IoT: Technologies

- RFID
- WiFi
- Barcode
- QR Code
- ZigBee
- Sensors and Smartphones

IoT: Hardware, Middleware and Software

Hardware	Middleware	Software
Arduino Nano Pro Mini	OpenIoT	Eclipse IoT
Raspberry-Pi	OpenRemote	Google Brillo
IBM Watson	OpenHUB	IBM IoT Foundation
Azure	Kaa	Azure IoT Suit
AWS	Oracle-Fusion	Cloud Sensor
INTEL JOULE		Ninja Sphere
Netduino		Control Any
Flutter		Arduino

http://www.gadgetronicx.com/10-best-iot-hardware-platforms/

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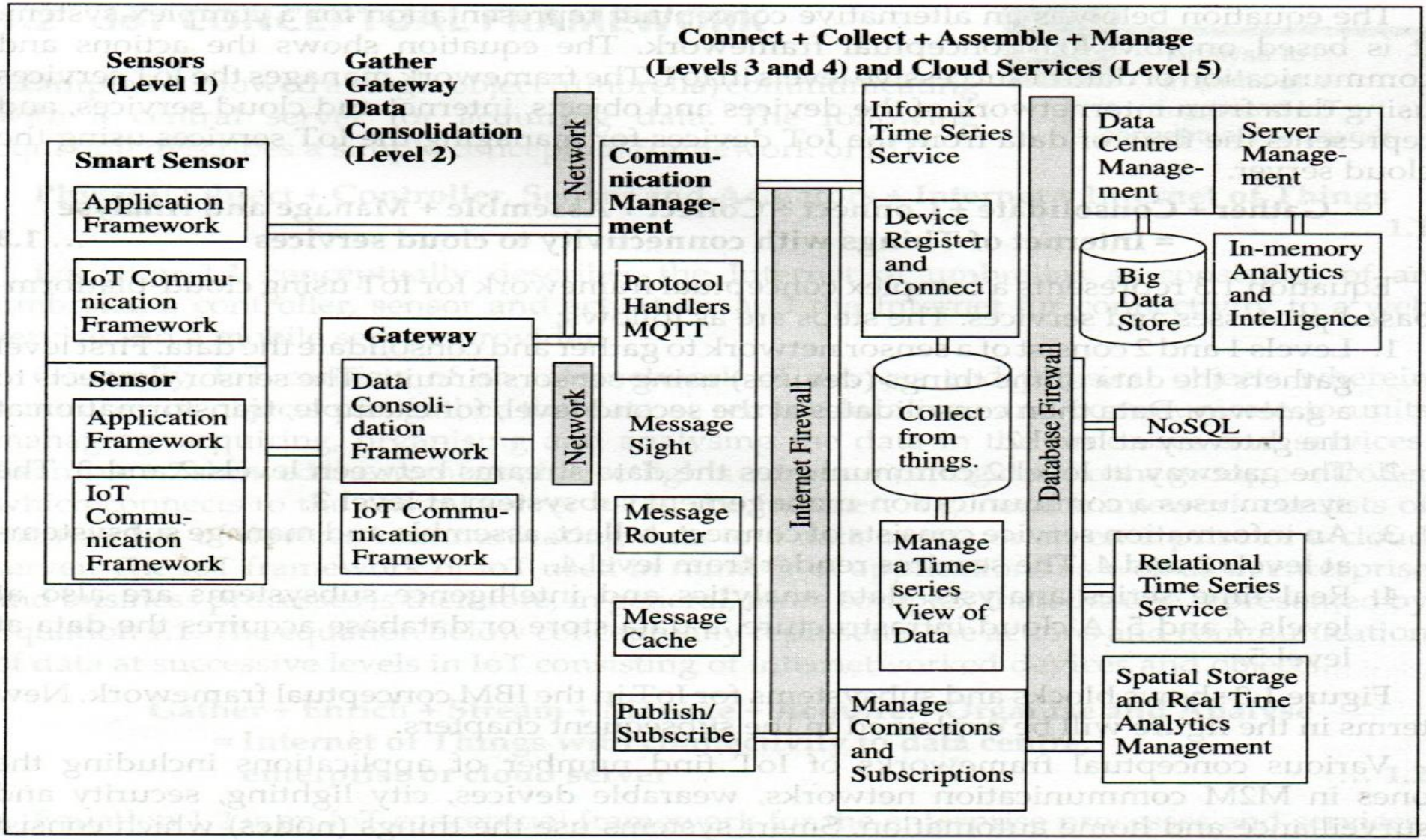
IoT: Conceptual Framework



IBM IoT Conceptual Framwork

(Curtesy: TMH; IoT Architecture and Design Principles by Raj Kamal)

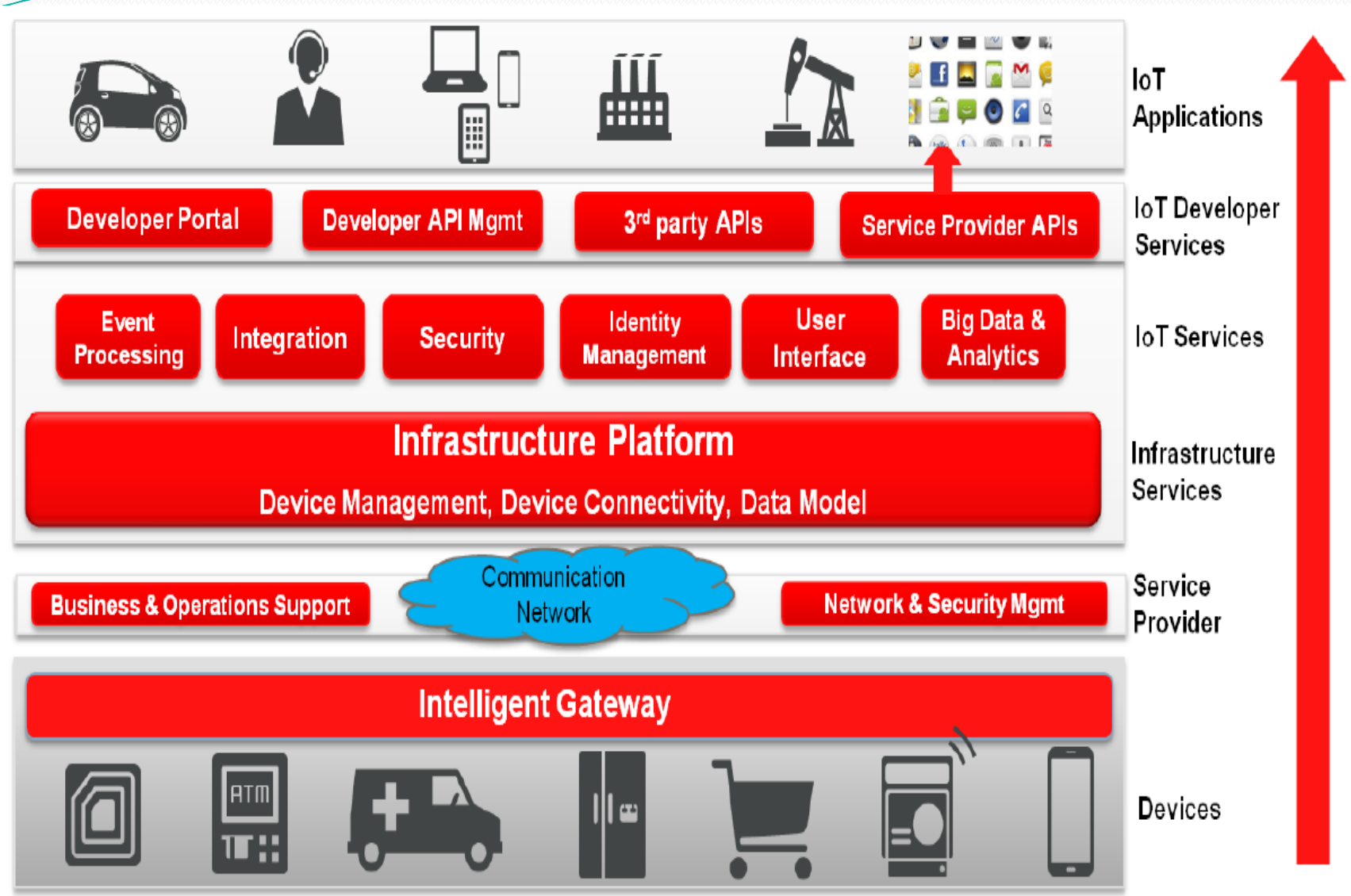
- Gather + Consolidate + Connect + Collect + Assemble + Manage and Analyse= Internet of Thing with connectivity to cloud services… 1.3
- Equation 1.3 represents a complex conceptual framework for IoT using cloud-platformbasedprocesses and services.

The steps are as follows:

- Levels 1 and 2 consist of a sensor network to gather and consolidate the data. First level gathers the data of the things (devices) using sensors circuits. The sensor connects to a gateway. Data then consolidates at the second level, for example, transformation at the gateway at level 2.
- 2. The gateway at level 2 communicates the data streams between levels 2 and 3. Thesystem uses a communication-management subsystem at level 3.
- 3. An information service consists of connect, collect, assemble and manage subsystems at levels 3 and 4. The services render from level 4.

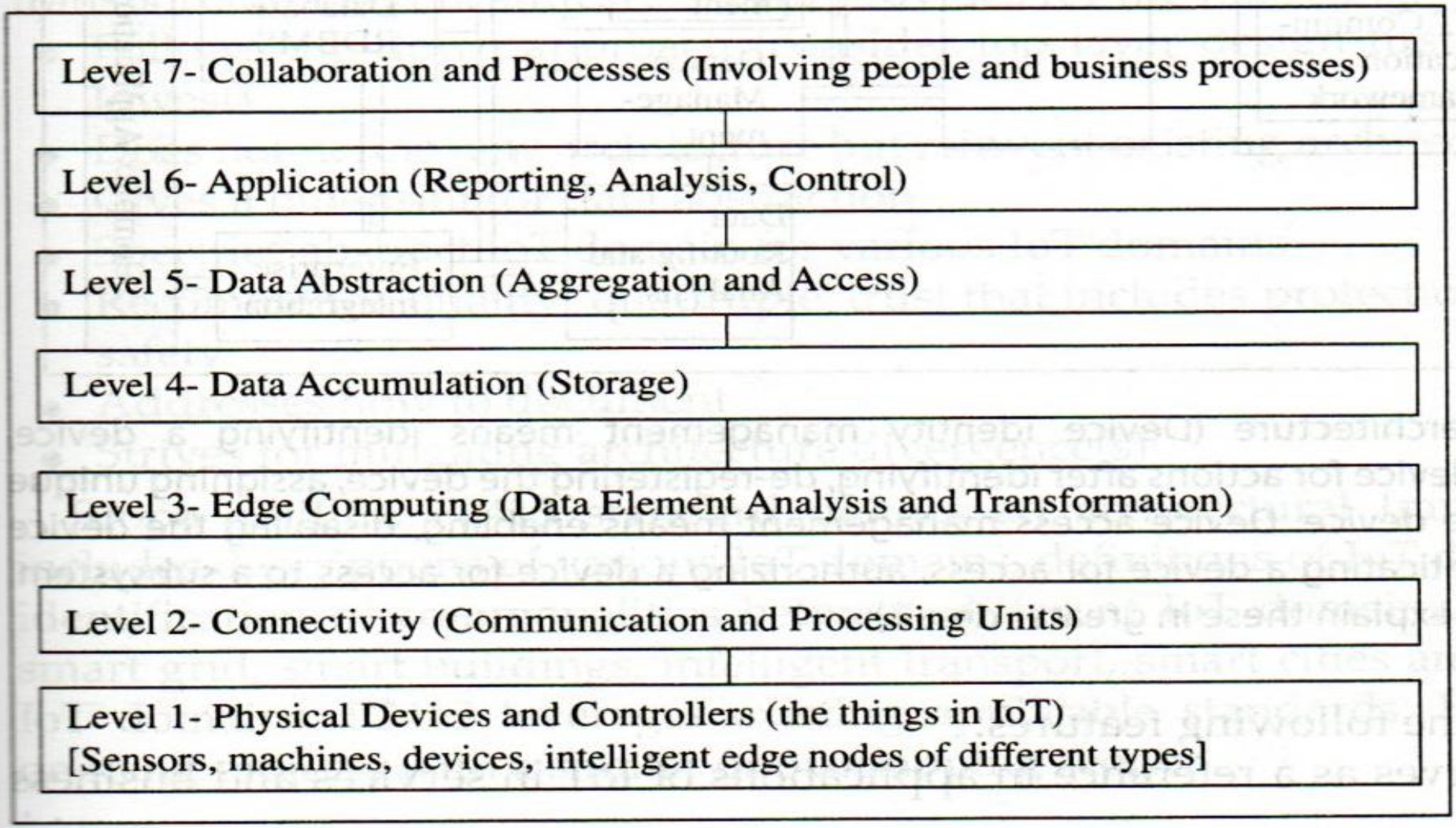
- 4. Real time series analysis, data analytics and intelligence subsystems are also atlevels 4 and
- 5. A cloud infrastructure, a data store or database acquires the data atlevel 5.

IoT: Architectural Framework



Curtsey: Oracle

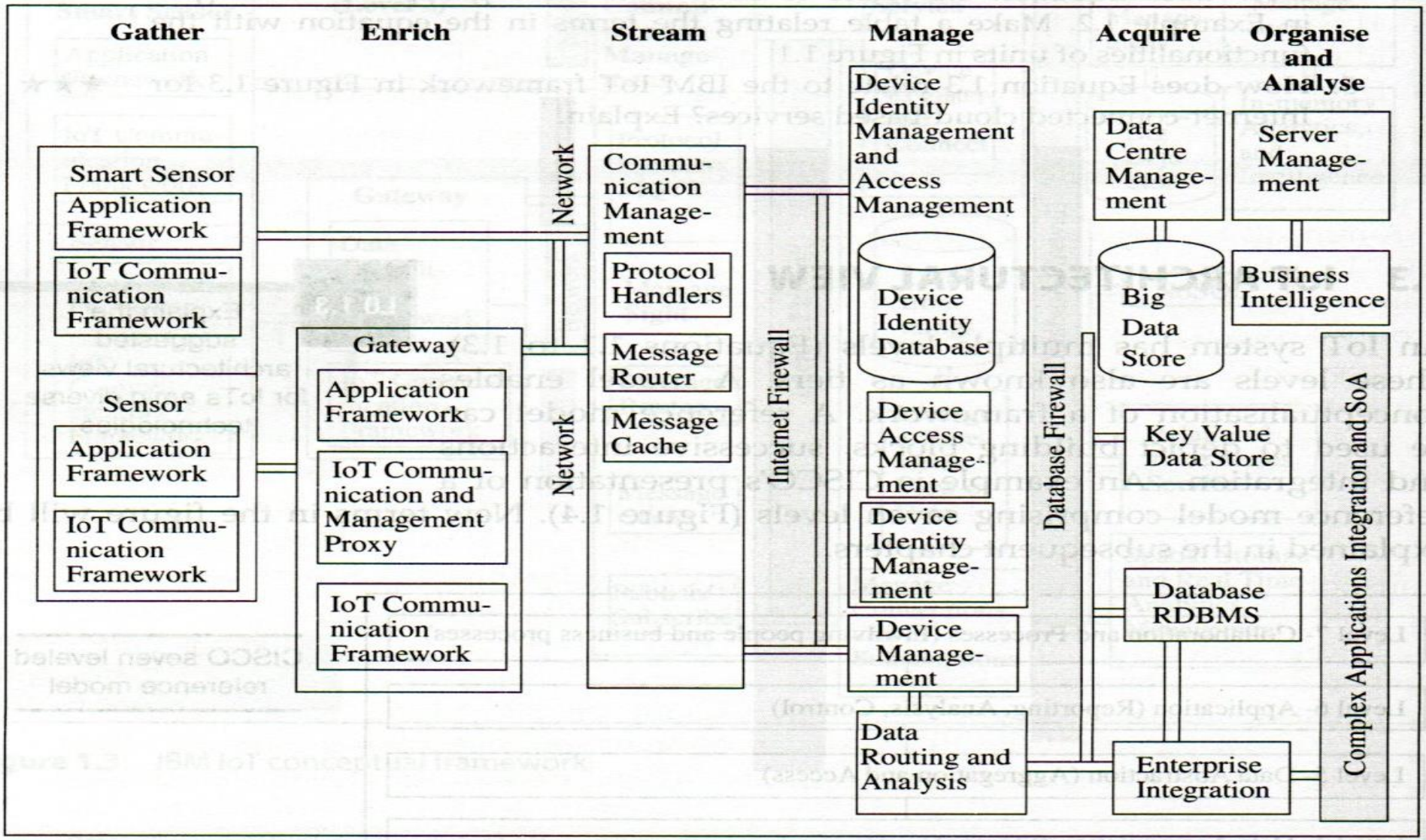
IoT: Architectural View



IoT Reference Model Suggested By CISCO

(Curtesy: TMH; IoT Architecture and Design Principles by Raj Kamal)

IoT: Architectural View



Oracle's IoT Architecture

(Curtesy: TMH; IoT Architecture and Design Principles by Raj Kamal)

- Gather + Enrich + Stream + Manage + Acquire + Organise and Analyse= Internet of Thing with connectivity to data centre, enterprise or cloud server

  … 1.2

- Equation 1.2 is an IoT conceptual framework for the enterprise processes and services, based on a suggested IoT architecture given by Oracle

The steps are as as follows:

- 1. At level 1 data of the devices (things) using sensors or the things gather the pre data from the internet.
- 2. A sensor connected to a gateway, functions as a smart sensor (smart sensor refers to a sensor with computing and communication capacity). The data then enriches at level 2, for example, by transcoding at the gateway. Transcoding means coding or decoding before data transfer between two entities.
- 3. A communication management subsystem sends or receives data streams at level 3.

The steps are as as follows:

- 4. Device management, identity management and access management subsystems receive the device's data at level 4.
- 5. A data store or database acquires the data at level 5.
- 6. Data routed from the devices and things organises and analyses at level 6. For example, data is analysed for collecting business intelligence in business processes.

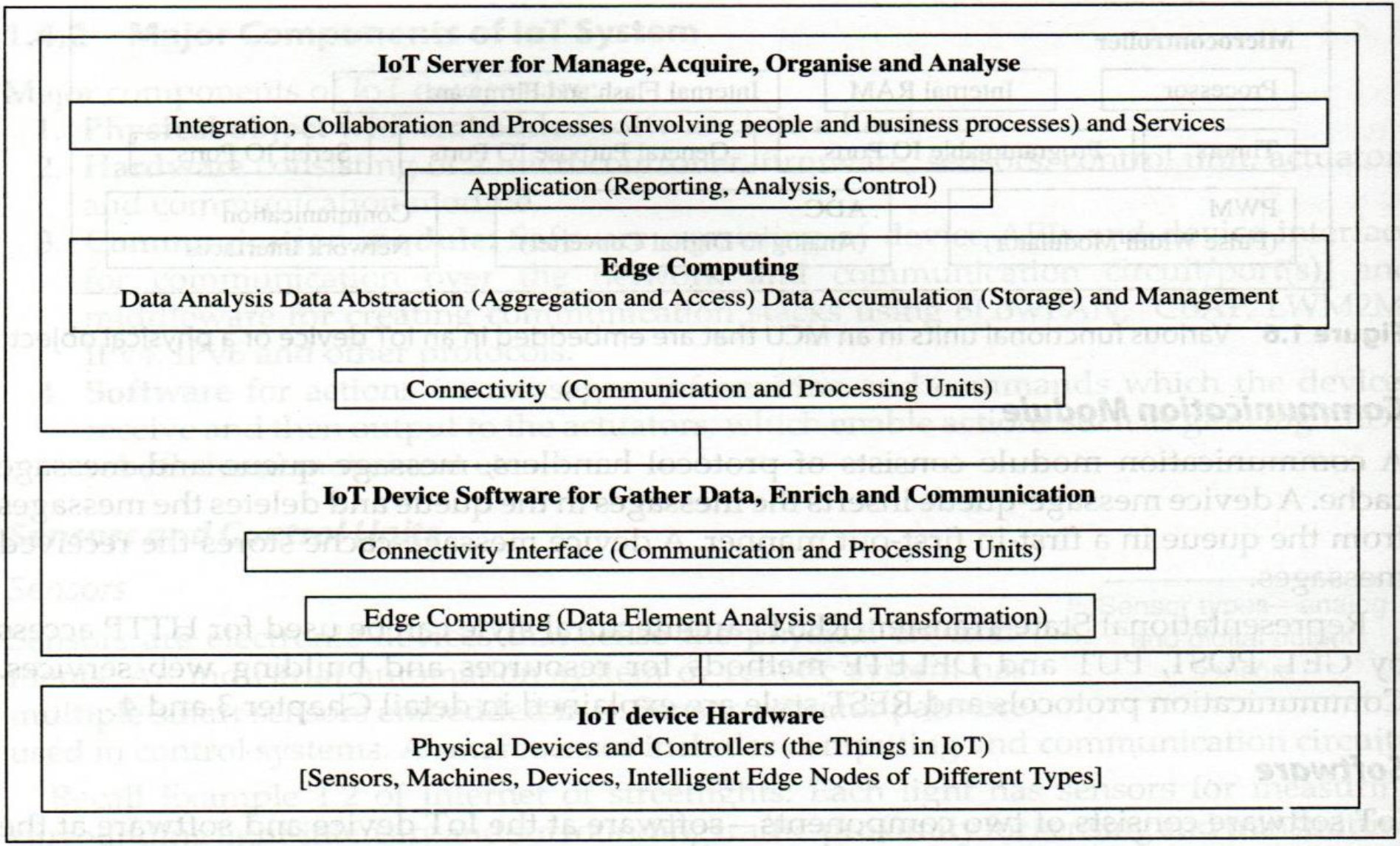
IoT: Processing

- Continuous Complex Event Stream Processing
- Standard-based Continuous Query Language (CQL)
  - Example

Continuously calculate the sustained temperature alerts from remote machines occurring at least 5 times every minute

```
SELECT SUM (alert) as c, sensorID, "sustained" as alerttype
FROM AlertsInputChannel [range 60 minutes]
GROUP BY sensorID
HAVING SUM(alert)>5
```

IoT: Software Components



IoT Software Components for Device Hardware

(Curtesy: TMH; IoT Architecture and Design Principles by Raj Kamal)

IoT: Hardware, Middleware and Software

Hardware	Middleware	Software
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Raspberry-Pi	OpenRemote	Google Brillo
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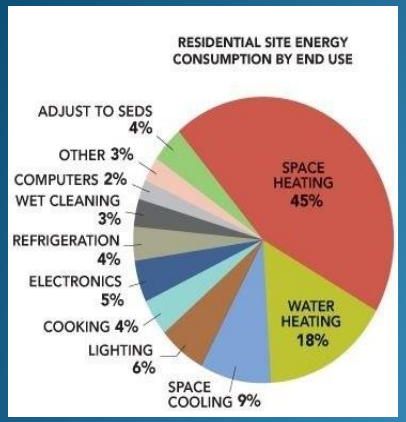
IoT: Applications

- Traffic Monitoring
- Healthcare
- Agriculture
- Security
- Transport and Logistics
- Connected Cars
- Smart City
- Smart Home
- Wearables Devices

IoT:Issues and Challanges

- Privacy
- Security
- Connectivity

Energy Saving, Monitoring and Security System

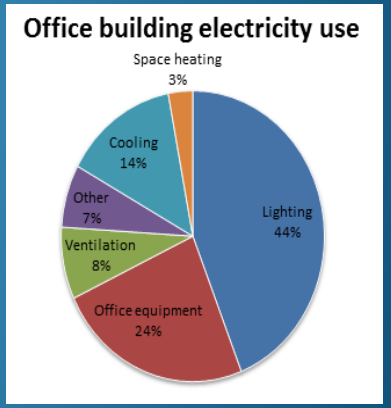


Incentive:

- Both residential and Office buildings waste a huge amount of electricity by virtue of overusing appliances due to different reasons like Ignorance, low maintenance or lack of awareness.
- We waste about 20-40% of residential and office building electricity due to this which makes up to 20% of the total energy produced.
- Most of this wastage can be prevented by using home and office appliances smartly. Since, time is of the essence for anyone such mistakes and inefficiency is only natural. Thus, the best solution is to automate their use.

Objectives:

- To engineer most energy efficient technique for automating the use of appliances in homes and offices that doesn't invade privacy, keeping security a paramount concern. We accomplished this by logically planning use of appliances on the basis of people present in the premises.
- We used infrared sensors for keeping track of people in the building instead of cameras which is both energy efficient and does not create a sense of being monitored all the time. Though we still have the capability of integrating a camera into the system if required.
- Some important features of the system are user defined profiles, authorized entry, security alarm and customizability and expandability.
- Future additions have also been left room for, from android integration, weather assessment and suggestion to remote locking and monitoring as it is designed using open source and



Result:

The System can detect entry and exit as well as the number of people with high accuracy in the premises and take actions like switching appliances on, off or set them at a given rate. Profiles according to residents can be created. It is also capable of detecting intrusion and alarming the correct authorities. We were able to save up to 70% of the wasted electricity in a medium sized setup.

Materials Required

For a prototype with floor plan including Two rooms, Four doors and Eight appliances

- **Raspberry Pi 3 model B & Micro SD cards with OS** **x1** **Rs. 2999/- & Rs. 500**
  - The heart of all the computation and interface for controlling the whole system, this is where logical decisions will be made based on gate sensor modules input, policies predetermined by the developer as well as a few policies built on user input and configuration.
- **Waveshare Raspberry Pi 3.5" Display Module** **x1** **Rs. 1900/-**
  - A screen for accessing the Pi directly without using any other system and while offline. Though it is optional but makes the system more portable and field programmable without connecting to insecure connections over LAN or Wi-Fi
- **Arduino UNO R3** **x1** **Rs. 550/-**
  - For taking data from each gate module (NANO) and forwarding it to RPi 3
- **Arduino NANO V3.0** **x4** **Rs. 300/-**
  - For taking analog input from combination of sensor modules of each gate and converting computing it to represent state of a gate and forwarding the data to central Arduino UNO which provides interface between analog input and Raspberry Pi.
- **Directional and Obstacle Sensor modules** **x20** **Rs. 35-55/-**
  - Directional: To find the direction in which any passing object moved. Based on principle of IR beam break detection.
  - Obstacle: To find which part of the gate was occupied at any instance of time. Also helps in recognizing whether the object is moving on legs or not.
- **Switching Module** **x2** **Rs. 200/-**
  - A decoder to convert incoming binary input into the index of relay which is to be switched on or off.
- **Miscellaneous:** Sensors to facilitate decision making, elements to create circuits and basic electronic tools

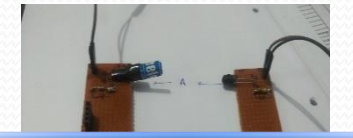
Heart of the Problem and Working Principal

Working Principal:

- Any door can be treated as a half duplex mode of transaction of objects between two spaces.
- Given the floor plan and ability to know the direction and number of such transactions we can compute which space is occupied by how many objects.

Solution and Application:

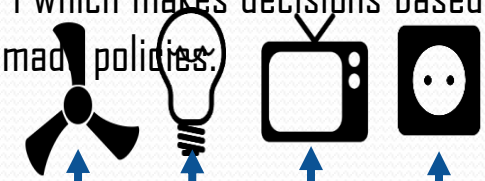
- To build sensor modules which can identify in which direction an object passed and whether it had legs or not.
- A pair of infrared beam breakers can be used to identify the direction of motion while another set of beam in coordination with the above mentioned sensor can identify if the body moved on legs by gap due to count of two legs per object.



Directional Sensors & Beam Break Sensors

Arduino Nano

- These Gate modules will be working in collaboration with each other to compute a desired output for this they will communicate to a Central Unit which will in turn take required actions.
- This Central Unit is the Raspberry Pi which makes decisions based on predetermined factors and user made policies.



Gate Module

DHT Module

UNO interface to RPi

Rpi 3/ Central Unit

Decoder and Relays

Code for Direction Sensor Module

Direction_update §

```
void setup() {// using A1 and A2 as input pins
  Serial.begin(9600);//initializing Serial port with baud rate=9600
}
//global variables to save the previous state of module
int prv=0,pa=0,pb=0,dir=0;
void loop() { //global variable to save the previous state of modul
  // a and b represent the two infrared pairs in the module
  int a=0,b=0;
  //reading the state of sensor a with threshold value as 920
  if(analogRead(A1)>920)
  a=1;
  else
  a=0;
  //reading the state of sensor b
  if(analogRead(A2)>920)
  b=1;
  else
  b=0;
  if(pa!=a)// checking for a change in state of sensor A
  {
    if(prv==2)
    dir--;// direction from B to A
    prv=1;
  }
  if(pb!=b)// checking for a change in state of sensor B
  {
    if(prv==1)
    dir++;// direction from A to B
    prv=2;
```

Direction_update §

```
  if(pa!=a)// checking for a change in state of sensor A
  {
    if(prv==2)
    dir--;// direction from B to A
    prv=1;
  }
  if(pb!=b)// checking for a change in state of sensor B
  {
    if(prv==1)
    dir++;// direction from A to B
    prv=2;
  }
  if(a==0)
  {
    if(b==0)
    {
      // when the sensor is free
      prv=0;
      // in case it is free just after object passed
      if(dir!=0)
      {
      Serial.println(dir);
      dir=0;
      }
    }
  }
  pa=a;// setting up the previous state for next iteration
  pb=b;
}
```

Code for DHT Sensor Module

DHT11

```
#include "dht.h"
#define dht_apin A0 // Analog Pin sensor is connected to

dht DHT;

void setup(){

  Serial.begin(9600);
  delay(500);//Delay to let system boot
  Serial.println("DHT11 Humidity & temperature Sensor\n\n");
  delay(1000);//Wait before accessing Sensor

}//end "setup()"

void loop(){
  //Start of Program

    DHT.read11(dht_apin);

    Serial.print("Current humidity = ");
    Serial.print(DHT.humidity);
    Serial.print("%  ");
    Serial.print("temperature = ");
    Serial.print(DHT.temperature);
    Serial.println("C  ");
    delay(5000);//Wait 5 seconds before accessing sensor again.
  //Fastest should be once every two seconds.
}// end loop()
```

Code for Interfacing gates to RPi

multiplexing_all_sensors_through_gates §

```
/*reading values from 4 gates having 3 sensor
 * modules each through a single arduino board*/
int gate1=2,gate2=5,gate3=8,gate4=11;
/*each value of gate represents the pin where
 * its first sensor module has been pinned*/
int sensors=3;
void setup() {
  /*using all 12 pins for representing sensor of gates*/
  for(int i=2;i<=13;i++)
  {
    pinMode(i,OUTPUT);
  }
  Serial.begin(9600);
  }
void loop() {
  readgate(gate1);
  readgate(gate2);
  readgate(gate3);
  readgate(gate4);//processing of the read data
  //setting outputs according to the set data
}
void readgate(int address)
{
  for(int i=0;i<sensors;i++)
  {
    digitalWrite(address+i,HIGH);
    digitalWrite(address+i,LOW);
  }
}
```

IoT: Recent Trend >> IoE

- The Internet of Everything (IoE)

  *"is bringing together **people**, **process**, **data**, and **things** to make networked connections more relevant and valuable than ever before-turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunity for businesses, individuals, and countries.", (Cisco, 2013)*

- So, IoE is **the intelligent connection of people, process, data and things**
  - **Pillars of The Internet of Everything (IoE)**
  - **People**: Connecting people in more relevant, valuable ways.
  - **Data:** Converting data into intelligence to make better decisions.
  - **Process:** Delivering the right information to the right person (or machine) at the right time.
  - **Things:** Physical devices and objects connected to the Internet and each other for intelligent decision making; often Called *IoT.*

IoT: Research Topics

- Wireless Sensor Networks
- Cloud Computing
- Big Data
- Distributed Systems
- Mobile Computing
- Artificial Intelligence
- Machine Learning
- Security
- Semantic Web
- RFID
- Smart Cities

Conclusion and Future Scope

- Conclusion
  - IoT can connect devices embedded in various systems to the internet.
  - IoT is everywhere.
  - It deliver smart, connected and secure customer experience.
  - Physical Object + Controller, Sensor and Actuators + Internet = IoT
  - Gather + Enrich + Stream + Manage + Acquire + Organise and Analyse = IoT
  - Gather + Consolidate + Connect + Collect + Assemble + Manage and Analyse = IoT

Conclusion and Future Scope

- Future
  - Hybrid AI
  - SMART IoT
  - IoT in Agriculture and farming.
  - Daily life (traffic monitoring, shopping, etc.)
  - Tracking and shipping of goods
  - Health
  - IoT→IoH→IoN

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- And Many More……..

THANKS…

For Your Kind Attention

Finally…

Please Give Your Input