Introduction to Internet of Things

Opportunities and Challenges

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About me:

- Government employee by day, maker by night
- Data analyst, Seksi PABD, Dit. SITP, Ditjen Perbendaharaan, Kemenkeu RI
- Tech evangelist
- IoT, mechatronics, cloud computing, cyber security, photography, cycling, archery, self defense practitioner
- I speak C++, NodeJS, Python, and Kotlin

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“I am not lazy, I am in energy saving mode.”

Generally, internet is connecting people.

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

History

- Kevin Ashton, co-founder of the Auto-ID Center at MIT, first mentioned the internet of things in a presentation he made to Procter & Gamble (P&G) in 1999. Wanting to bring radio frequency ID (RFID) to the attention of P&G's senior management, Ashton called his presentation "Internet of Things" to incorporate the cool new trend of 1999: the internet.

- MIT professor Neil Gershenfeld's book, When Things Start to Think, also appearing in 1999, didn't use the exact term but provided a clear vision of where IoT was headed.

History (2)

- The idea of connected devices has been around since the 1970s, under the monikers embedded internet and pervasive computing.
- The first internet appliance, for example, was a Coke machine at Carnegie Mellon University in the early 1980s. Using the web, programmers could check the status of the machine and determine whether there would be a cold drink awaiting them, should they decide to make the trip to the machine.

History (3)

- ATMs are considered of the first IoT objects and went online as far back as 1974

Back in 2008 there were already more objects connected to the internet than the people by 15:10

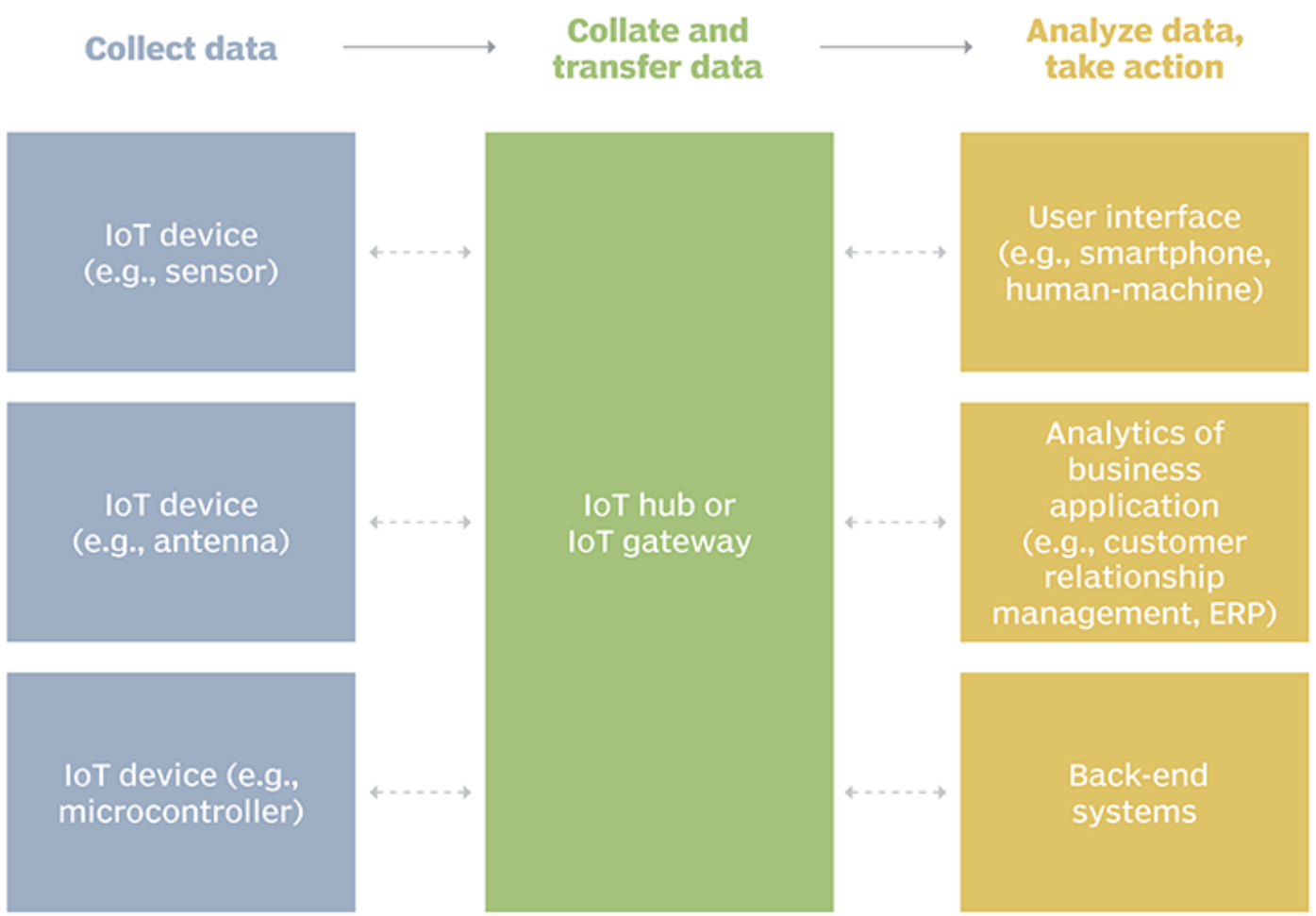
How Its Work

An IoT ecosystem consists of web-enabled smart devices that use embedded processors, sensors and communication hardware to collect, send and act on data they acquire from their environments.

IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally.

Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

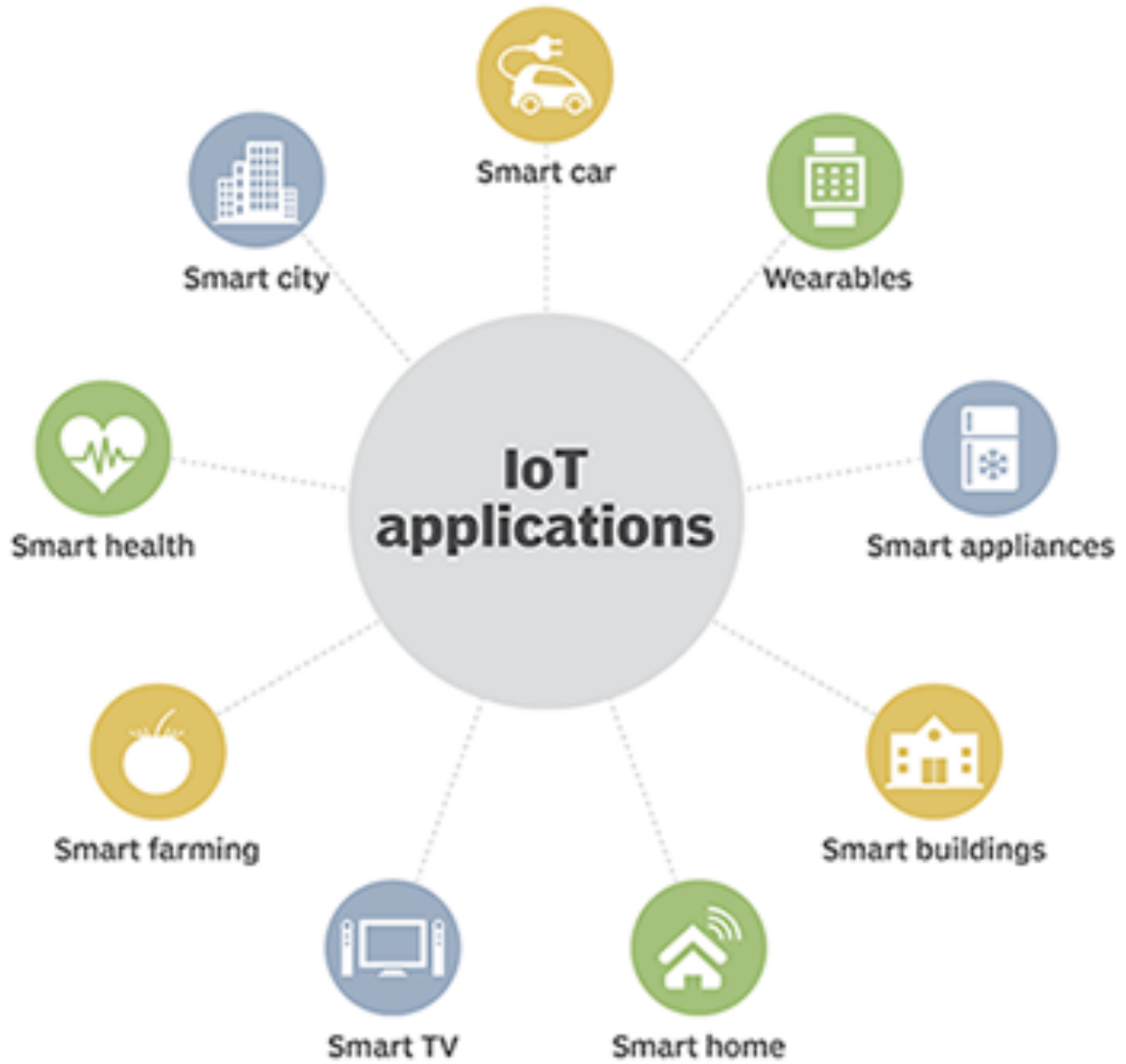
Example of an IoT system



Generally speaking: IoT will make your life more simple.

Benefit of IoT to Organizations

- Monitor their overall business processes
- Improve the customer experience
- Save time and money
- Enhance employee productivity
- Integrate and adapt business models
- Make better business decisions
- Generate more revenue
- Etc.


Smart car
Smart city
Wearables
IoT applications
Smart health
Smart appliances
Smart farming
Smart buildings
Smart TV
Smart home

Wearable

- Wearable devices with sensors and software can collect and analyse user data, sending messages to other technologies about the users with the aim of making users' lives easier and more comfortable.

- Wearable devices are also used for public safety -- for example, improving first responders' response times during emergencies by providing optimised routes to a location or by tracking construction workers' or firefighters' vital signs at life-threatening sites.

Healthcare

IoT offers many benefits, including the ability to monitor patients more closely to use the data that's generated and analyse it. Hospitals often use IoT systems to complete tasks such as inventory management, for both pharmaceuticals and medical instruments.

Building

Smart buildings can, for instance, reduce energy costs using sensors that detect how many occupants are in a room. The temperature can adjust automatically -- for example, turning the air conditioner on if sensors detect a conference room is full or turning the heat down if everyone in the office has gone home.

Agriculture

IoT-based smart farming systems can help monitor, for instance, light, temperature, humidity and soil moisture of crop fields using connected sensors. IoT is also instrumental in automating irrigation systems.

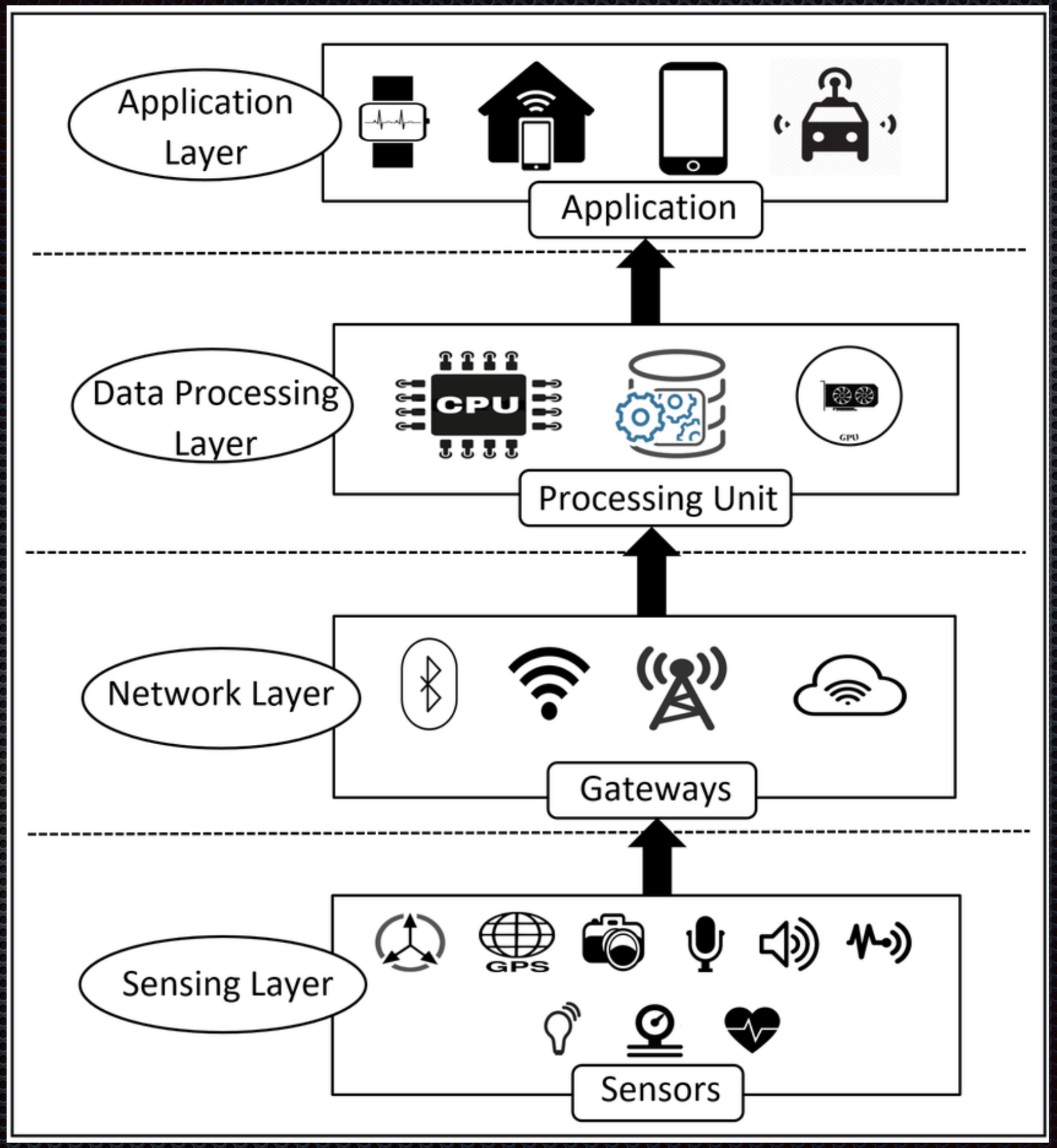
Smart City

IoT sensors and deployments, such as smart streetlights and smart meters, can help alleviate traffic, conserve energy, monitor and address environmental concerns, and improve sanitation.

IoT security and privacy issues

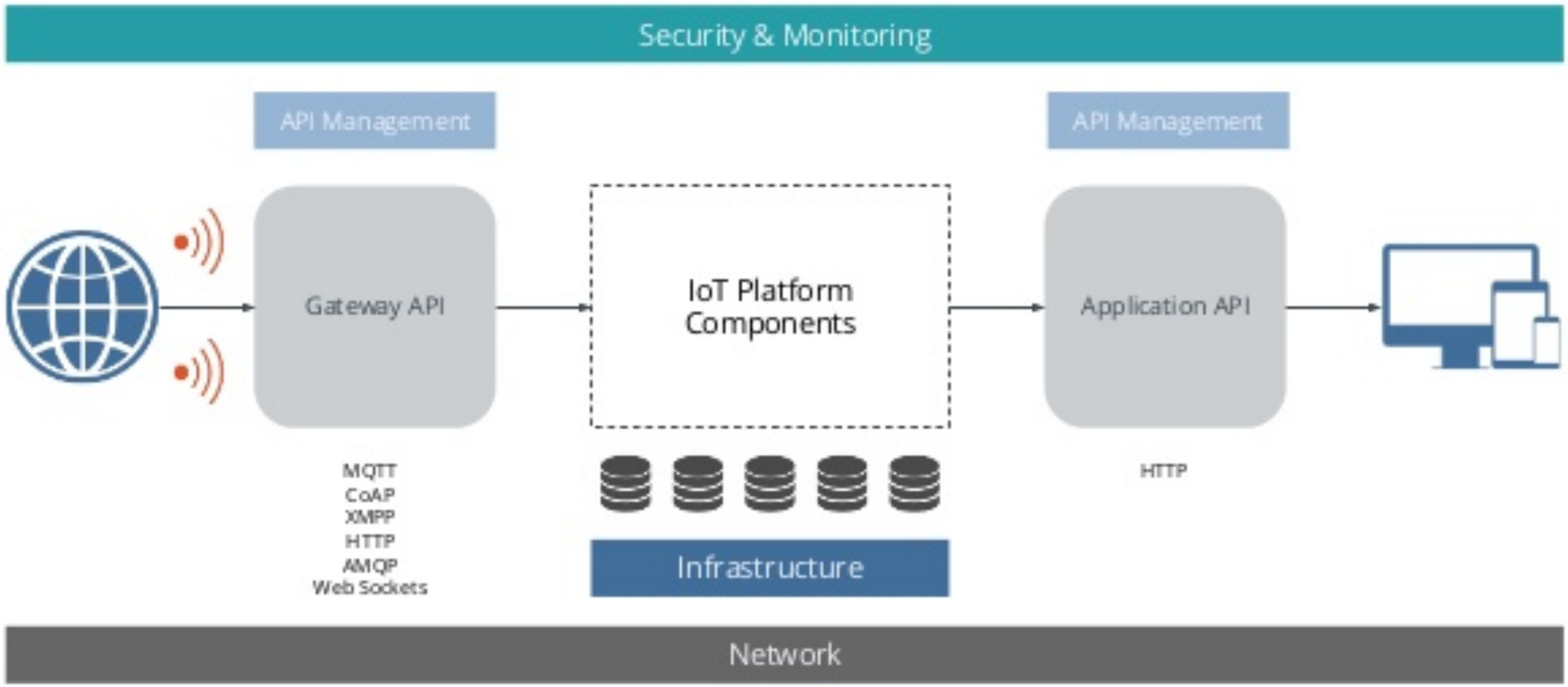
- The internet of things connects billions of devices to the internet and involves the use of billions of data points, all of which need to be secured. Due to its expanded attack surface, IoT security and IoT privacy are cited as major concerns.
- Attackers gained access to the network by exploiting poorly secured IoT devices.
- Privacy is another major concern for IoT users. For instance, companies that make and distribute consumer IoT devices could use those devices to obtain and sell users' personal data.

IoT System Architecture


Application Layer
Application
Data Processing Layer
CPU
GPU
Processing Unit
Network Layer
Gateways
Sensing Layer
GPS
Sensors

IoT System Data Lifecycle

End-to-End IoT System



A complete IoT system covers the *lifecycle of data* from device to application

IoT Data Link Protocol

- Bluetooth
- Zigbee - IEEE802.15.4
- Z-Wave - RFC6282
- 6LowPAN - RFC6282
- Thread - IEEE802.15.4 and 6LowPAN
- WiFi - 802.11n
- Cellular - GSM/GPRS/ EDGE (2G), UMTS/ HSPA (3G), LTE (4G)
- NFC - ISO/IEC 18000-3
- Sigfox - Sigfox (900MHz)
- Neul - Neul (900MHz)
- LoRaWAN - LoRaWAN

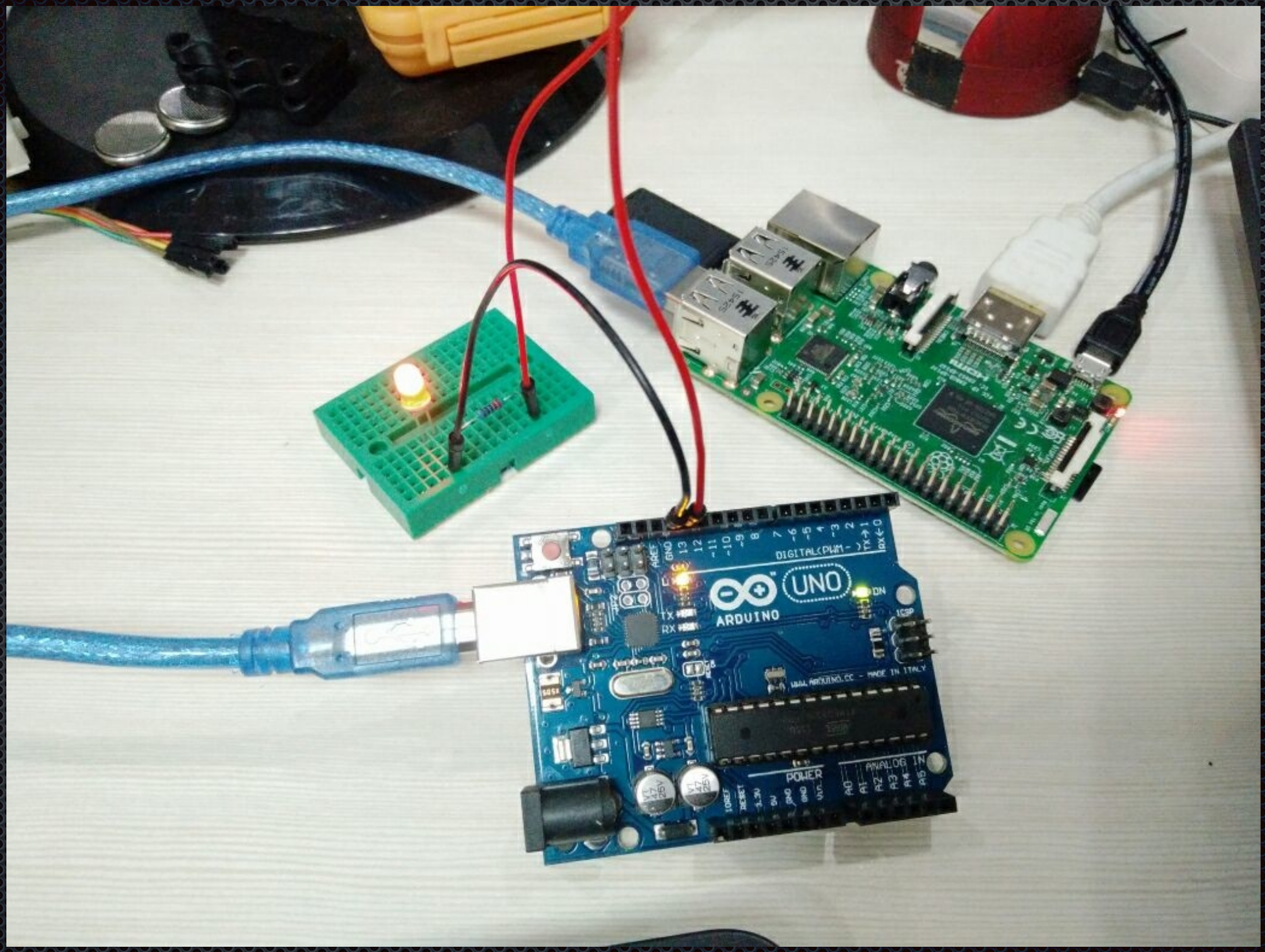
IoT Session Layer Protocol

- MQTT (Message Queue Telemetry Transport)
- SMQTT (Secure MQTT)
- AMQP (Advanced Message Queuing Protocol)
- CoAP (Constrained Application Protocol)
- XMPP (Extensible Messaging and Presence Protocol)
- DDS (Data Distribution Service)

IoT Chip and Module

- Marvell Technology Group - Marvell 88W8977
- Texas Instruments
- Silicon Labs
- Semtech
- Redpine Signals
- Qualcomm
- NXP Semiconductors
- Nordic Semiconductor ASA
- Atmel
- Lantronix
- Intel
- GainSpan (Acquired by Telit)
- Espressif Systems
- Dialog Semiconductor
- Cypress Semiconductor
- ARM
- Qualcomm
- Freescale

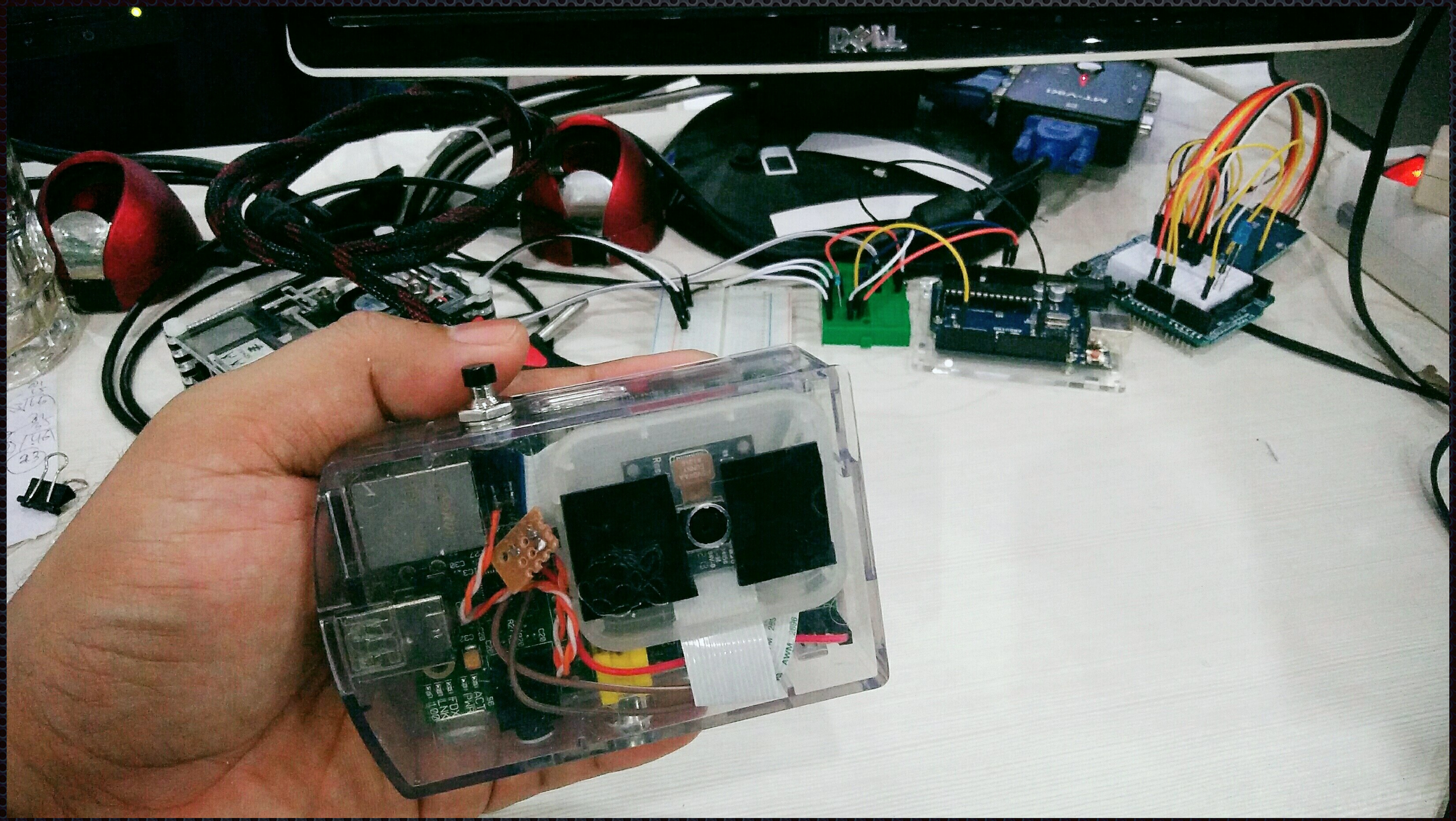
Microcontroller



Proof of Concepts

Prototype

Final product



Output Samples

Output Samples

Output Samples

Some PoC Videos

CODE and DEMO

THANK YOU