Home & Building Automation

Session 2

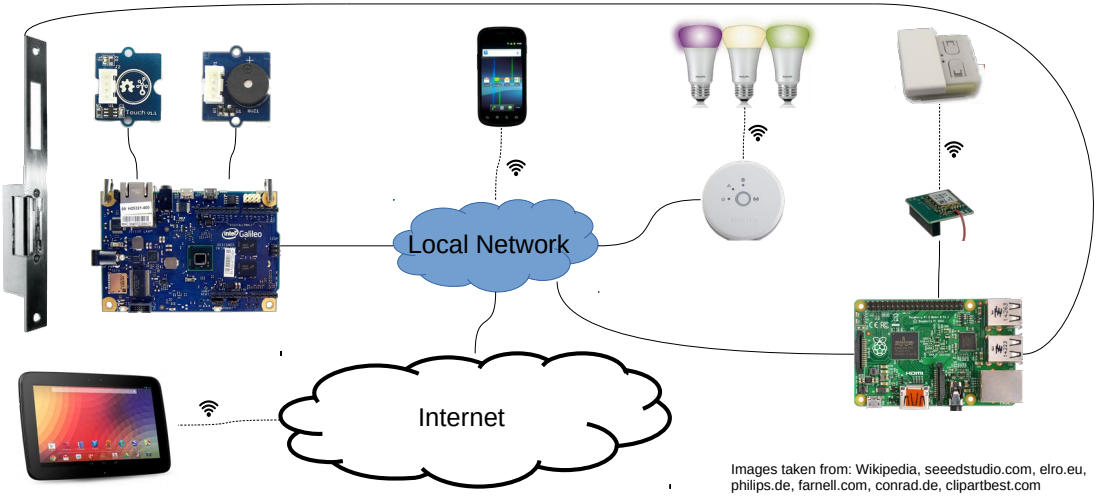
Content

- Introduction (IoT & H&B Automation)
- MQTT
- Build your own lock
- NFC

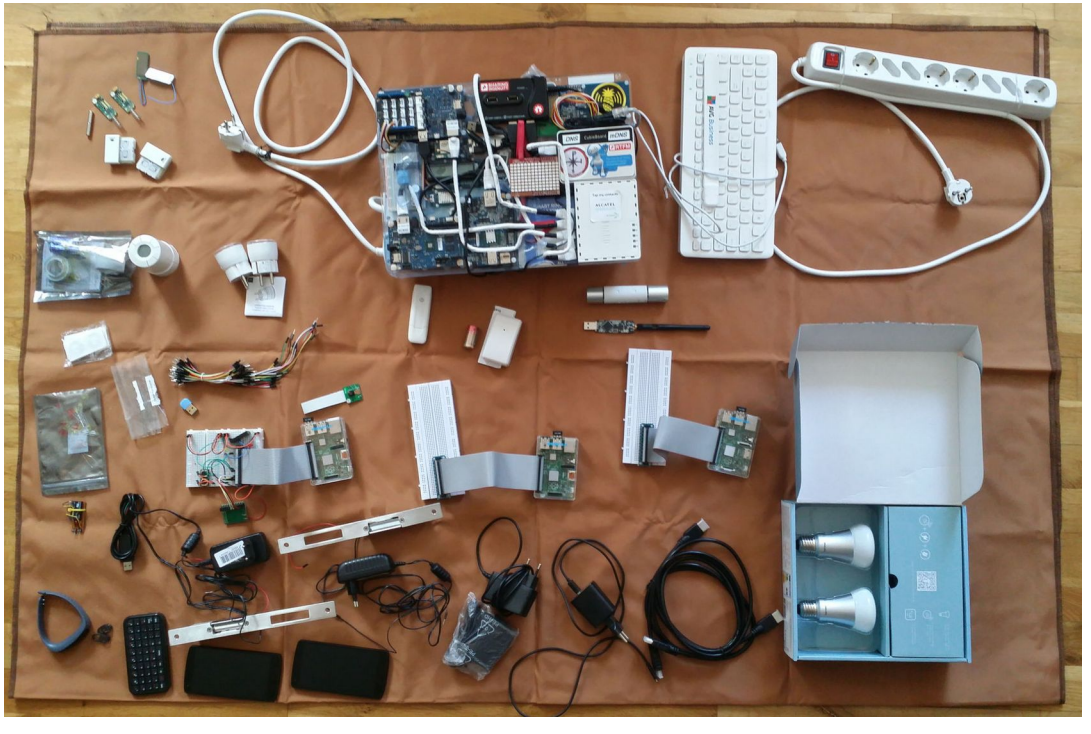
Internet of Things (IoT)

- **Cloud Computing**
  - Client/Server
  - Distributed computing
  - Grid computing
  - Software as a network service
- **IoT**
  - Ubiquitous Computing (Pervasive Computing)
  - Home automation
  - Urban Computing/Smart Cities
  - Embedded Computing
  - Actor/Sensor Networks
  - M2M Communication
  - Mobile Computing, Wearable Computing
  - (Hacking/Making)
  - Big/Actionable Data

→ **Connectivity and data**



Images taken from: Wikipedia, seeedstudio.com, elro.eu, philips.de, farnell.com, conrad.de, clipartbest.com



H&B Automation

- What does the term entail?

H&B Automation

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H&B Automation

- What does the term entail?
- Answers: Security, Privacy, Protection, Configurability, Flexibility, Stability, Connectivity/Networking, Automation, Efficiency (Energy, Work, Convenience), Synergy, Integrability, Pervasiveness, Comfort, Transparency
- Services: Lighting, Switches, Heating, Physical Access, Entertainment, HVAC, Traffic Control/Guidance, Information, Backups, Monitoring, Remote Access

H&B Automation

Residential and commercial buildings should provide an ideal environment for all activities in them …

Comfort

Protection

… at minimal expense!

Efficiency

This and following slides taken from previous H&B Automation class

H&B Automation

Direct interaction with the environment

Goal: More and more “intelligent” buildings!

Homes vs. Buildings

- Fundamental tasks are identical
- Larger uniform units in functional buildings
  - Increased mechanization and automation becomes economical
  - Automation technology applied more comprehensively
- Differences regarding motivation
  - Users “at home” more likely to consider financial impact of their actions
  - Choose individual level of comfort/peace of mind (security/safety)
- Challenges in construction/operation of small residential buildings
  - Organization, skills, cost

Requirements for Building

- Provide an ideal environment
  - For various activities
  - Varies according to purpose
  - Office, factory, swimming pool, …
- Appropriate environmental conditions
  - Humans: Comfortable (productive/relaxing)
  - Machines/goods: Temperature, humidity, avoid condensation, solar radiation
- Supporting structure and facilities
  - Stairways, corridors, sanitary facilities, …
- Protection against hazards and threats

Building services

List from Uniformat D - Services
= „Catalogue“ of functional elements in a building(e.g., for cost estimations)

- Conveying

  Elevators, escalators, moving walks, …

- Plumbing

  Domestic water distribution, sanitary waste, rainwater, natural gas, …

- HVAC

  Heat generation, refrigeration, HVAC distribution, instrumentation and controls, …

- Fire protection

  Sprinklers, …

- Electrical

  Service and distribution, interior/exterior lighting, communciation and security, …

cf. DIN 276-1
cf. ÖNORM B1801-1
(building costs)

Heating, Ventilation, Air Conditioning (HVAC)

Supply and remove heat

Ventilation
Free or mechanical

Humidify / dehumidify
Clean / filter

Centralised / decentralised handling

Different requirements: room/stairs, sunny/shady side, occupied/not occupied, … ▸ zones

Lighting and Shading

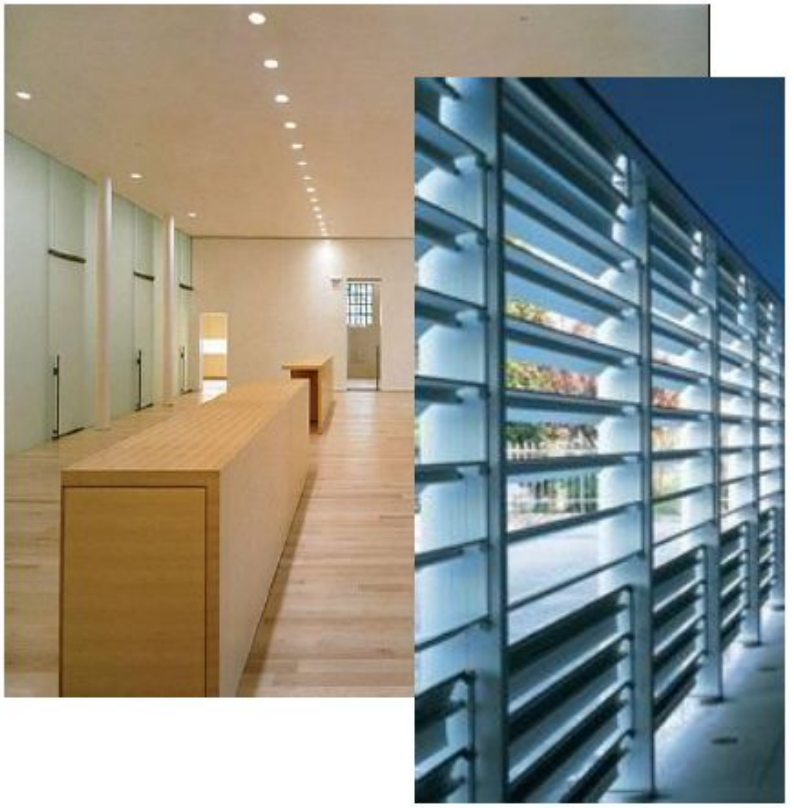
Blinds: protect against glare, brightness, heat

Switching/dimming; drive motors

Motion detectors, presence detectors;
Lux sensors, wind sensors

Daylighting

Switchable (translucent/transparent) and
electrochromic glazing („smart windows“)



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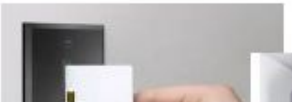
Security and Safety

Protect people and property

- Access control, danger alarms, fire-fighting measures
- Local alarms (klaxons, pre-recorded announcements, evacuation routing, …) and remote alarm



Protect against malevolence (security)

- Glass breakage detectors, motion sensors
- Turnstiles /revolving doors, authentication
- Surveillance cameras (CCTV)
- Guard tour systems

Protect against negligence/force of nature (safety)

- Fire protection/alarms (smoke, heat)
- Fire dampers/doors, smoke extraction, sprinklers
- Gas sensors (CO), water detectors (in raised floors)
- Emergency lighting
- Social alarms

Security and Alarms

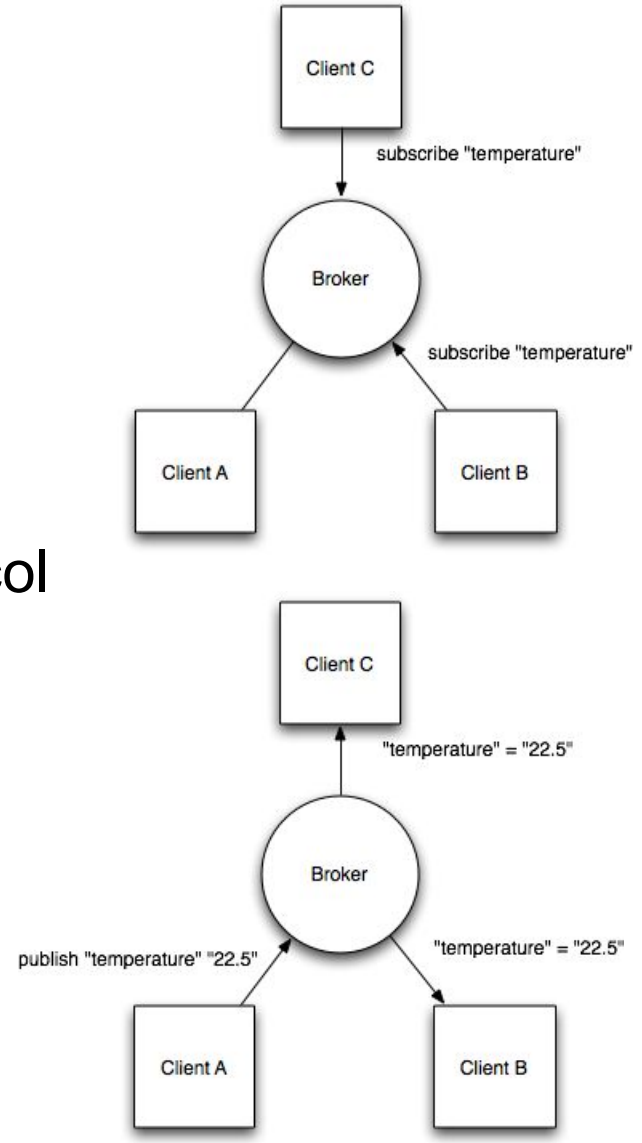
- Ability to
  1) detect intrusion/threat (sensors)
  2) raise alarm (actors)
  3) open/lock access (actors+sensors) for doors and windows
  4) interact remotely

Security and Alarms

- Sensors
  - Motion, Light Gate, Camera, Microphone, Pressure, Temperature, Light Intensity, Humidity, Wifi/Bluetooth Strength Analysis, Smoke, Presence, Acceleration, Gyroscope, (Kinect – 3D Presence)
- Actors
  - Lights, Speakers, Motors (Windows, blinds), Locks, AC/Ventilation Units, Sprinklers, SMS Sender, Screens (for messages)

MQTT – M2M Communication

- MQ Telemetry Transport
  or Message Queue Telemetry Transport
- MQTT Gateway/Broker, star topology
- Publish Subscribe (Listener, Observer Pattern)
- ISO standard, Invented in 1999
- Runs over TCP/ any other stream-based protocol
- Very lightweight
  → runs even on slow Pis and routers
- Many implementations
- Built in security
  - Allows layered security/stacked gateways
  - User access management
  - End to end encryption possible



from https://eclipse.org/community/eclipse_newsletter/2014/february/article2.php

Connect Lock To Wemos D1 Mini

- Wemos → gpio-port → relais
  - define output
  - challenge: do with servo motor
- 12V power adapter → lock → relais
- Use node-red (mqtt nodes) to control

Finish challenges from last time