Key Success Factors for Future IoT Systems

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Think Tank and Research Centre for Building Intelligence
LIVING IN THE FUTURE. TODAY.
Drivers for Future IoT Systems

Megatrends: Sustainability, Demographics, Lifestyle & Digitization Drive Change

Application Context:
• Mobile & Autonomous systems
• Wearables & Health
• Social Media
• Smart Environments
  • Home, Building
  • City
  • Industry 4.0
Drivers for Future IoT Systems

Megatrends: Sustainability, Demographics, Lifestyle & Digitization Drive Change

Technological Development

• Ubiquitous Connectivity
• Software & Cloud Computing
• Machine Learning
  • Speech & Image Recognition
  • Learning & Generalization
• Energy harvesting & longer battery life
• New Sensors
• Privacy & Security
• Device Lifecycle

Source: Daan Lenearts on Pixabay.com
The future of IoT will be driven by the applications we choose & this will create new engineering challenges.

Source: iStock
Swiss Think Tank and Research Centre for Building Intelligence

Smart Energy Management
• Load Management and integration of Renewables
• Decentral Energy measurements, Smart Metering & Load Recognition

Active Assisted Living
• Enabling elderly people a longer, active & independent lifestyle
• IoT applications for higher Quality of Life

Safe Building Intelligence
• Private, individualized support by intelligent buildings
• Digitalisation, Privacy & Data Security

Visitor Center
• 250 Events / 2500 – 3500 Visitors per year
• Up to 25 Visitors per visit (15-60 min.)
17 years of Application Oriented Research in IoT

Collaboration Modes

Innosuisse (KTI) Projects
- Industry Collaboration

EU Consortia
- Industry & Academia

Research Contracts
- Industry Partners
- BfE, EdF

Student Projects, Theses
- Industry, Investigation

iHomeLab Partners
- Partnership
iWalkActive: Personal Mobility for the elderly
Relaxed Care: Connecting People
Home4Dem:
Activity Based Profiles – Dementia Detection

![Floor Plan with Sensors and Analysis Result](image-url)
Research Tool: iHomeLab Multi-Sensor

Sensor Fusion & input for Machine Learning Algorithms

- Low-Power universal sensor system
  - PIR-Sensor
  - Humidity
  - Temperature
  - Luminosity
  - Air Pressure
  - VOC (Volatile Organic Components)
  - Acceleration / Vibration
  - Door Contact Sensor
  - Magnetometer
  - Sound Pressure
  - Distance Sensor
Energy Aware IoT Study

Energy Savings through Distributed Intelligence

Energy awareness:
- Current energy use
- Forecasted energy use
- Flexibility
- Control inputs

Enables coordinated energy savings at large scale
IoT Ecosystems: Creating Caring Communities

- Sensors
- Service providers
- Relatives
- Neighbours
- Friends
- Volunteers
- Service providers
- Ambulant caregivers
- Hospitals
  - Emergency Calling
  - Centres
- Medical doctors
- Pharmacies

Person at home
EU Project BUTLER – Location, Context, Security

ubiquitous, secure internet-of-things with location and context-awareness

SmartHome
- Smart Shopping List:
  - Ex: As you leave home, a shopping list on your mobile is automatically updated...
  - Smart Energy Savings:
  - Ex: As the last person leaves home, the thermostats in the bedrooms are turned down...
  - Etc...

SmartCity
- Smart Event Management:
  - Ex: Information about upcoming and future events are automatically available to patrons and citizens.
  - Smart Parking:
  - Ex: Parking information and suggestions are made available in near-time events.
  - Etc...

SmartShopping
- Smart Sales/Advertisements:
  - Ex: The shop offers you personalized discounts on items suitable for but likely to buy.
  - Smart Cross-referencing:
  - Ex: Your wife is informed of the items you are buying and their prices...
  - Etc...

SmartHealthcare/Wellness
- Smart Prevention Care:
  - Ex: Elderly people have their day-to-day activities monitored, triggering automatic response when needed.
  - Smart Case Sheet:
    - Ex: Medical personnel are given contextualized information on patient’s conditions...
  - Etc...

SmartOffice
- Smart Meeting:
  - Ex: Automatic exchange of business cards with new clients/colleagues in meetings...
- Smart Secured Access:
  - Ex: Only personnel listed to attend a security briefing are warned into door...
  - Etc...

SmartTransport/Mobility
- Smart Navigation:
  - Ex: Traffic information such as the approaching of an ambulance is broadcasted to vehicles on the road...
- Smart Updating:
  - Ex: Your own office, clients, family, are informed of significant delays...
  - Etc...
Successful design of IoT Systems

Key is mastering complexity and ensuring acceptance by users

- Context
- Communication – M2M, H2M
- User acceptance
  - Design
  - Trust
  - Quality of Service

- Design Parameters
  - Connectivity
  - Localization
  - Energy supply
  - Intelligence
  - Interaction

Source: iStock
iHomeLab IoT Development Process

Open development environment, Results validated in the field

- Design Thinking
  - Early user involvement
  - What’s the real need?
  - Value Proposition Engineering

- Agile SW Development

- Field Trials
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  - MVP* to prove prototypes
  - Sharing information supports innovation & efficiency

- Field Trials

* Minimum Viable Product
**iHomeLab IoT Development Process**

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- Agile SW Development
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  - Sharing information supports innovation & efficiency

- Field Trials
  - Validation in the real environment
  - Handover to users and project partner

Source: Donald Giannatti unsplash.com
IoT Applications are Context-Embedded

Application Context

IoT EcoSystem

IoT Device Design

Device Components

Functionality
QoS / RAM

Network Management
Security
Intelligence Architecture

Sensing, Processing
Configuration, Diagnostics

RAM, Failure Modes
Connectivity,
Energy & processing
Costs

Sources: Context: pxhere.com, Ecosystem: pixabay.com, Device: pixabay.com: Components: Own Photo & Screenshot
Digital Twins provide structure

Reality

Context

EcoSystem

Device

Components

Digital Twins
Model Based Systems Engineering structures the IoT Design Process

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Digital Twins

Context

EcoSystem

Device

Components
Tools & Simulation based Validation increases efficiency and agility

Digital Twins

Efficiency via Tools

Validation via Simulation

Context

EcoSystem

Device

Components
The future of IoT will be driven by the applications we choose & this will create new engineering challenges

Digital Twins provide a Framework to master this complexity
The alternative is a world of IoT Hackers....
iHomeLab – Living in the future, today

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