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LoRa - A Survey of Recent Research Trends

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Tampere University of Technology (TUT), Pori

- Pori is town of 85 000 citizens, students and modern enterprises and also one of the leading Finnish cities in happenings.
- TUT Pori is located in University Consortium of Pori (UCPori).
- Laboratory: Pervasive Computing
- Group: SEIntS - Software engineering and intelligent systems

LoRa - A Survey of Recent Research Trends

Content of presentation

- Background
- Research questions.
- Literature research
- Findings and conclusion
- Future work

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Background

- Collaboration between Keio University and Tampere university of Technology.
- IoT prototype development and testing within various projects.
- The power consumption is one markable issue in these prototypes
- This study introduces one Low Power Wide Area Network (LPWAN) technology - LoRa

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The key features of LoRa

- Operates in the lower Industrial, Scientific, and Medical (ISM) bandwidths (USA: 915MHz, EU: 433MHz and 868MHz).
- Long-range communication from 10 to 15 kilometers in an outdoor.
- very low power consumption
- Low data throughput
- **The LoRaWAN**
- The communication protocol
- Standardized by LoRa Alliance
- Version 1.1 of the LoRaWAN specification published in 2017
- ensures data rates from 0.3 kbps up to 50 kbps

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The aim was to find out what the others have done with LoRa

Research questions:

1. How to categorize LoRa research papers?
2. What are the application trends in LoRa?

To answer these questions, we performed a literature study.

The method: Systematic Literature Review approach (SLR)

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The databases used:

- IEEE Xplore Digital Library (IEEE)
- Multidisciplinary Digital Publishing Institute (MDPI),
- Association for Computing Machinery Digital library (ACM),
- ScienceDirect,
- The others (Google Scholar and similar)

Keywords(in various combinations):

- IoT, LoRa, LPWAN, Wireless sensor networks
- Result of combinations: 54 research papers (33 mentioned in paper)

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RQ1: How to categorize LoRa research papers?

a) Analysis/Survey/Factual Discussion

- Introduction of LoRa or LoRaWAN technology.
- Technology-based issues: Architecture and protocols, Functional components, Performance, Security issues such as possible vulnerabilities.

b) Performance/Technical Evaluation

- Performance testing with the real deployment of LoRa in a test environment.
- LoRa technology was key technology in the experiment.
- LoRa technology was used to test some technological features, for example, the scalability of the network.
- LoRa signal propagation testing indoors and outdoors

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RQ1: How to categorize LoRa research papers?

c) Real Deployment/Experimental/Prototype Implementation

- Environmental sensor data. Tracking applications. Few industry-specific prototypes.
- The reasons to choose LoRa were low power devices with batteries or solar power.
- The most commonly used hardware was Semtech LoRa module with Arduino or Raspberry Pi

d) Simulation/Modeling/Networking Stack/Software

- Commonly used research method was simulation when one or more LoRa technology issues were tested.
- Actual device deployment was not fully implemented.
- Typical simulation was large amount of simulated devices and connections were tested with some program.
- Modeling used the same technique. -Without any real devices.
- Research related to networking stacks typically used the network protocol and included some special software combination which was tested or simulated.
- Simulated the presence of a (maximum) number of end devices

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RQ1: How to categorize LoRa research papers?

e) Application

- Targeted applications aimed to use LoRa as a long-range communication interface for real time monitoring.
- Monitoring the temperature of the blood fridges.
- LoRa for a sensor node powered by vibration from an electromechanical energy harvester on a real bridge to monitor road conditions, such as the temperature of the asphalt and the presence of water or rain.
- Monitor and control the temperature and humidity of different rooms, with the aim of reducing costs related to heating ventilation and air conditioning.
- Real-time air quality monitoring using various gas sensors.
- Detect and prevent a destructive landslide.
- Monitor the environment of sea and sailboats, including the speed and direction of wind and current, the location and orientation of the sailboat for sailing sports and races
- Geo-location tracking applications, such as tracking animals or elderly people.
- LoRa in gateways targeting a vehicle diagnostic system for driving safety.

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2. RQ: What are the application trends in LoRa?

- (Battery powered) WSN's sensor node
- Data: temperature, humidity, vibration, location and tracking, …

=> a small amount of data to be transferred

- Great potential for observing the physical environment both indoors and outdoors.
- ...

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Thank you

Questions?

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