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Agile Environmental Sensing

CILIX: Virtual Machine for Wireless Sensor Network Applications

Abstract

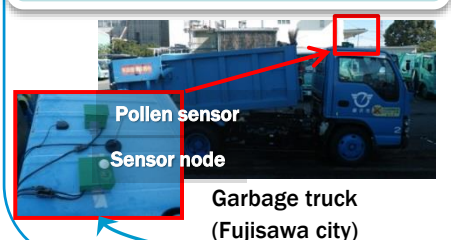
We propose agile software development and maintenance for environmental sensing based on *CILIX*, our virtual machine. CILIX has three essential characteristics: (1) enables programmers to develop sensor node software using familiar programming language, (2) replaces sensor node software by wireless networks, (3) requires no large program memory. Using CILIX, sensor node software programmers can quickly develop a minimum set of software using familiar programming language and iteratively updates it depending on practical situations. We conducted several field-sensing experiments to investigate our technologies.

Atmospheric environmental sensing

ClouT Project funded by NICT*

Monitoring atmosphere of Fujisawa city using garbage trucks equipped with atmospheric sensors

Sensors:
CO, O3, NO2, PM2.5, pollen, dust, etc.



Garbage truck (Fujisawa city)

Endangered species habitat monitoring

Cooperative experiment with Kinki Univ.

Monitoring endangered fish habitats to conserve biological diversity

Sensors:
water temperature, DO, etc.

Endangered species biotape at Kinki Univ.

Greenhouse monitoring

Cooperative experiment with Sakuho town

Recording temperature and humidity distribution to clarify feasible cultivation environment

Sensors:
temperature, humidity, soil water

Eustoma greenhouse

Program
(CIL executable)

VB Compiler | C# Compiler | J# Compiler

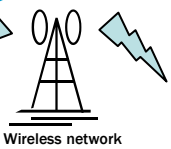
VB code | C# code | J# code

Developers don't have to use specialized programming environment for sensor nodes. CILIX can **execute CIL** program** developed with MS Visual Studio.

** CIL : Common Intermediate Language

CILIX

VM for wireless sensor devices that realize agile development and management for environmental sensing!



Operators can easily replace a program code of sensor nodes **through wireless networks**.

Minimum system requirements:
ROM 32K
RAM 4K

CILIX **execute programs on smaller sensor devices** that prolong battery life and reduce on-site maintenance for sensor nodes.

Development phase → ***Management phase***

*Part of research results were achieved by "Extending the cloud paradigm to the Internet of Things - Connected objects and sensor clouds within the service perspective", the Commissioned Research of National Institute of Information and Communications Technology (NICT), JAPAN.

Related works

Y. Yanagisawa, Y. Kishino, T. Suyama, F. Naya, T. Terada, and M. Tsukamoto, "CILIX: a CIL Virtual Machine for Wireless Sensor Devices," in *Proc. The 2014 International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA'14)*, 2014.

Contact

Yoshinari Shirai Learning and Intelligent Systems Research Group, Innovation Communication Laboratory
E-mail : shirai.yoshinari(at)lab.ntt.co.jp