【Grant-in-Aid for Scientific Research (S)】

Broad Section J

Title of Project： Context Recognition of Humans and Objects by Distributed Zero-Energy IoT Devices

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【Purpose and Background of the Research】

In recent years, various research and development aiming at the realization of the “super smart society” utilizing IoT, wireless communication, AI and big data have been advanced. In order to realize such super smart society, it is important to spread battery-less, maintenance-free IoT devices (hereafter referred to “zero-energy IoT devices”). Generally, IoT devices consume power for sensing, processing and communication where the power consumption for communication is very high (sensing is on the order of tens of μW, while wireless communication is on the order of mW to hundreds of mW). The key technology for the Internet connection of IoT devices is the spread of ultra-low power communication mechanisms.

In recent years, Wi-Fi based backscatter communication technology (power consumption of about 10 μW) that can transmit and receive at a distance of several tens of meters at several Mbps and RFID communication technology that can transmit and receive data from a distance of several meters have been developed. In addition, IoT devices using only the power obtained by environmental power generation and their sensing technology have been devised. However, many of those existing sensing devices and technology remain in the development of relatively simple context recognition technology such as the presence or movement of humans at the target point.

In this research, by utilizing knowledge of cross layers of the application layer and physical layer in zero-energy IoT device networks, and building machine learning mechanisms using many zero-energy IoT devices, we aim to create advanced context recognition technology.

【Research Methods】

In this research, first, by combining (i)zero-energy IoT devices, (ii)backscatter/RFID communication devices, and (iii)electronic circuits made by 3D printers, we will create zero-energy IoT devices for context recognition of humans and objects. In addition, we will build zero-energy IoT device networks combining these devices in mesh forms and create more advanced context recognition technology such as trajectory estimation and behavior recognition of humans and objects.

Then, using such zero-energy IoT devices applicable to context recognition of humans and objects, we create new context recognition technology for (i)watching over the elderly at the nursing facilities, (ii)understanding the activities of athletes, (iii)trajectory estimation of human and objects, (iv)construction of sociograms for grasping human relations of children, (v)understanding of wind power and ground movement, and (vi)air conditioning management in commercial facilities (Fig.1).

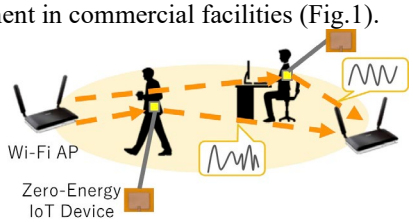

Fig.1 Context recognition using zero-energy IoT devices

【Expected Research Achievements and Scientific Significance】

By developing various context recognition systems using zero-energy IoT device networks as described above, and evaluating and examining their effectiveness, we expect to contribute the design and development of context recognition technology of humans and objects for the realization of the “super smart society” promoted by the government. We think we also contribute to the spread of various context recognition systems by realizing the design development environment of such context recognition systems.

【Publications Relevant to the Project】

[1] T. Higashino, A. Uchiyama, S. Saruwatari, H. Yamaguchi and T. Watanabe: “Context Recognition of Humans and Objects by Distributed Zero-Energy IoT Devices”, *Proc. of 39th IEEE Int. Conf. on Distributed Computing Systems (ICDCS 2019)*, pp.1787-1796, 2019.

[2] Y. Fukushima, D. Miura, T. Hamatani, H. Yamaguchi and T. Higashino: “MicroDeep: In-network Deep Learning by Micro-sensor Coordination for Pervasive Computing”, *Proc. of 4th IEEE Int. Conf. on Smart Computing (SMARTCOMP 2018)*, pp.163-170, 2018.

【Term of Project】

FY2019-2023

【Budget Allocation】

154,000 Thousand Yen

【Homepage Address and Other Contact Information】

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