MITSUBISHI ELECTRIC CORPORATION
PUBLIC RELATIONS DIVISION
7-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo, 100-8310 Japan

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Customer Inquiries   *Media Inquiries*

Advanced Technology R&D Center   Public Relations Division
Mitsubishi Electric Corporation   Mitsubishi Electric Corporation
www.MitsubishiElectric.com/ssl/contact/company/rd/form.html   prd.gnews@nk.MitsubishiElectric.co.jp
www.MitsubishiElectric.com/company/rd/   www.MitsubishiElectric.com/news/

Mitsubishi Electric Develops Visualization Technology for Use in Domestic Power Consumption Management

Estimates the power consumption of home appliances without the need for additional equipment

TOKYO, January 29, 2019 – Mitsubishi Electric Corporation (TOKYO: 6503) announced today that it has developed new technology that allows the estimated power consumption of individual home appliances to be extrapolated from the overall power consumption of each household. The new solution, the result of joint research with Tohoku Electric Power Co., Inc., makes use of Mitsubishi Electric's pioneering AI technology Maisart®* to estimate power consumption to a high degree of accuracy without the need to install new measuring instruments.

* Mitsubishi Electric's AI creates the State-of-the-ART in technology   M a i s a r t

With this new technology, Mitsubishi Electric Corporation aims to spur the provision of new services using the power consumption data of electricity supply companies and to improve energy conservation awareness in homes. The solution has already been deployed in an energy-saving assist service under the Customer-Assisted Smarter Project that Tohoku Electric Power Co., Inc. commenced in July 2018.**

** See Tohoku Electric Power Co., Inc.'s news release at http://www.tohoku-epco.co.jp/news/normal/1197475_1049.html

Based on the results of recent verifications, Mitsubishi Electric Corporation will continue research and development aimed at further improving the estimation accuracy of its new solution.
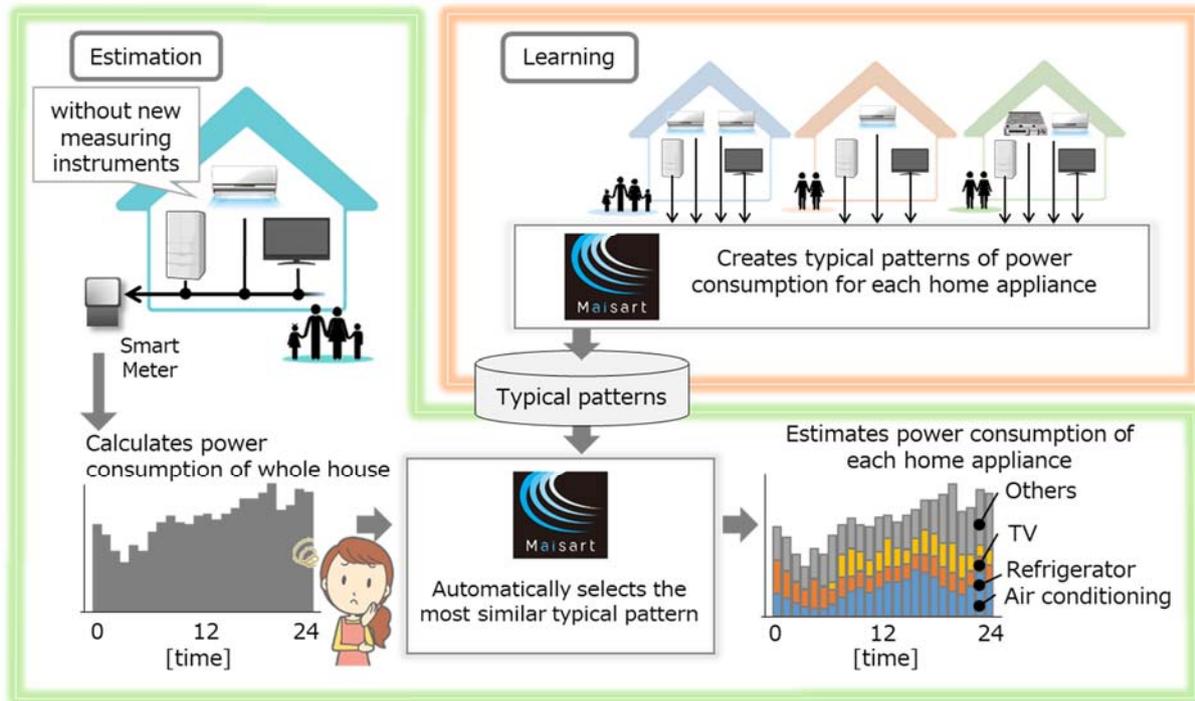
Fig. 1 Outline of visualization of power consumption details

Background

Smart meters that measure household electricity consumption at frequent regular intervals are becoming increasingly common. Existing smart meters only measure the overall power consumption of the whole house, but there is a growing need to know the power consumption of individual home appliances. Technically, the installation of a current sensor on the home's power distribution board would allow the power consumption of each appliance to be monitored, but the cost of installing such sensors can be prohibitive. Mitsubishi Electric Corporation has therefore developed this new "Technology to Visualize Power Consumption" solution, which deploys artificial intelligence to extrapolate the power consumption of individual home appliances from the power consumption of the whole house to a high degree of accuracy.

Key Features

1) *Leverages AI technology to estimate individual home appliance power consumption without the need for additional measuring devices*

    - Artificial intelligence is used to extrapolate the power consumption of each home appliance from the power consumption data of the whole house, as measured by a smart meter.
    - No need to install new measuring instruments since existing smart meters are used.
    - The amount of data collected and stored is just one percent of that required by conventional estimation methods.
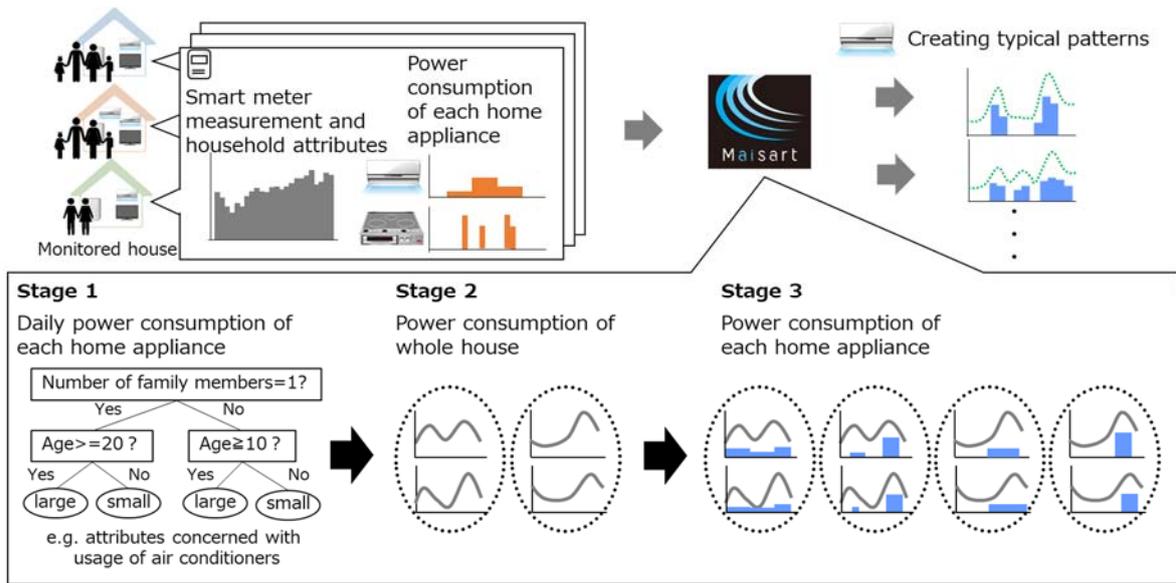
    Using AI, typical electricity usage patterns are extracted from data such as family composition and the attributes of the home appliances. The power consumption of each home appliance is then extrapolated

from the power consumption data of the whole house measured by a smart meter. Traditional methods measure the power consumption of individual home appliances at intervals of 10 seconds or less using a current sensor or other measuring device. However, this new technology utilizes the existing data captured by smart meters, so there is no need to install new measuring instruments. As a result, the amount of stored data can be reduced to one percent or less of that required by existing methods, which in turn reduces the amount of calculation required to provide estimates.

2) *Typical patterns allow power consumption for each home appliance to be estimated to a high degree of accuracy*
   - The AI functionality performs a three-stage clustering based on the power consumption of the whole house and each home appliance measured in advance within monitored houses, as well as information on the composition of the family and the home appliances they own.
   - A typical pattern is created using AI, which corrects fluctuations caused by variations in daily activity time and groups together houses with similar power consumption characteristics.
   - The AI functionality automatically selects the most similar typical pattern, reducing errors by applying actual values and achieving a high level of accuracy.

The AI functionality performs three-stage clustering (see Fig. 2) based on the pre-measured power consumption of the whole house and each home appliance, and on attributes such as family composition and the number and type of home appliances. Houses with similar electricity usage are automatically grouped and representative values for each group are created as a typical pattern. In addition, by absorbing minor time fluctuations in activities that vary depending on the day and the family, such as waking, cooking and the time at which family members return home, the AI calculates the correlation between the typical pattern and the measured data to estimate power consumption more accurately (see Fig. 3). Since the AI function automatically selects the most similar typical pattern, the discrepancy with actual values is reduced, achieving a high level of estimation accuracy.

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Stage 1	AI extracts attributes that determine the daily power consumption of each home appliance; for example, the characteristics of groups whose usage of air conditioners accounts for a large proportion of their total electricity consumption (e.g. their daily power consumption, floor space, the age of their house)
Stage 2	The results of groupings made in the first stage are further classified by the similarities established by smart meter measurements, such as those using more electricity in the morning and evening and those using more electricity during the night.
Stage 3	The results of grouping in the second stage are further classified by the similarities of the hour-by-hour power consumption for each home appliance, such as those using air conditioners regardless of the time of day, those using air conditioners only at night or those using air conditioners extensively in the mornings and evenings.

Fig. 2 Method of creating a typical pattern
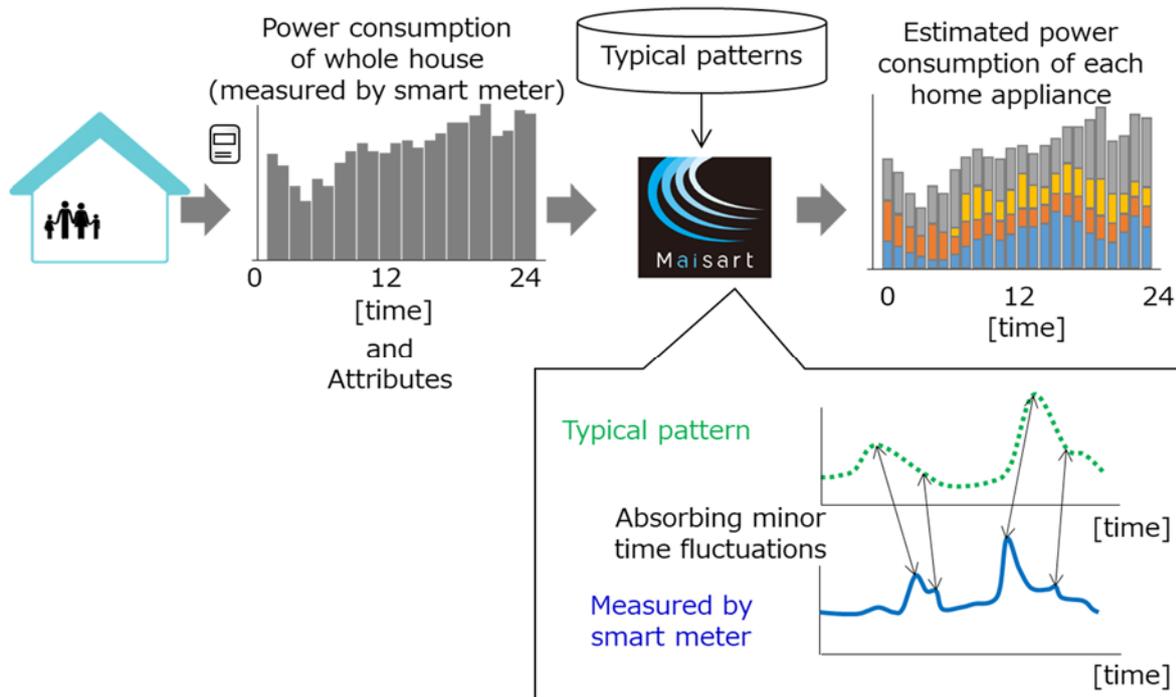
Fig. 3 Power consumption estimation method for each home appliance

Contribution to the Environment

The provision of energy-saving advices and other services to households by electric power companies helps reduce the environmental impact of energy generation by promoting energy conservation in homes.

About Maisart

Maisart encompasses Mitsubishi Electric's proprietary artificial intelligence (AI) technology, including its compact AI, automated design deep-learning algorithm and extra-efficient smart-learning AI. Maisart is an abbreviation for "Mitsubishi Electric's AI creates the State-of-the-ART in technology." Under the corporate axiom "Original AI technology makes everything smart," the company is leveraging original AI technology and edge computing to make devices smarter and life more secure, intuitive and convenient.

Patents

Pending patents for the technology announced in this news release number four in Japan.

Maisart is a registered trademark of Mitsubishi Electric Corporation.

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About Mitsubishi Electric Corporation

With nearly 100 years of experience in providing reliable, high-quality products, Mitsubishi Electric Corporation (TOKYO: 6503) is a recognized world leader in the manufacture, marketing and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, energy, transportation and building equipment. Embracing the spirit of its corporate statement, Changes for the Better, and its environmental statement, Eco Changes, Mitsubishi Electric endeavors to be a global, leading green company, enriching society with technology. The company recorded consolidated group sales of 4,444.4 billion yen (in accordance with IFRS; US$ 41.9 billion*) in the fiscal year ended March 31, 2018. For more information visit:

www.MitsubishiElectric.com

*At an exchange rate of 106 yen to the US dollar, the rate given by the Tokyo Foreign Exchange Market on March 31, 2018