Designing for comfort and safety

Tecnomatix helps Osaka Gas Co. develop friendly, personalized living spaces

Issues:

Develop – within five years – a system that supports the national initiative for better ergonomics in new and remodeled homes

Address behavioral conditions according to degree of importance

Deliver comprehensive system, including the ability to predict heart rate and blood pressure

Approach:

Use Tecnomatix™ Jack technology as core human simulation solution

Express primary behaviors in combinations of nine basic actions

Customize Jack to support advanced requirements

Results:

"CUPS" (comfort, usability, performance and safety) system developed on schedule

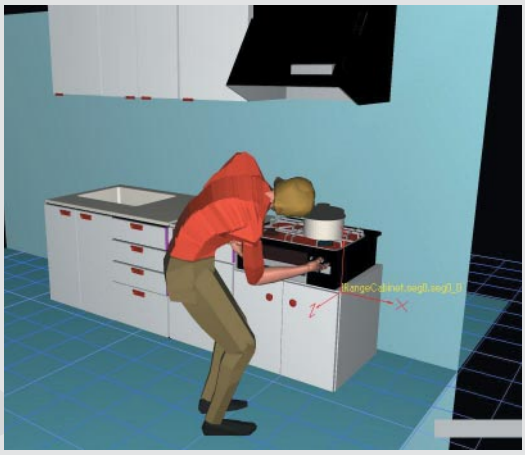
Heart strain prediction model mirrors actual physical behaviors

New industry applications under review

OSAKA GAS COMPANY, LIMITED

A national initiative for ergonomic living spaces created the need for highly advanced human simulations – so advanced that even blood pressure and pulse can be considered.

A vision of comfort



Osaka Gas Co. Ltd., part of the Osaka Gas group, formulated its "2010 Vision" in October 1999, establishing the "energy business" and "urban business" as its two-pronged foundation for the future. The company's 2010 Vision included finding methods to create a more comfortable way of life for its customers. Around this same time, Japan had established a national initiative for greater awareness of ergonomics during building construction and renovation. To support its vision and Japan's Ministry of Economy, Trade and Industry's national initiative, Osaka Gas began development in late 1999 of "CUPS" (comfort, usability, performance and safety), a design support system that addresses human behavior relative to function and comfort throughout a home or commercial living and working space.

Osaka Gas' CUPS project leaders identified several critical development items.

The first was behavioral simulation. Since there were user requests to evaluate various kinds of behaviors in a variety of environments, Osaka Gas sought to develop a system in which human behaviors and movements can be easily and automatically simulated.

The second was to establish a comprehensive evaluation method. Someone emphasizing aesthetics in home remodeling will obviously weigh factors differently than someone requiring efficiency in office development, so Osaka Gas sought to develop a method for evaluating behaviors taking into consideration relative importance across a number of independent factors.

The third was the development of a heart strain prediction system. Considering that environments must address a variety of individual needs, e.g., young and old, healthy and physically challenged, etc., Osaka Gas sought to develop a system that could predict the blood pressure and heart rate that would correspond to a specific movement.

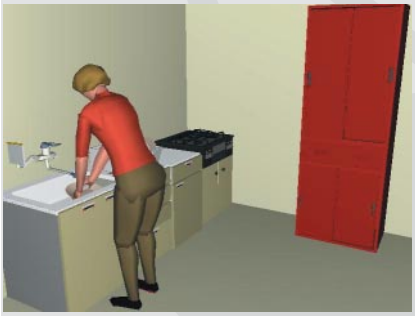
TECNOMATIX

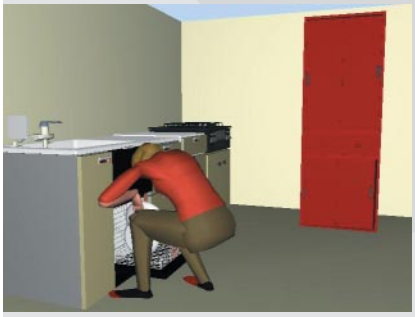
Proven technology

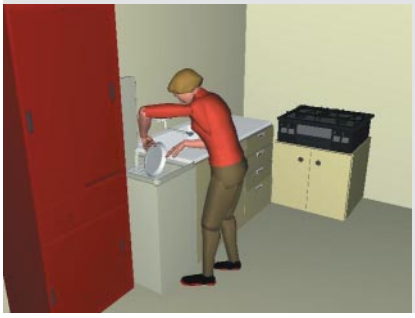
Osaka Gas decided against an in-house development, noting that the digital human model that would serve as the core of the system would be best procured in first class, commercially available software. As there were no Japanese-based digital human modeling products available at that time, the company evaluated offerings from abroad. Osaka Gas consequently narrowed the choices to two – Safework and Tecnomatix Jack (also known just as Jack). Performance benchmarking was conducted for about two months and a detailed comparative examination was prepared.

Osaka Gas Co. chose Jack based on the exceptional expandability of the system and the ease with which it can be customized.

Masaru Hotehama, an energy information technology researcher at Osaka Gas Energy Technology Laboratories, explains, "When we did our comparative examination of several digital human models, we learned that the technical level of Jack is superior. We felt it was obvious that there was no other choice but to introduce Jack."







A customized behavioral simulation solution

Using Jack as the core, Osaka Gas developed behavioral simulation functionality by videotaping activities, such as cooking and washing dishes. The result was that virtually all movements could be accurately accounted for in nine basic movements. These movements were combined and inputted into Jack.

Hotehama notes, "We needed to develop a behavioral algorithm and incorporate it into Jack. Using the Tcl/Tk language, we did just that. The system development went very smoothly, and since it is possible to load and execute a variety of external programs using Jack, the degree of freedom is extremely high."

In addition, Osaka Gas implemented the "OWAS evaluation" – a method for assessing posture by means of a 4-step scale. When the score is 1 or 2, the behavior is evaluated as acceptable, but when it is 3 or 4, it is found to be problematic and meriting improvement. The OWAS evaluation – also loaded into Jack as a standard capability – enables Osaka Gas to carry out the behavioral assessment automatically. Jack generates the results – recorded in a time series – with individual behaviors independently assessed.

Behavioral assessments according to lifestyle preferences

During system development, Osaka Gas generated deviation values for eight kinds of assessment criteria, such as comfort, usability, performance and safety. This enabled the company to carry out a comprehensive evaluation and at the same time – compare and adjust within these assessment criteria. That means each behavior can be modeled according to user requirements. For example, young persons and elderly persons live different lifestyles and are likely to make different adjustments to the behavior based on personal preferences and needs. One person might feel the operation is utilizing an unnatural posture and like to change it; another person might want to keep back stress low, even if the behavior would result in requiring more time than is typically needed across age groups.

Persons (or clients) simply review the eight assessment items and address their preferences. CUPS obtains information about how much importance the person places on the respective

Solutions/Services

Tecnomatix Jack

Client's primary business

Osaka Gas Co. provides natural gas, appliance and energy systems throughout the Kinki region (the cities of Osaka and Kyoto and four Japanese prefectures), with natural gas delivery to approximately 6.4 million customers.
www.osakagas.co

Client location

Osaka
Japan

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Masaru Hotehama
Energy Information Technology Researcher
Osaka Gas Energy Technology Laboratories

items and appropriately weights each. This capability represents a significant step forward in behavioral modeling, providing a more accurate measurement of desired performance against personally-defined requirements.

Safe spaces for the elderly

Osaka Gas' heart strain prediction system measures strain on the elderly. To develop this system, Osaka Gas decided first to classify heart motion into three types and to carry out simulations of these separately. The motions were classified into isotonic contractions (motion that moves the joints), isometric contractions (motion that does not move the joints) and rising action (a sudden change in the heart's position), and models of each were prepared separately.

Previously, there were no systems that predicted blood pressure and heart rate by envisaging the activities of daily life. Now there is. Osaka Gas' simulation results, in fact, closely mirror that obtained in live experiments of the same behaviors. Hotehama says, "When we were preparing the heart strain prediction model, Jack enabled us to easily execute files that we had prepared with the Visual Basic language."

Open standards, impressive results and future opportunities

Jack's open structure was very important in making the behavioral model a reality. Hotehama points out, "We were able to process the results of the comprehensive evaluation of the living environments and to create our own unique interface. Thus we were able to generate results in the precise form we wanted using the very versatile Jack technology."

Osaka Gas is now examining the use of Jack for the development of its gas appliances product line. For example, the posture of the user will differ depending on the respective type of gas appliance and how it is operated. The "quantification" of strain on the waist and of other factors can lead to new product innovation.

The company is also looking into simulating such activities as nursing care. In caregiving, there are two standpoints, that of the caregiver and that of the non-caregiver. The burden on the caregiver isn't typically taken into account, but it is an issue, e.g., lifting patients. Currently, CUPS is used to simulate only one person's behaviors. Both nursing care provider and recipient behaviors can be simultaneously evaluated when the simulations are increased to two persons interacting.

In addition, Osaka Gas is examining the system's application to other industries, hoping to expand its range to include the design of plant equipment that is easy to maintain, the design of highly productive and pleasant assembly factories that are both highly productive and pleasant to work in, and the design of stores that are comfortable, inviting and compelling for customers.

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