Abstract: One of the central issues in service engineering is how to understand human behavior for service quality control (QC). In this paper, we first briefly explain behavior measurement of employees and the visualization by using mixed-reality information sharing technologies. Next, we introduce several case examples of the applications in actual service fields such as a Japanese restaurant, nursing home, and Japanese-style hotel.


For the reason that mentioned above, we have developed MRIS technologies that realize computerization or virtualization of real-world entities, and intuitive visualization while promoting their practical use in the real service fields. Figure 1 shows the overview of MRIS technologies and the horizontal/vertical development.

Human behavior measurement techniques in our MRIS technologies are composed of (1) PDRPlus [4] in which PDR (Pedestrian Dead-Reckoning) [3] cooperates with action recognition to improve both accuracy, (2) SDF (Sensor Data Fusion) [5] that integrates mobile/wearable...
sensing including PDRplus, infrastructure based positioning with IMES (Indoor MEssaging System)/Wi-Fi/RFID/VLC (Visible Light Communication), and map matching with 3D environmental maps, and (3) SOE (Service-Operation Estimation) [6]. The massive cost for initial installation and maintenance is inevitable if we densely cover indoor service fields only with positioning infrastructure. The combination of PDR, sparse positioning infrastructure, and map information realizes cost-effective and adaptive measurement. Also using interactive 3D indoor modeler [7] makes it possible to create virtualized-reality models of service fields only from a set of photos while reducing the creation cost. Moreover, the indoor models have high re-usability since they can be used not only for maps in SDF, but behavior analysis, ethnography, navigation, etc.

3. HBIplus for Service Quality Control

If human-behavior indicators (HBIs) of employees are obtained, such as trajectory, staying time at a specific area, category of service operation, and so on, we will come into sight of which behavior of employees may cause resulting indicators such as accounting history, nurse call log (customers’ response), energy consumption log, plant operation log, and subjective evaluation results. It is assumed that issues due to intangibility and heterogeneity of service can be alleviated to some extent by seeing a service field as snapshots at every moment using evidences from several different points of view. Thus, by combining HBIs

Fig.2: HBIplus: Alleviating issues due to intangibility and heterogeneity by visualizing diverse and normalized indicators based on the combination of human-behavior indicators and additional factors such as stimuli, constraints, and resulting indicators.

and additional factors, such as stimuli, constraints, and resulting indicators, we can provide diverse, normalized, and unbiased indicators. As shown in Figure 2, we call such framework “HBIplus”.

4. Applications to the Service Industry

In this section, we introduce several case examples of the applications of MRIS technologies with HBIplus in actual service fields such as a Japanese restaurant, nursing home, and Japanese-style hotel. Figure 3 shows a visualization tool on human-behavior and sales indicators to support QC circles (QCC) and job analysis at one of Japanese cuisine chain restaurants. In this case, trajectory, staying time at each area and POS data (number of customers at each table, ordered items) are obtained and visualized. It is expected that the reasonableness and effectiveness of QCC activities or job analysis are improved by such micro-macro hybrid visualization and by verification of employees’ activities in the context of each customer’s position.

The next example in Figure 4 is at a nursing home. In this case, the same visualization tool shown in Figure 3 is used to analyse the on/off-state of nurse calls (NCs) at each resident’s room coupled with employees’ behavior. Herewith

Fig.3: Visualization tool on human-behavior and sales indicators to support QC circles and job analysis (Ganko foood service).
Fig.4: Visualization on how to deal with nurse calls at a nursing home (City Estate).

Fig.5: Examples of visualization for various HBIs at a nursing home (City Estate).

Fig.6: Retrospective interview support using virtual first-person-views based on human-behavior measurement (Kinosaki Hot Springs).

We can see various factors: how long it took to respond to the NC, which care worker responded to the NC, where and how far the care worker and other workers were when the NC was switched on, how each care worker actually took action until the NC was turned off. The upper part of Figure 5 is radar charts variables of which are the number of walking steps, the number of floor changes in the four-story facility, staying time in residents’ rooms, and the number of utterance counted up by using a VAD (Voice Activity Detection) technique [8]. The lower part of Figure 5 is timelines that show the transition of rooms that nurses R and S visited and the amount of VAD. Both of the visualized data are useful to check the actual role, to classify how they work, and to validate the hypotheses on what is related to high skills. For instance, the managers of the nursing home can intuitively validate their hypotheses like “Workers who are skillful at comprehensive awareness is to talk to residents frequently everywhere, but each conversation is basically short.” by utilizing such visualization methods.

Figure 6 shows a case example of “CCE Lite” in which CCE (Cognitive Chrono-Ethnography) [9] is supported by the usage of virtual first-person-views (FPVs) based on human-behavior measurement. Although CCE is assumed to be effective in understanding human behavior selections in daily life and in service fields, it was time-consuming to record behavioral data of the interviewees and to arrange them for retrospective interview. By using MRIS technologies, we can realize over 50% cost reduction on labor cost and preparation time compared with the original CCE.

5. Conclusions and Future Works

The last example in Figure 6 is the integration of the subjective evaluation and the objective measurement of human behavior rather than the combination of various s. However, it gives us a suggestion that intuitive visualization of human behavior measurement data in retrospective interviews can effectively facilitate episodic memory retrieval on how and why the interviewees selected each
behavior at each moment of work in the decision-making process that relies on the definitive rationality and satisficing principle.

As for future works on MRIS technologies with HBIplus, for instance, we have been making effort on installation of CSQCC (Computer Supported Quality Control Circle) [10] in the actual Japanese restaurant using the technologies as shown in Figure 3 to see how differently each participant thinks/communicates/acts in the new style of QCC compared with the current traditional QCC, and also to see how effectively MRIS technologies with HBIplus work for QC. In such a way, we would like to keep working on R&D to realize service QC and improvement based on MRIS technologies that is driven by actual service fields. We believe that our contributions will be not only to control or improve service quality but also to induce service innovation.

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