Architectural Design Method for Smart Sleeping Systems

Shuh-Ping Sun [1] and William S. Chao [2]

[1] I-Shou University, Department of Digital Media Design, Professor, Kaohsiung, Taiwan
[2] Association of Chinese Enterprise Architects, President, Taipei, Taiwan

Abstract—**In this paper, we propose an architecture-oriented design method for smart sleeping systems. This design method adopts the Structure-Behavior Coalescence (SBC) Architecture Description Language (SBC-ADL) to present systems design results. SBC-ADL systems design results help integrate different stakeholders' works on the same track and unfold the backbone of smart sleeping systems. The smart sleeping system design result of SBC architecture can be used as smart sleeping system design schemes to improve the acceptance and effectiveness of the development of smart sleeping systems.**

Keywords—**Systems Design, Architecture-Oriented Design Method, Architecture Description Language, Smart Sleeping Systems.**

I. Introduction

In general, a smart sleeping system is exceptionally complex that it includes multiple views such as structure, behavior, and information views. The systems model designs the smart sleeping multiple views possibly using two different methods. The first one is the non-architecture-oriented method and the second one is the architecture-oriented method [1, 4]. Non-architecture-oriented systems model respectively picks a model for each view [5, 6]. Architecture-oriented systems model, instead of picking many heterogeneous and unrelated models, will use only one single coalescence model [2, 3].

An architecture-oriented design method for gaming business administration systems adopts the SBC architecture [1, 2, 3, 4] as a systems model. With SBC architecture, we then can effectively design the structure, behavior, and information of smart sleeping systems; resolve uncertainties and risks caused by those non-architecture-oriented design methods. Overall, SBC architecture design method helps integrate different stakeholders' works on the same track and unfold the backbone of smart sleeping systems. The smart sleeping system design result of SBC architecture can be used as smart sleeping system design schemes to improve the acceptance and effectiveness of the development of smart sleeping system.

II. METHOD

The systems model designs the smart sleeping system multiple views possibly using two different methods. The first one is the non-architecture-oriented method and the second one is the architecture-oriented method.

The non-architecture-oriented method respectively picks a model for each view as shown in Figure 1, the structure view has the structure model; the behavior view has the behavior model; the information view has the information model. These multiple models are heterogeneous and unrelated of each other, thus there is no way to put them into a conformity model [5, 6].

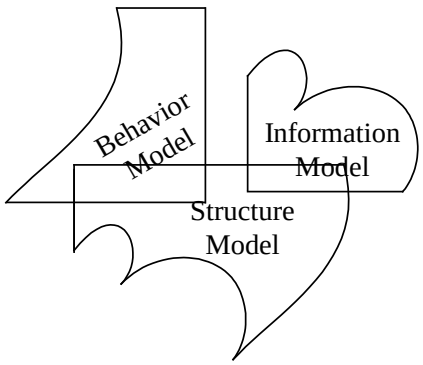

Figure 1 The Non-architecture-oriented Approach

The architecture-oriented method, instead of picking many heterogeneous and unrelated models, will use only one single coalescence model as shown in Figure 2. The structure, behavior, and information views are all integrated in this multiple view coalescence (MVC) systems model [1, 2, 3].

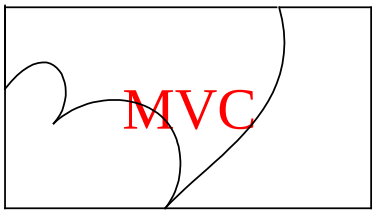

Figure 2 The Architecture-oriented Approach

Figure 1 has many models. Figure 2 has only one model. Comparing Figure 1 with Figure 2, we unquestionably conclude that an integrated, holistic, united, coordinated, coherent, and coalescence model is more favorable than a collection of many heterogeneous and unrelated models.

Since structure and behavior views are the two most prominent ones among multiple views, integrating the structure and behavior views apparently is the best approach of integrating multiple views of a system. In other words, structure-behavior coalescence (SBC) facilitates multiple view coalescence (MVC) as shown in Figure 3. Therefore, we claim that SBC architecture is an architecture-oriented systems model.

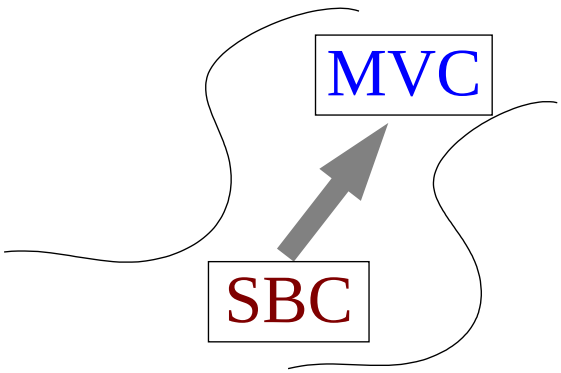

Figure 3 SBC Facilitates MVC

III. SBC ARCHITECTURE DESIGN METHOD FOR SMART SLEEPING SYSTEMS

SBC architecture design method for smart sleeping systems adopts the SBC architecture as a systems model. SBC architecture design method shall start from the preparation phase and then goes through the planning, preliminary design, and detailed design phases of SBC architecture construction. Each phase checks with the SBC architecture to make sure the constructed smart sleeping system is what the users want as shown in Figure 4.

SBC architecture design method uses three fundamental diagrams as Structure-Behavior Coalescence Architecture Description Language (SBC-ADL) to formally design the essence of a smart sleeping system and its details at the same time. In the planning phase, framework diagram (FD) is used. In the preliminary design phase, component operation diagram (COD) is used. In the detailed design phase, interaction flow diagram (IFD) is used.

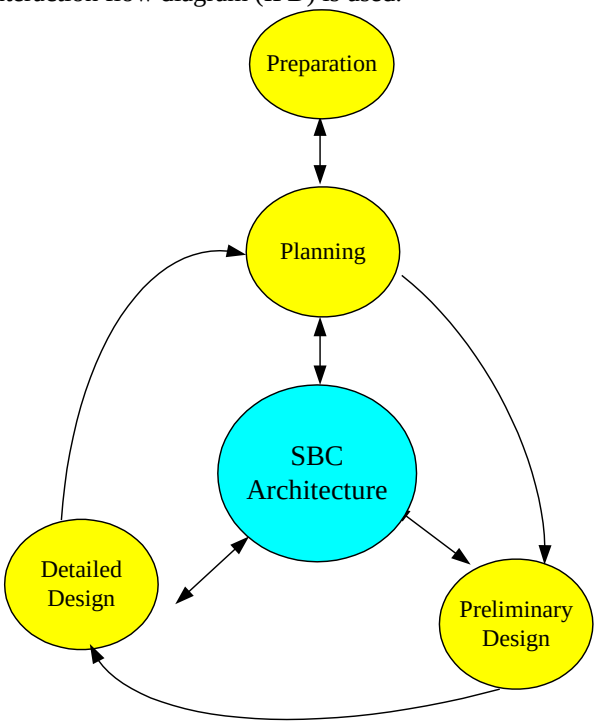

Figure 4 SBC Architecture Design Method for Smart Sleeping Systems

A. Planning Phase

The framework diagram (FD) designs the decomposition and composition of the smart sleeping system in a multi-layer manner. Only non-aggregated systems will appear in the FD. As an example, Figure 5 shows the FD of smart sleeping systems. In the figure, *Application_Layer* contains the components *SleepingGesture_GUI*, *SleepingReport_GUI*, and *SleepingAnalysis_GUI*; *Data_Layer* contains the *Sleep_Database* component; *Technology_Layer* contains the *Sleep_Sensor* component.

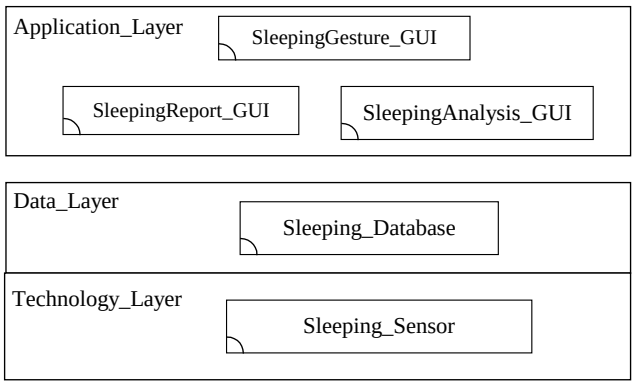

Figure 5 FD of *Smart Sleeping Systems*

B. Preliminary Design Phase

For a smart sleeping system, we use component operation diagram (COD) to design all components' operations. Figure 6 shows the COD of *Smart Sleeping Systems*. In the figure, component *SleepingGesture_GUI* has one operation: *Measurement_Input*; component *SleepingReport_GUI* has one operation: *Status_Output*; component *SleepingAnalysis_GUI* has one operation: *Analysis_Output*; component *Sleeping_Database* has one operation: *Sleeping_ SQL_Query*; component *Sleeping_Sensor* has one operation: *Sleeping_Measure*.

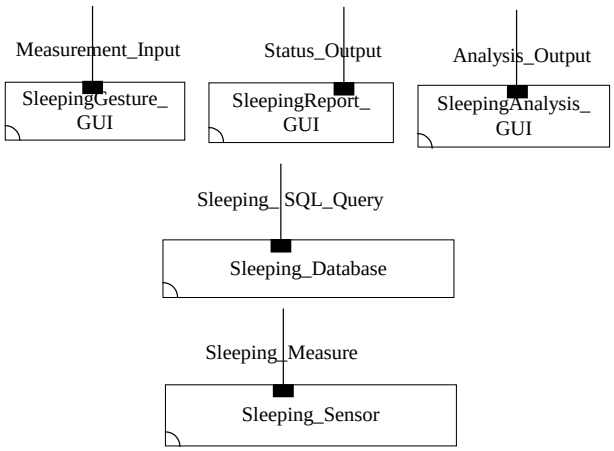

Figure 6 COD of *Smart Sleeping Systems*

C. Detailed Design Phase

In a smart sleeping system, if the components, and among them and the external environment's actors to interact, these interactions will lead to the systems behavior. That is, "interaction" plays an important factor in coalescing structures with behaviors for a smart sleeping system.

The overall behavior of a smart sleeping system consists of three individual behaviors: Sleeping_Measure, *SleepingStatus*, and *SleepingAnalysis*. Each individual behavior represents an execution path. We use interaction flow diagram (IFD) to design this individual behavior.

Figure 7 shows the IFD of the *Sleeping_Measure* behavior. First, actor *Customer* interacts with the *SleepingGesture_GUI* component through the *Measurement_Input* operation call interaction. Next, component *SleepingGesture_GUI* interacts with the *Sleeping_Sensor* component through the *Sleeping_Measure*operation call interaction. Finally, component *SleepingGesture_GUI* interacts with the *Sleeping_Database* component through the *Sleeping_ SQL_Query* operation call interaction.

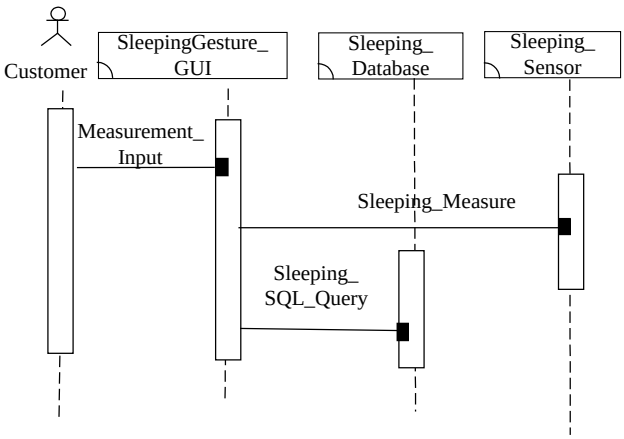

Figure 7 IFD of the「Sleeping_Measure」Behavior

Figure 8 shows the IFD of the *SleepingStatus* behavior. First, actor *Customer* interacts with the *SleepingReport_GUI* component through the *Status_Output* operation call interaction. Finally, component *SleepingReport_GUI* interacts with the *Sleeping_Database* component through the *Sleeping_ SQL_Query* operation call interaction.

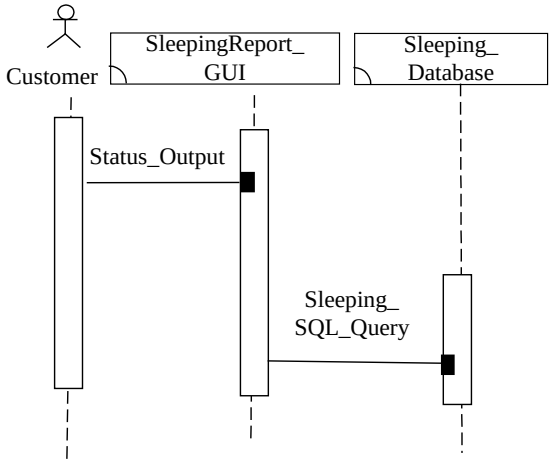

Figure 8 IFD of the「SleepingStatus」Behavior

Figure 9 shows the IFD of the *SleepingAnalysis* behavior. First, actor *Company* interacts with the *SleepingAnalysis_GUI* component through the *Analysis_Output* operation call interaction. Finally, component *SleepingAnalysis_GUI* interacts with the *Sleeping_Database* component through the *Sleeping_ SQL_Query* operation call interaction.

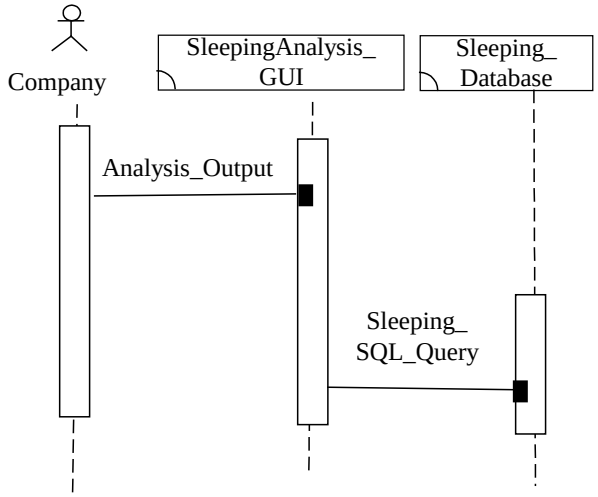

Figure 9 IFD of the「SleepingAnalysis」Behavior

Overall, SBC architecture design method helps integrate different stakeholders' works on the same track and unfold the backbone of smart sleeping systems.

IV. CONCLUSIONS

SBC architecture design method starts from the preparation phase and then goes through the planning, preliminary design, and detailed design phases of SBC architecture construction. SBC architecture design method uses the Structure-Behavior Coalescence Architecture Description Language (SBC-ADL) to formally design the essence of a smart sleeping system and its details at the same time. In the planning phase, framework diagram is used. In the preliminary design phase, component operation diagram is used. In the detailed design phase, interaction flow diagram is used. The smart sleeping system design result of SBC architecture can be used as smart sleeping system design schemes to improve the acceptance and effectiveness of the development of smart sleeping system.

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