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# A Study of Timing Issues for Multimodal Human Machine Interface for Smart Home

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**Keywords:** smart home, multimodal human machine interface.

Nowadays, vary with the development of Wireless Networks, rapid evolution of Internet of Things (IoT), smart home, smart city are very near to us. Smart Home is a home like environment that possesses ambient intelligence and automatic control, in which to responds to behavior of residents with various facilities. The main target of smart home is to support resident goals of life comfort, safety, security, energy-efficiency and enhance intelligent living. One important thing towards making a smart home is automation. The automation could be related to the individual appliances or equipment being intelligent enough to take local decisions. Traditional human machine interface (HMI) is good enough for the normal user, but not adaptive to ambient environment. Thus, multimodal HMI is proposed which process two or more combined user input models, such as original switch, remote controller, speech, pen, touch, manual gestures, gaze, and head and body movements in a coordinated manner with system output of home appliance. These kind of combinations always lead conflict problems, thus, the timing issues need to be analyzed before the implementation of MHMI.

In this research, I do a study of timing issues for multimodal human machine interface for smart home. In the first chapter, I introduced the background of MHMI for smart home environment, which is the trend of near future to any human in the world. The aim of this research is that

before create the novel MHMI for smart home, the timing issues need to be discussed. Thus, the survey of home appliance and related interaction methods is necessary. Then, based on the survey, the real experiment of MHMI should be built to measure the real date for the analysis. Moreover, based on the results, the questionnaire survey with absolute category rating to evaluate the tolerable response time is important. The results of tolerable response time can be used for the optimization of MHMI.

Chapter 2 presents the introduction about smart home. By defining smart home, discussing the components of smart home. Then, a comprehensive judgment of my research background in human machine interface for smart home is introduced. In addition, the traditional human machine interface has lots of limitations so we need to explain how to build a multimodal human machine interface to help user interact with machine in Smart Home.

Chapter 3 discusses the typical classification about the existing User Interface and proposes the basic four categories for MHMI. After the explanation of four user interfaces, the time issues of MHMI is described with the combination of these UI.

In Chapter 4, a real experiment environment is setup to do the response time measurements of TUI, AUI, MUI and GUI. Based on the typical response time of each UI, a additional delay range is designed to test the human feeling/tolerable timing of each UI. A questionnaires with absolute category rating is prepared for the tolerable experiments. Based on the results, the time issues of MHMI is discussed for smart home. Instead of real implementation of console, AUI and TUI are used to evaluate the importance and effectiveness of synchronization for MHMI. Instead of real implementation of console, AUI and TUI are used to evaluate the importance and effectiveness of synchronization for MHMI.

At last, we discussed the contribution of these research work, and show the future works.