

# IrRC-Logger: A Logging System for IR Remote Control Signal to Analyze User's Operation Intention

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**Abstract.** This paper proposes a quantitative recording system for users' operation on home appliances. This system records automatically Infrared-signal (Ir-signal) from remote controller of the appliances and pictures of TV Output from the appliances simultaneously. The system acquires the Ir-signal and the pictures without particular interfaces or modification of appliances. Evaluator of appliances is able to review the users' operation by playing back the signals and the pictures.

## 1 Introduction

Usability of rich-function home appliances such as Digital Video Recorder or DVD Player is an important factor to product selection. In many product development processes, usability testing is executed with short-term field trial of inexperienced users to extract usability problem. On the other hand, there is a problem that short-term usability testing neglects users' learning effect for the product. The users accustom themselves to the products for long-term (months or years) experiences. Authors consider *Long-Term Usability* testing is necessity for measuring the actual conditions of utilization [1] [2]. However, enormous cost is required for applying typical techniques of usability-testing such as Interview, Video recording and think-aloud protocol [3].

On the other hand, quantitative analysis of operation histories is required for consistency of evaluation results among the different evaluators. Some studies are conducted to evaluate usability of computer software quantitatively. Cook et. al. analyzed a operation log of text editor on the computer [4]. However, for most of home appliances, acquiring quantitative data is difficult because the appliances prepare no module of evaluation analysis and interfaces.

In this paper, we propose *IrRC-Logger*, a quantitative recording system for users' operation on home appliances. The system acquires operation histories of home appliances and pictures of their TV output. In these appliances, most of user operation can record by observing remote controllers, and every operation result is presented on TV Output from their appliances. Our system captures Infrared-signal (Ir-signal) and their TV output from devices **Ir Capture** and **Video Capture**. Recording the TV

Output from the appliances is important, because of some operations such as *Selection of an item from the menu* (pushing arrow buttons and Select/Enter button) can understand only by reviewing their operation histories and their GUIs. The usability of the GUI characterizes the usability of the appliances more than Channel Selection or Adjusting of volume. The system supports analysis of users operation to the home appliances for recording the operation histories and the TV Output from the appliances.

The rest of the paper is constructed as follow: Section 2 presents architecture and functions of proposed system IrRC-Logger. In Section 3, we describe how the system replays users' operation with captured pictures from the home appliances. Contribution and future work is discussed at Section 4.

## 2 IrRC-Logger

Fig. 1 describes architecture of IrRC-Logger. The system is composed of (a An Ir-Capture, (b A Video Capture, and (c A RC Operation Recorder to achieve following three functions.

### 2.1 Recording Ir Signal

IrRC-Logger records Ir-signal acquired from the device, **Ir Capture**. Typically, remote controller of home appliance spreads the commands by Ir signals. Capturing the signals by the device placed near of home appliance enables recording of the commands without particular interfaces or modification of the home appliance.

Ir signal of home appliance is not standardized and each appliance assigns different commands for same Ir signals. Therefore, analyst has to grasp which signal means each of commands. The system supports the analyst by labeling each of signals according to list of signals defined in advance.

In our implementation, Ir Capture consists of USB substrate (USB232B/876 manufactured by International Parts & Information Corporation) and Ir reception device; it can make inexpensively (Approximately 7000 Yen or 60 US Dollar.)

### 2.2 Recording GUI with Ir Signal

A **Video Capture** acquires TV Out from the appliance as jpg file. As pointed out on Section 1, particular commands such as "Enter" or "Back" can be interpreted as several intentions from situation of use. To support analyst, the IrRC-Logger records pictures and the Ir signals simultaneously. The analyst can review them to understand the intention of the users. Acquiring the pictures is fulfilled easily by splitting the output from the appliance to TV (see Fig. 1).

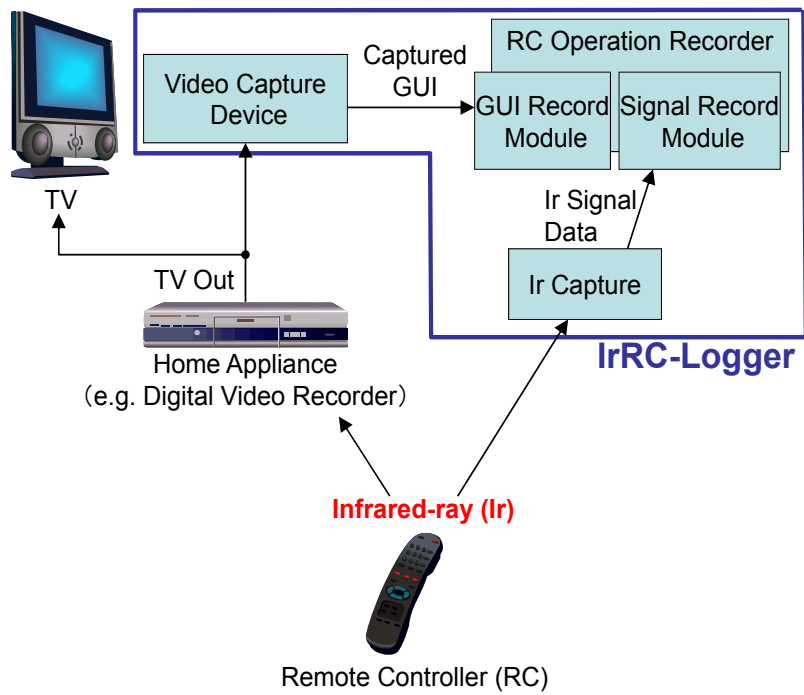


Fig. 1. System Architecture of IrRC-Logger

We have selected commercial video capture device as Video Capture that supports Microsoft DirectShow[5].

### 2.3 Time-Sequenced Recording

A software tool **RC Operation Recorder** documents the Ir signals, captured pictures and date of operations into a PC as time-sequenced information. We implemented the software using the C Sharp language with DirectShow.NET[6]. The operations are recorded as csv format file, it can read and process as many analysis support tool. Each data of operation is represented as a line of csv file (100 characters: 100Byte) and a jpg file (30-50KB), which mean about 2 million operation can record in a hard disk which has 100GB space. This may be sufficient number to record long term operations.

## 3. Operation Review using Proposed System

Here, we show an example of operation review using the proposed system. RC Operation Recorder can display and play back the recorded Ir signals and captured

pictures. Fig. 2 shows example of playing back by signal information and pictures. The system displays General Information (Start date and end date of Recording, csv file name, etc), Signal Information (Label, Date of operation, etc) and captured display from the appliance simultaneously. The analyst can traverse each signal using Signal Slider and Calendar.

The system combines continuous signals as *Action*, which represents a task of users such as “item selection of playing back” or “recording reservation.” In current version of the system, we use interval time between actions to split the signals. Action Information (Start date and end date of action, length of action, etc) is also displayed by Action Slider.

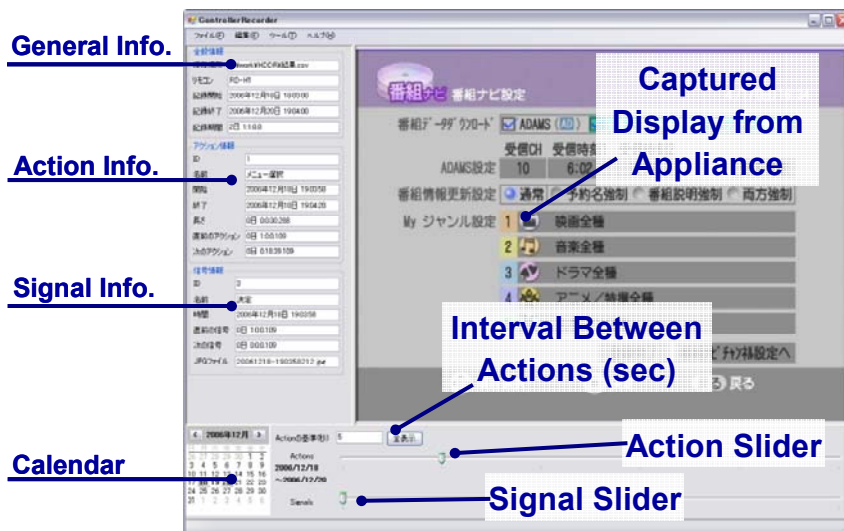


Fig. 2. Replay of Ir Information and Captured Pictures

#### 4. Conclusion and Future Work

In this paper, we proposed the IrRC-Logger: long term and quantitative record system for remote controller of home appliances. The system records the Ir signals and display outputs from home appliances automatically.

As future work, we are planning to conduct experiments of long term recording with proposed system. Long term recording of user operation allows us quantitative analysis of users' intent among the actual situation. Evaluation of Action-wise analysis is also an interesting topic to establish an efficient analysis method. To divide using particular type of signals which suggest a beginning of consecutive operation is useful for analysis support. Labeling of Actions using type of signals or order of signals composing the Action is meaningful for efficient analysis.

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