

Interactive Design of Smart TV based on Internet of Things Technology

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Abstract

With the advent of the information age, Internet of things technology has been favored by many industries and has become another profound revolution in the information technology industry. In such an era, the application of Internet of things technology in intelligent building construction can broaden the practicability of intelligent system, optimize resource allocation, improve the management and service ability of intelligent building, so as to improve people's quality of life. This paper expounds the development status and future challenges of Internet of things technology, and analyzes the interactive design of smart TV.

Keywords

Internet of Things Technology; Smart TV; Interactive Design; User Experience.

1. Introduction

The Internet of things (IOT) usually refers to a ubiquitous network of intelligent daily objects. Things will be connected not only through humans, but also through a highly distributed network of all projects, embedded systems and other devices. The integration of interactive communication devices has increased the popularity of the Internet. In recent years, the development and application of things has always been a complex task, which requires a wide range of professional knowledge.

With the continuous development of science and technology, many experts are studying the Internet of things technology. For example, Liu y discussed the design of intelligent hive structure, and expounded the application of Internet of things technology in beekeeping industry from two aspects: intelligent hive and intelligent factory. Help the beekeeping industry reduce employment, improve production efficiency and improve honey quality [1]. Hsu T C shows how to use data communication computing algorithms and communication systems to build an intelligent architecture and actively respond to services on different devices. In addition, the use of wake-up detection system can avoid the problems of equipment response and delayed task result delivery after receiving the task [2]. Taking the enterprise as an example, LV x studies the process flow and existing problems in the factory logistics link. Combined with the management concept of the Internet of things, it integrates IC card identification technology, RFID radio frequency identification technology, obstacle and ground sensing technology, OPC / PLC. Combined with PLC / OPC technology, the design and integration of software and hardware system are realized [3]. Although the research results of Internet of things technology are quite rich, there are still deficiencies in the interactive design of smart TV based on Internet of things technology.

In order to study the interactive design of smart TV based on Internet of things technology, this paper studies the Internet of things technology and intelligent TV interactive design, and finds the refractive index sensitive mechanism of plastic optical fiber. The results show that the Internet of things technology is conducive to the interactive design of smart TV.

2. Method

2.1 Internet of Things Technology

(1) IOT Technology Architecture

The Internet of things system obtains the information of the physical world and feels the changes of the external environment through the hardware of the perception layer. The network layer establishes a network connection in the Internet of things system to realize the transmission of Internet of things information [4]. The network layer realizes the information transmission between objects in any time and space. The application layer refers to the part of the Internet of things technology system that directly interacts with users. Users rely on the hardware equipment of the Internet of things application layer and use the program software in the equipment to achieve their required functional objectives [5]. Internet of things technology realizes the interconnection communication between personal computers. Mobile Internet of things technology realizes the information exchange between users anytime and anywhere, and expands the application scenario of computer technology.

(2) Internet of things concept

As an extension of the Internet, Internet of things technology can not only realize the interconnection of devices in the Internet of things space, but also connect with the Internet through gateway devices, so that internal information can be transmitted to the outside through the Internet, and external information can be perceived and fed back [6]. Internet of things technology has lower data transmission rate, so it is more suitable for simple status reporting and control services. It is necessary to design and develop targeted active scheduling and conflict reduction mechanisms, because a large number of devices work in this frequency band, and each device is competing for the power to send data, which may interfere with each other in communication [7].

2.2 Interactive Design of Smart TV

(1) Development status of smart TV

Smart TV subverts the limitations of traditional TV and gradually occupies the core competitive share of the industry market. The so-called smart TV refers to the participation of Internet functions. Most of them are equipped with Android operating system, with most computer functions and gorgeous large screens. Young families have become the main consumer group of smart TV [8]. The development of smart TV has driven the rise of emerging industries. Whether in product design or promotion strategy, it is full of networking, intelligence and personalization. In the future, smart TV will become an indispensable household appliance in people's daily life. It will also replace traditional TV and provide users with better video, audio and entertainment services. Compared with traditional TV that can only watch live programs, smart TV keeps pace with the times. It has a web link portal and an open software platform [9]. Users can download and install applications independently to expand the basic functions of TV and meet users' personalized needs. The way smart TV receives information should be an active way completely different from the passive way of traditional TV. Passive reception means that the information provider, that is, the television station, sends data to the information receiver, that is, the television user, according to its own will and business plan [10]. For example, for the traditional TV that is still the mainstream, the TV station will arrange the TV program broadcasting table according to its own business strategy and broadcasting plan, and the TV audience can only passively receive the viewing pictures.

(2) Concept and characteristics of interaction design

Interaction design is a new extension of user experience [11]. Its purpose is to study the connection and interaction between products and users, design products that meet the needs of end users in

combination with user background, use experience and feeling in the operation process, make users satisfied, conform to their own logic, and effectively complete and efficiently use the products. The goal of interaction design is to optimize and improve the usefulness, usability and human emotion of products. Various easily available materials make it easier for interaction design theory to analyze and study from different angles, thus enriching its own theory. Nowadays, more and more products optimize the user experience after considering the interaction design in the market [12]. Products without interactive design cannot stand out in the tide of the big data era.

(3) Advantages of intelligent TV interactive design

The design of product interaction mode is based on the scene of users using the product, and remote control is the basic scene requirement of smart TV. The application of gesture recognition interaction mode builds a scene for users to watch somatosensory games through smart TV, which meets the immersion needs of smart TV games. The application of voice interaction is to meet the scene needs of users to put forward instructions to TV anytime and anywhere. Eyes are the most important organ for users to use smart TV. Users can only watch the program through their eyes to control the TV without making gestures and talking. The application of human eye control interaction can meet some extreme scenarios. For example, when disabled people watch programs, they can switch channels through their eyes. Normal people are eating snacks, which is inconvenient to use gestures and language. In addition to gestures and sounds, eyes can also be used as high broadband information input channels. The human-computer interaction fault tolerance rate of smart TV is high, and the accuracy of interactive instructions is as high as other devices. The application of human eye control interaction can enrich the interaction mode of smart TV.

2.3 Refractive Index Sensing Mechanism of Plastic Optical Fiber

There are two radial distributions of fiber refractive index. One is that the refractive index of the fiber core and cladding is constant, but because the refractive index of the fiber core and cladding is not equal, the interface between them will jump. The radial refractive index distribution is expressed as formula (1):

$$n = \begin{cases} n_1 & 0 \leq r \leq a \\ n_2 & r > a \end{cases} \quad (1)$$

Where a is the core radius and R is the radial coordinate of the optical fiber.

Calculate the difference between the gray values of the image data pixels of the current frame and the previous frame, and further obtain the absolute value of the difference. The result is differential image data D_n , as shown in formula (2):

$$D_n(x, y) = |f_n(x, y) - f_{n-1}(x, y)| \quad (2)$$

If one frame data in the video is obtained from the video, the image data of the current frame is recorded as f_n , and the image data of the previous frame adjacent to the current frame is recorded as f_{n-1} , the gray values of the pixels recording the two frames of image data are $f_n(x, y)$ and $f_{n-1}(x, y)$ respectively.

Add the current image frames to be tested to $P(x, y)$ respectively, and further calculate the average value, as shown in equation (3):

$$F_i(x, y) = (D_i(x, y))|2 \quad (3)$$

Where $I = 1, 2, 3, \dots, n$ is the sequence image, $D(x, y)$ is the i -th frame sequence image to be detected, and $F_i(x, y)$ is the i -th frame sequence image after illumination compensation.

3. Experience

3.1 Object Extraction

The target users are the owners and buyers of smart TV. Users can provide the deficiencies and needs in the current use of smart TV, and buyers can analyze the cognition and expectations of indirect users for smart TV. Select people with high utilization of smart TV, divided into users and people who want to buy. The proportion of men and women is basically equal, including all age groups. It is mainly aimed at users in the home use environment. In order to highlight the needs of users, most of the selected families are direct users of smart TV, with more than three people and at least two generations living together.

3.2 Experimental Analysis

A client is one or more applications running on a user's computer. The server is deployed on computers or ECs. There are two types of servers. One is the server in the form of database. The client sends a request to access data on the server. The other is a server in the form of socket. The client program communicates with the server program through a socket. Motivation and ability are listed as internal attribute elements of user behavior, and trigger is listed as external attribute elements of user behavior. It is proposed that persuasion technology can provide users with persuasion information as incentive, improve users' internal factors, behavior motivation and behavior ability, so as to achieve the purpose of changing users' behavior. Then, taking information as the center and starting from the life cycle of information, the concept of persuasion system is established, and the persuasion system is divided into three parts: behavior data collection, behavior data conversion and persuasion information effect. The server background monitoring and management system is managed by the background management personnel. The monitoring and management system manages the remote database and equipment monitoring through the distributed remote data access technology. Monitoring and management procedures can be configured according to customer needs. The specific functional modules are divided into two modules: equipment monitoring module and management module.

4. Discussion

4.1 Research Status of Smart TV Industry

Television has a long history of development. Its development has experienced from the initial black-and-white TV to CRT color TV, from color TV to integrated circuit LCD and digital TV, and then from LCD digital TV to OLED, intelligent and digital TV, that is, the current era of intelligent TV. Table 1 shows the per capita viewing time of viewers of all ages.

Table 1. Per capita viewing hours of viewers of all ages from 2019 to 2021

	4-14 years old	15-24 years old	35-44 years old	45-54 years old	55-64 years old
2019	7%	3%	15%	21%	35%
2020	10%	1%	17%	25%	40%
2021	12%	1%	20%	27%	41%

It can be seen from the above that in 2021, the viewing time of the audience aged 4-14 is 12%, the viewing time of the audience aged 15-24 is 1%, the viewing time of the audience aged 35-44 is 20%, the viewing time of the audience aged 45-54 is 21%, and the viewing time of the audience aged 55-64 is 41%. The specific results are shown in Figure 1.

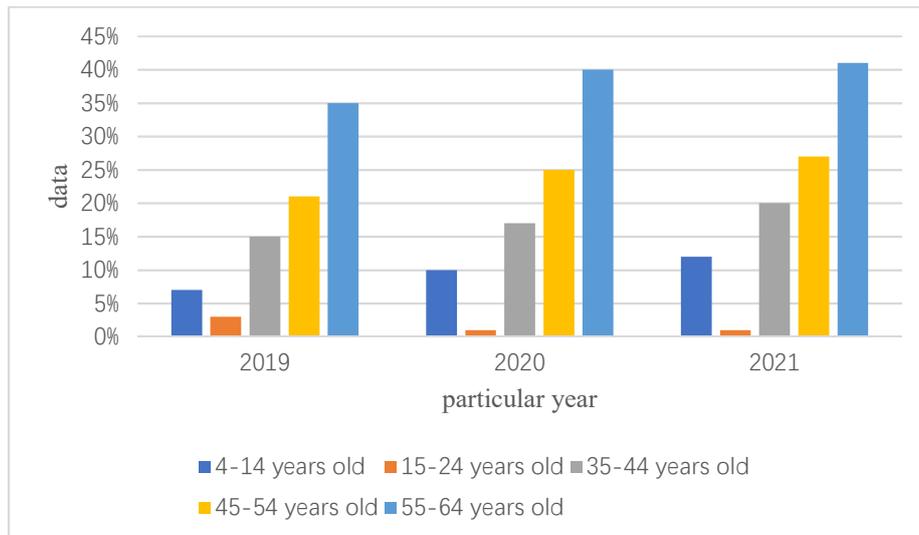


Figure 1. Per capita viewing hours of viewers of all ages from 2019 to 2021

According to the viewing duration data of all age groups from 2019 to 2021, the elderly have more demand for TV than the young, but this user group is seriously missing in the smart TV market. At present, the design of smart TV has become the combination, copy and paste of various technologies, its interaction mode has become more and more cumbersome, and the user experience index is declining year by year. Enterprises producing smart TV tend to be younger in the functional design of smart TV, completely ignoring the existence of elderly users who really use TV in experience and functional design.

4.2 Research on Target Users

Although intelligent mobile devices have been widely used, they can not completely replace TV. With its unique family attribute, TV still plays an important role in promoting family sharing and communication, and is stronger than other devices in video playback function. This paper investigates the behavior habits of target groups using smart TV, and analyzes the relatively important data. The reasons and influencing factors for users to buy smart TV are shown in Table 2.

Table 2. Reasons for purchasing smart TV

reason	percentage
The TV is broken	19%
Move to a new house	29%
Not intelligent enough	25%
Activity promotion	11%
other	16%

It can be seen from the above that the reason is that the proportion of moving to a new house for smart TV is 29%, the proportion of TV broken is 19%, the proportion of not smart is 25%, the proportion of activity promotion is 11%, and the proportion of other reasons is 16%. The specific results are shown in Figure 2.

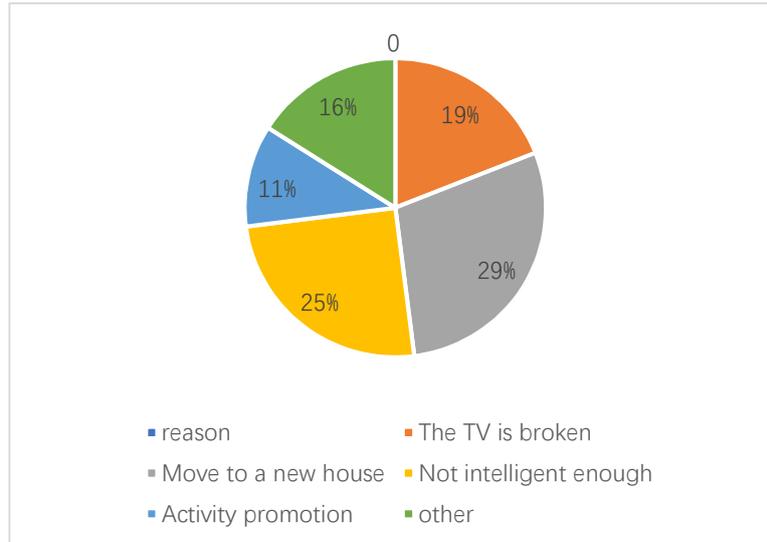


Figure 2. Reasons for purchasing smart TV

As can be seen from the above figure, the main reason for users to replace TV sets is to buy a new house. Secondly, because the intelligence of the old TV is not enough to meet the personalized needs of users, users have certain needs and expectations for the new functions and technologies of TV.

5. Conclusion

Since the revolution of information technology, Internet of things related products have gradually become an indispensable part of human society. From desktop computers to mobile smart phones, from the Internet to the mobile Internet of things, information technology is widely used in practical scenarios. The wide application of Internet of things technology has spawned many design directions based on computer technology, including interaction design and user experience design. This paper analyzes the Internet of things technology to meet the needs of users for smart TV, and realizes the availability and ease of use of TV intelligence.

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