

The design of smart home monitoring system based on WiFi electronic trash

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Abstract—Along with the rapid development of electronic products, there is a large amount of electronic waste, such as hundreds of millions of mobile phones and junk personal computers, which is not only a waste, but also a tremendous damage to the environment. The article presents a technique of reusing the electronic waste for the smart home monitoring system. It also describes how to set up the prototype of the system. Compared with the present normal household monitoring system, the technique will save lots of expenditure. And it can effectively reduce the cost in protecting the environment. Especially it can promote the smart home into ordinary homes better as well as faster.

Index Terms—smart home, video monitoring, E-waste, mobile phone

I. INTRODUCTION

ALONG/with the development of the network and information technology, people could survey the whole world in their own home. In turn, monitoring their home from any where and any time become a possible, this is smart home [1]. In the present, the mainly obstacle of smart home development is the price is too expensive, it seriously beyond the consumption capacity of most families. This leads the intelligent household not to be popularized in common families. So the smart home technology needs to be promoted, the spending in it needs to be reduced tremendously for the better and faster growth of the smart home [2].

At the present, except the high price, the function of the present monitoring system is very complex. During the arrangement of wire and the system debug, a professional engineer is essential. Any trouble taking place during the system working is difficult to be fixed for a normal family. This seriously hindered the rapid development of smart home. The article presents a new system based on scrap mobile phones, waste personal computers and wireless routers. The results of the experiments demonstrate the technique is effective. This can save lots of expenditure compared with the present normal household monitoring

system. And it can effectively reduce the cost in protecting the environment. Especially it can promote the smart home into ordinary homes better as well as faster [3].

With the rapid development of market economy and the replacement of electronic products, electronic waste has become the fastest-growing waste. How to make electronic waste to be profitable and not to affect the development of electronic market economy is an urgent problem facing the society. It is also an environmental protecting problem which people have to face [4].

The rest of this paper is organized as follows. In section II is an introduction of correlation work. The monitoring system is about designed in Section III. Section IV is experimental and analysis. In Section V is conclusion.

II. THE RELATED WORKS OF SMART HOME

In recent years, a lot of work of smart home system has been done in some developed countries. Like in the United States, intelligence smart home system focuses on the sense of luxury, comfort and pleasure. German intelligence living system pursuits the development of special function, pays more attention on the function. Japanese intelligent household makes full use of new materials and technology, which achieves modernization by integrating information technique, network technology and artificial Intelligence etc. The South Korean government gives lots of support to the intelligent community and intelligent household, such as in Seoul, new residential areas must install smart home system. The development of Chinese intelligent home has experienced for over 10 years of exploration, but the intelligent home in China is no popularity so far.

The intelligent home aims at setting up intelligent automation with a goal to provide its inhabitants with maximum possible comfort, minimum resource consumption. The work draws much attention from scholars. And many achievements have been acquired. Paper [5] discusses the basic concept of smart home, introduces its development in China, analyzes the main factors hindering the development and points out the trend in the future. Paper [6] introduces the implementation of smart home and points out the intelligent home can become an important part of the modern society. Paper [7] establishes a

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smart home system based on context-awareness. Its design based on Nash H learning framework makes the system reasonably controlled, significantly reduces energy consumption and improves users comfort. Paper [8] summarizes the research work related to smart home vision-based technique, audio-based technique, multimodal techniques etc. The paper summarizes the applications of smart home such as the eldercare, the childcare, energy efficiency applications and the research directions of multimedia retrieval. In all present work, there is little work related to how to use the electronic trash to construct a monitoring system. This paper describes a monitoring system as this based on scrap mobile phones, waste personal computers and wireless routers.

III. A MONITORING SYSTEM DESIGN

A. The basis of the system design

At the present, the expenditure in price, the complex in technique and the difficulties in operating prevent the normal monitoring system from entering the common families. However, this becomes the factor of pushing the technique to advance. For this reason, we present a new monitoring system utilizing the waste mobile phones, waste personal computers and wireless routers. Our system is established on the basis of electronic waste and internet of things.

Electronic waste, known as e-waste, including old computers, household appliances and all kinds of electronic instruments, is eliminated in the process of production. E-waste is now the fastest growing trash in the world. According to the European Union report, it is increased by 16% ~ 28% per five years, which is three times faster than the growth rate of total waste [8]. According to a survey report published by Nokia in 2008, the recovery rate of scrap mobile phones was only 3%. if each of 3 billion mobile phone users recycles an old mobile phone, you can save 240000 tons raw materials, and to reduce the emissions of greenhouse gases equivalent to 4 million cars a year [9]. Usually waste mobile phones have a sound camera and WiFi module. Recycling this material is not just to avoid e-waste growing, but also to promote the cost reduction of smart home monitoring system. So we present a new strategy based on the discarded mobile phones and personal computers.

B. The structure of the System

One of the most important components of smart home is monitoring system. It is composed of front camera, video signal lines, power cords, video monitor and recorder etc. The camera is used to take analog video signal. Power cords are used to supply power for the system. Transmission signal line is mainly composed of coaxial cable, which is used to transmit cameras real-time video image. Video recorder is used to store the video information. Monitor is used to display the received video.

We design the system as Figure 1. In Figure 1, on the left is a discard mobile phone, which contains a camera

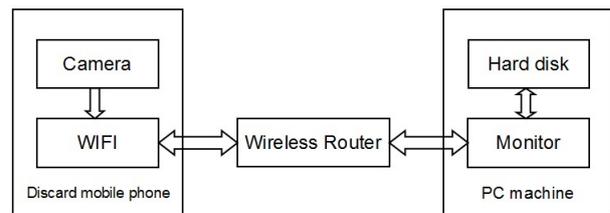


Figure 1. the monitoring system.

and a WiFi module, the camera takes the analog video signal. WiFi transmits the video signals. On the right is a discard PC machine, which includes a hard disk and a monitor. The disk records the video data. The monitor is used to monitor video scenes. In the middle is the wireless router, which links mobile phone and PC machine.

At the present, a discard mobile phone holds a sound camera and WiFi module. The hard disks and monitors in obsolete PC machines are in a good condition. The system constructed by the discard mobile phones and PC machines is easy to be realized. The technique can effectively control the growth of electronic waste and significantly reduce the cost of smart home monitoring system.

C. The algorithms of the System

We use a discard mobile phone carried with camera and WiFi module as client, a discard PC machine as server in the monitoring system. Android system is open operating system based on Linux whose development environment includes Eclipse, Google Android SDK etc. The bottom of Android system is based on the C and C + +. The upper application is mostly based on JAVA. An android mobile phone is taken as socket client. The camera in the mobile phone collects every frame image and sends to WiFi. WiFi transmits the picture signal to wireless router. The router receives the signal and delivers it to PC machine for recording and displaying. So the system can be divided into two parts.

We design the algorithm of client as below:

Algorithm.1: Image acquisition

Input: scene before camera

Output: picture signal

Procedure:

- 1) Initiate camera
 - a) Open camera
 - b) Set parameters of camera
 - c) Set preview display
 - d) Start preview
 - e) Stop preview
- 2) Set the permissions of camera and socket
 - a) Add a camera and socket permissions
 - b) Set the start of program execution activity
- 3) Obtain destination IP
 - a) Setting a login interface
 - b) Enter the server IP

- 4) Take the picture signal of the scene and transmit it to destination IP by socket
 - a) Set up the PreviewCallback
 - b) Capture a frame image data
 - c) OnPreviewFrame function is called
 - d) Convert YUV formats data into jpg format
 - e) Start a thread to send data through a socket
- 5) End.

In the algorithm1, step 1 is to initiate camera for obtaining video signal, step 2 and 3 are to obtain the transfer protocol and the destination address. Step 4 firstly takes the scene pictures before camera, and then transmits the signal to the destination address.

The algorithm 1 takes the scene before camera and transmits it to the destination. This is the first part of the system. The other part how to work is as algorithm 2.

Algorithm.2: Image display and record

Input: picture signal

Output: display the picture signal and record this data

Procedure:

- 1) Initiate Server
 - a) Start server
 - b) Start client
 - c) Establish a socket
- 2) receive the signal of picture by router
- 3) display in monitor
- 4) record the data in hard disk
- 5) End.

In the algorithm2, Step 1 is to link server with client. Step 2 receives the signal of scene. Step 3 and 4 complete monitor and storage of the scene before the camera.

Algorithm 1 and 2 fulfill the function of the monitoring system together. The materials used in the system are the discard mobile phones, abandoned PC machines and a wireless router. The cost is far less than the cost of a normal monitoring system and it can increase the recovery rate of electronic waste.

IV. EXPERIMENTS

In order to test the performance of the system presented by us, we implement the monitoring system. All the hardware materials include a PC machine, an android phone and a wireless router. We take windows 7, JAVA jkd1.7, Eclipse+google android SDK as development software.

We firstly develop server software based on algorithm.2, which is installed on the PC machine, and then implement algorithm1 as client software, which is set up on a android mobile phone. In addition, we equip a wireless router. Therefore a monitoring system based on the WiFi electronic trashes has been established.

The system logic diagram is as Figure.2

In Figure2, on the left is an android mobile phone. On the right is a PC machine. In the middle is a router.

In the process of the experiments, we place the PC machine in one class room. And the android phone in another room. Firstly, we start the server in the PC



Figure 2. the monitoring system.

machine. Then we start the client in the mobile phone. Finally, we turn on the camera in the phone.

The picture of scene in the android mobile phone is as Figure 3



Figure 3. the scene before the android mobile phone.

Figure 3 is a mobile phone and the scene before it after starting the camera in the mobile phone. The result of monitoring is as Figure 4.

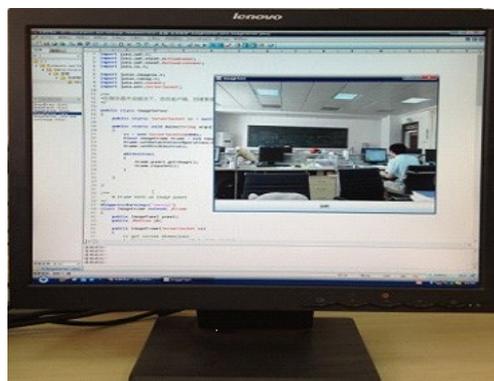


Figure 4. the picture of monitoring.

Figure 3 is a PC machine and its displaying contents. From the view of screen, the contents in the PC screen consist with the scene in the mobile phone.

V. CONCLUSIONS

Based on the current situation of the development of smart home, we put forward a new scheme of household monitoring system. The monitoring hardware system is composed of a waste android mobile phone, an old computer and a wireless router. The software is developed based on WiFi. We implement our scheme. The results show that the proposed system has good feasibility. It has realized the purpose of household monitoring. It reduces the cost of monitoring system at the same time. It partly solves the problem of e-waste recycling.

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