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EMBEDDED IMAGE CAPTURING SYSTEM USING RASPBERRY PI SYSTEM

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Abstract: ***An image capture system with embedded computing can extract information from images without need for an external processing unit, and interface devices used to make results available to other devices. The choosing of an Embedded platform is very unique and easy to implement. The paper proposed an image capturing technique in an embedded system based on Raspberry Pi board. Considering the requirements of image capturing and recognition algorithm, Raspberry Pi processing module and its peripherals, implementing based on this platform, finally actualized Embedded Image Capturing using Raspberry Pi system (EICSRS). Experimental results show that the designed system is fast enough to run the image capturing, recognition algorithm, and the data stream can flow smoothly between the camera and the Raspberry Pi board.***

Keywords –Image capturing, Embedded system and Raspberry Pi board.

1. INTRODUCTION

Traditional ways for personal identification depend on external things such as keys, passwords, etc. But such things may be lost or forgotten. One possible way to solve these problems is through biometrics, for every person has his special biometric features definitely. Biometrics identification has gained increasing attention from the whole world [1]. Biometrics features that can be used for identification include fingerprints, palm prints, handwriting, vein pattern, facial characteristics, face, and some other methods such as voice pattern, etc [2].

Compared with other biometric methods, the face recognition has the following advantages: The face image acquisition requires no physical contact, so face identification system is non-invasiveness

Since the face is created in a nearly random morphogenetic process during the gestation, it has little probability to find two people in the world whose face textures are identical. So face recognition is the most accurate method and has the lowest false recognition rate.

The face recognition has more stability than other biometric identification methods because the face has much more features than other biometrics and it won't change in people's life. With the advantages of non-invasiveness, uniqueness, stability and low false recognition rate, face recognition has been researched widely and has a broad usage, such as security, attendance, etc.

Most of the recognition systems are based on PC. However, the portability of PC is limited by its weight, size and the high power consumption. Thus results in that the using of face recognition is confined in few fields, and it is inconvenient to use. The way to get rid of the limit of PC is using embedded system.

The designed EICSRS platform acquires the images and stores them into the real time database , which in turn later used for comparing the faces of the users to provide access to them or to deny the access to a place or to operate a device. Recent technological advances are enabling a new generation of smart cameras that represent a quantum leap in sophistication. While today's digital cameras capture images, smart cameras capture high-level descriptions of the scene and analyze what they see.

These devices could support a wide variety of applications including human and animal detection, surveillance, motion analysis, and facial identification. Fortunately, Moore's law provides an increasing pool of available computing power to apply to real-time analysis. Smart cameras leverage very large-scale integration (VLSI) to provide such analysis in a low-cost, low-power system with substantial memory. Moving well beyond pixel processing and compression, these systems run a wide range of algorithms to extract meaning from streaming video.

Because they push the design space in so many dimensions, image capturing are a leading edge application for embedded system research.

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Tools are available for Python as the main programming language with support for BBC BASIC (via the RISC OS

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image or the Brandy Basic clone for Linux), C, Java and Perl.

2. SYSTEM HARDWARE DESIGN

The whole system is composed by following parts: an image capturing camera, Raspberry Pi board to run image recognition programs on it. DVI compatible monitors also connected with this system during initial stages to preview the captured images and give the user indication. The system block diagram is shown in Figure 1.

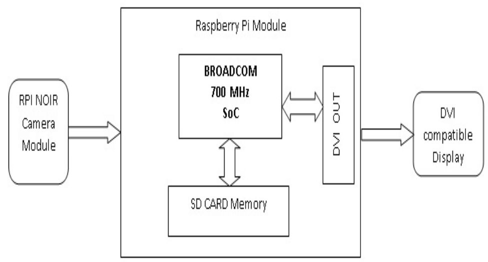

Figure .5 System Block Diagram

2.1 RASPBERRY PI BOARD

This board is the central module of the whole embedded image capturing and processing system as given in figure 2. Its main parts include: main processing chip, memory, power supply HDMI Out, Ethernet port, USB ports and abundant global interfaces.

2.1.1 MAIN PROCESSING CHIP

The main signal processing chip used in our system is a Broadcom 700MHz Chip in which CPU core is a 32 bit ARM1176JZF-S RISC processor designed by Advanced RISC Machines, Ltd. It has very rich peripheral. This main processing chip connects a camera and display units.

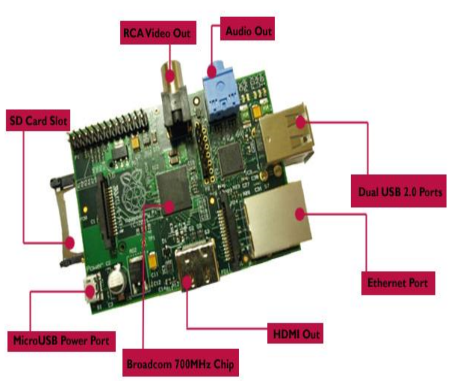

Figure 2. Raspberry Pi Board

2.1.2 MEMORY

The design does not include a built in hard disk or solid state drive, instead relying on an SD card for booting and long term storage. This board is intended to run Linux kernel based operating systems. This Raspberry Pi module has a Samsung class 4 micro SD card preloaded with the official Raspberry Pi NOOBS (New Out of Box Software) package, and a beautifully screen printed Micro SD card adaptor

2.1.3 INTERFACES

Plenty of interfaces are contained on the Raspberry Pi board, including 2 USB ports through which a Keyboard and mouse can be connected, a HDMI out for connecting HD TVs and monitors with HDMI input or HDMI to DVI lead for monitors with DVI input. Other peripherals like A standard RCA composite video lead to connect to analogue display if HDMI output is not used. Ethernet port is used for networking even though it is optional, although it makes updating and getting new software for Raspberry Pi board much easier. An Audio lead is also provided for getting the stereo audio if HDMI is not used, otherwise HDMI will get digital audio with it.

3. CAMERA INTERFACE

The camera module used in this project is RPI NOIR CAMERA BOARD i.e. Raspberry Pi No IR camera board as shown in the Figure 3. The camera plugs directly into the CSI connector on the Raspberry Pi. It's able to deliver clear 5MP resolution image, or 1080p HD video recording at 30fps. The module attaches to Raspberry Pi, by way of a 15 pin Ribbon Cable, to the dedicated 15 pin MIPI Camera Serial Interface (CSI), which was designed especially for interfacing to cameras. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data to the BCM2835 processor.

This camera board which has no infrared filter making it perfect for taking infrared photographs or photographing objects in low light (twilight) conditions. Other features of this camera board are

Automatic image control functions ,Programmable controls for frame rate 32 bytes of embedded one time programmable (OTP) memory and Digital video port (DVP) parallel output interface Excellent

Figure 3 Raspberry Pi NoIR camera board

4. METHODOLOGY OF WORK

The system designed system can be operated in two different sessions, ie one for capturing and creating a data base and the other session is to capture the image and which can be used for identifying or comparing the

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images in the database. Here in the second session we use Eigen faces methodology of face recognition for finding the matches.

5. FUTURE APPLICATIONS

To date, exploitation of smart camera technology has been mainly for industrial vision systems, but a crossover is just starting to take place. Camera technology will begin to enter new applications, for example, in the security and access control markets, in the automotive industry, for collision avoidance, and even – one day – for the toy industry.

Even our automobiles may soon be outfitted with miniature eyes. Built into a cruise control system, for instance, such a camera would suddenly alert the driver if it noted a rapidly decelerating vehicle. The cameras could also take the place of the rear view and side-view mirrors, thereby eliminating dangerous blind spots and - in the event of an accident – recording the seconds prior to a collision.

Another example would be with intelligent lifts. An office block, with many lifts and floors, may see a lot of people travelling up and down between floors, particularly at high traffic times such as early morning or end of the working day. At the moment, lifts are called by somebody pressing a button and putting in a request for the lift to stop at a particular floor. Connected with smart camera technology, lifts could be routed on demand, working intelligently, stopping only when there was a pre-set number of passengers waiting at a floor – and missing out a floor if too many people were waiting to meet the maximum capacity of the lift.

6. CONCLUSION

It's a progress of realizing embedded imagecapturing system. We describe our design method in this paper. Based on these methods, we design the experimental prototype of the embedded image capturing system with Raspberry Pi system. This system is smaller, lighter and with lower power consumption, so it is more convenient than the PC-based face recognition system. Because of the open source code, it is freer to do software development on Linux. Experimental results show that it's an effective method of using Raspberry Pi board to actualize embedded image capturing system.

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