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Home Automation - Real Time Video Monitoring System Using Raspberry Pi

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Abstract:

In this paper, Embedded Real-time videomonitoring system based on ARM is designed, in which the embedded chip and the programming techniques are used. The central computing microprocessor which uses Raspberry pi is the core of the whole system. Real time video transmission is widely employed in police investigation, conferencing, media broadcasting and applications that include remote assistance. First, Raspberry's Camera Module video data are collected by the embedded Linux system. All information are processed, compressed and transferred by the processing chip. Then, video information are sent to the monitor client by wireless network. This embedded observance system is to overcome the weak points of the traditional video surveillance systems, such as complex structure, instability, and expensive cost. It can been widely used in many fields.

Keywords —**Video Capture, Video Compression,Video Streaming, Raspberry Pi**

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I. INTRODUCTION

Where home automation becomes actually "smart" is within the Internet-enabled devices that attach to the network and manage it. The classic control unit is the home desktop, for which many of the earlier home automation systems were designed. Today's home automation systems are more likely to distribute programming and monitoring control between a specific device in the home, like the control panel of a security system, and a user-friendly app interface that can be accessed via an Internet-enabled PC, smartphone or tablet. Video surveillance has been evolving significantly over the years and is becoming a vital tool for many organizations for safety and security applications [5]. The Video surveillance systems play an increasingly important role to maintain social security. It has been widely used in many fields, such as finance, public security, banking, and home.

Wi-fi is used as the medium in which the whole system will operate. Wi-Fi is technology for radio wireless local area networking of devices supported on the IEEE 802.11 standards. Devices that can use Wi-Fi technologies include, among others, desktops and laptops, video game consoles, smartphones and tablets, smart TVs, printers, digital audio players, digital cameras, cars and drones. Wi-Fi compatible devices will hook up with net via a wireless fidelity

and a wireless access point. Such an access point (or hotspot) has a radius of about 20 meters (66 feet) indoors and a great range outdoors. Like mobile phones, a WiFi network makes use of radio waves to transmit information across a network. The computer ought to embody a wireless adapter that may translate data sent into a radio signal. This same signal are transmitted, via an antenna, to a decoder known as the router. Once decoded, the data will be sent to the Internet through a wired Ethernet connection. The term hotspot is used to highlight an area where Wi-Fi access is offered. It can either be through a closed wireless network at home or in public places such as restaurants or airports. In order to access hotspots, your computer should include a wireless adapter[12].

II. LITERATURE SURVEY

Smart home is not a brand new term for science society, it is been used from decades. As electronic technologies are advancing, the field of home automation is expanding rapidly. There were many smart systems that have been proposed where the control is via Bluetooth [14], internet etc. Bluetooth capabilities are good and most of recent laptop/desktops, tablets, notebooks and cell phones have built-in adaptor that will indirectly decrease the cost of the system. But it limits the control to within the Bluetooth range of the environment while most other systems are not so economical to be implemented as low budget solution. In Wi-Fi based home automation system is presented. It uses a PC (with built in Wi-Fi card) based web server that manages the connected home devices. The system supports a wide spectrum of home automation devices like fans, lights, other household appliances. A similar architecture is proposed in where the actions are coordinated by the home agent running on a PC. Other papers such as also presented internet controlled systems consisting of a web server, database and a web page of websites for interconnecting and handling the devices[13].

III. HARDWARE SYSTEM DESIGN

The hardware system includes processor, video-capture devices, and router to receive video information through Wi-Fi. In this project Raspberry pi (ARM 11 processor) is chosen to fulfill the core control; Raspberry pi camera is used as a video-capture device; and also the user's phone or PC connected to the wireless Internet to receive video information to achieve real-time monitoring.

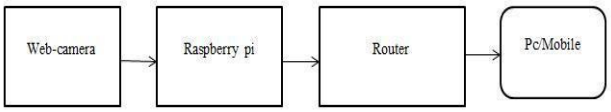

Figure 1: Block diagram of the hardware system design.

Pi Camera module is a camera which can be used to capture images and high definition video.Raspberry Pi Board has CSI (Camera Serial Interface) interface to which we can attach Pi Camera module directly.This Pi Camera module will attach to the Raspberry Pi's CSI port using 15-pin ribbon cable.

Features of Pi Camera-

Here, we have used Pi camera v1.3. Its features are listed below,

- Resolution – 5 MP
- HD Video recording – 1080p @30fps, 720p @60fps, 960p @45fps and so on.
- It Can capture wide, still (motionless) images of resolution 2592x1944 pixels
- CSI Interface enabled.

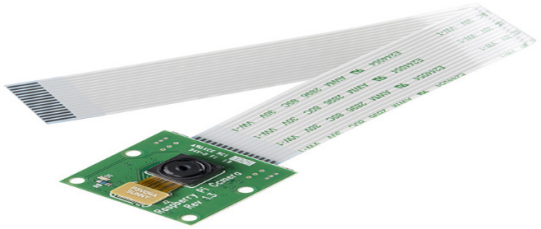

Figure 2: Raspberry Pi Camera Module

Raspberry pi[8] Raspberry pi(ARM 1176JZF-S 700 M Hz) is used for hardware module. Raspberry pi

may be a master card size Linux microprocessor used for easy programming. The Raspberry Pi is a microprocessor designed to cost around Rs. 1K for the cheapest model. This includes a 700 Megahertz ARM11 processor; 128 or 256 MB of memory (RAM); there is additionally a memory card slot, audio/video outputs to connect to TV, and a USB port for keyboard, mouse and so forth. The brain of the Raspberry is the Broadcom BCM2835 "system-on-a-chip," which includes the main components needed for a computer system. These include the central processing unit (processor), which handles the main workload; the graphics processing unit (GPU), which accelerates the process of producing the complicated graphics you see on your screen; and the random access memory (RAM) which acts as somewhere for the CPU to keep the information that it is working on.

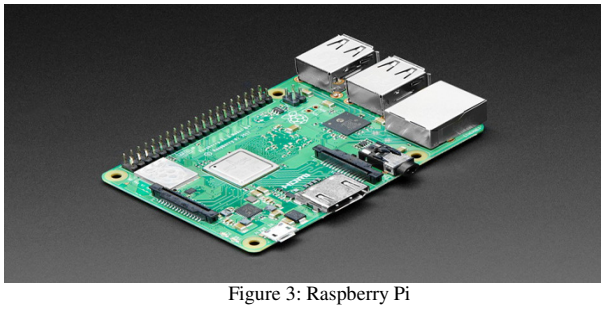

Figure 3: Raspberry Pi

Router*:* Router is used for route the video streaming onnetwork.

PC/Mobile*:* Pc/Mobile is used for to watch live videostreaming on server.

Some prerequisite connections will be required in order for the system to start functioning in a correct manner.

1) The Wi-fi router should be up and working before starting up the Raspberry Pi.
2) The Camera Module should be properly connected into the CSI (Camera Serial Interface) port of the Raspberry Pi.
3) The Raspberry Pi 3 is powered by a +5.1V micro USB supply. A 2.5A power supply will give ample amount of power to run the Raspberry Pi.

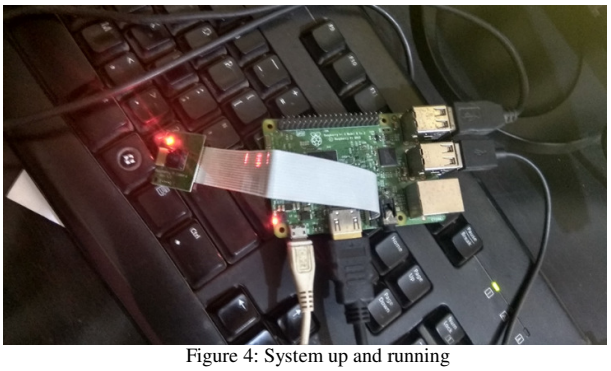

Figure 4: System up and running

IV. SOFTWARE DESIGN

The tradition mode has many disadvantageswith the increased requirements. Nowadays, embedded device has played an important role in many applications such as equipment control. Embedded device has outstanding character for its small size and more mobility. In our system,we combine the wireless communication and embedded device together. As for EOS (Embedded Operating System), we select the embedded Linux as our bottom system. But nowadays during this digital world, the embedded video surveillance systems are more advantageous compared to the traditional surveillance systems, as it is provided at low cost with high performance and good stability [2].

There are two sides for programming in the system-

- Android Programming
- Raspberry Pi Server Side Programming

Android Programming

An application is made for the user to interact with the raspberry pi. This app on launching shows a button, upon clicking it, live stream of the raspberry pi is showed on the application. All the Android Programming is done on Android Studio (64 bit).

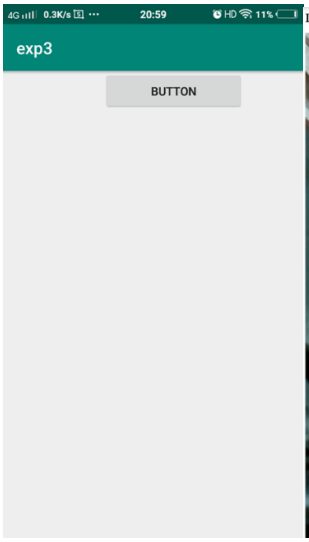

Figure 5: GUI Android App Figure 6: Live Stream

Raspberry Pi Server Side Programming

The Raspberry Pi on startup gets connected to the Wi-fi network automatically. The Raspberry Pi is programmed so that on booting up it will automatically execute a shell script which will in turn execute a python script. This python script upon execution starts up a Web Server which streams the live feed of the camera module on the local address 192.168.0.100:8000 .
The shell script will make sure that the python script is executed after 20 seconds of firing up of the shell script. This delay is important because it will take some time for the Raspberry Pi to get connected onto the Wi-fi network.

A. Video Capture Module

The Video Capture Based Video4Linux Video4Linu x (referred to as "V4L") is a Linux kernel on the video device driver, which is for video equipment, application programming interface functions to provide a system. V4L USB camera using the programming on the need to use Linux system calls the next two, respectively, ioctl() and mmap(). Application to get the camera image data collected in two ways, namely read() (method of direct reading) and mmap() (memory mapping method). mmap() system call allows processes mapping the same file through memory sharing achieved, the advantages of high efficiency, because the process can directly read and write memory, copy any data without the need to speed up the I / O access, the system is using this method[12].

B. Video Compression

With the increasing demand to include video information into telecommunications services, the corporate environment, the entertainment industry, and even at home has made digital video technology a necessity. A problem, however, is that still image and digital video data rates are very large, typically in the range of 150Mb its/sec[12]. This magnitude of data rates would consume a great deal of the bandwidth, storage and computing resources in the typical personal computer. For this reason, Video Compression standards are developed to eliminate image redundancy, permitting video info to be transmitted and saved in a compact and efficient manner[12].

C. Mpeg (Motion Picture Experts Group)

The MPEG-2 is a standard for "the generic coding of moving pictures and associated audio information". It describes a combination of lossy video compression and lossy audio data compression methods, which permit storage and transmission of movies using currently available storage media and transmission bandwidth [9].

It is widely used as the format of digital television signals that are broadcast by terrestrial (over-the-air), cable, and direct broadcast satellite TV systems. It conjointly specifies the format of flicks and alternate programs that are standards developed by the Moving Pictures Expert Group (MPEG) and is a world standard (ISO/IEC 13818). Parts 1 and 2 of M PEG-2 were developed in collaboration with ITU-T, and they have a respective catalog number in the ITU-T Recommendation Series[12].

D. Mpeg-2 Compression Algorithm

MPEG-2 provides for flexibility in the type of compression. Encoders can vary significantly depending upon the software, so details of the encoding scheme must be transmitted along with the data, to enable the decoder to reconstruct the signal. First a reduction of the resolution is done, which is followed by motion compensation in order to reduce temporal redundancy. The next steps are the Discrete Cosine Transformation (DCT) and a division because it is employed for the JPEG compression ; this reduces the spatial redundancy (human visual perception). The final step is an entropy coding using the Run Length Encoding and the Huffman coding algorithm [1].

E. Video Streaming

Once RGB web camera is connected through the CSI connector to arm board make minicom-s settings in the terminal window, during the settings we run the application related shell script in terminal which is able to execute application in board ensuing video streaming on browser using http protocol, entering a static IP address by user in any wireless device which is in local network can view the remote location. Here the browser is predicated on MJPG streamer for streaming captured video from camera placed in remote location. The MJPG streamer is cross - compiled and loaded in to the Raspberry pi board to act as a web streaming server. The server periodically obtain videos from camera through the private network, such videos are transmitted from camera to the server [12].

V. DISPLAY VIDEO ON SERVER

We can access live stream from camera from any browser with the assistance of Uniform Resource Locator-http://192.168.137.50:8080

Here 8080 is port where we configuration our stream in motion. conf file. We can see our own configuration setting “stream_port” in mot ion.conf for port.

VI. CONCLUSION

In this paper, an embedded real-time video monitoring system based on ARM is designed; the embedded web streaming server is based on the ARM -Linux Operating System. It succeeds in network video observance .The system has low-cost, good openness and portability and is easy to maintain and upgrade. Here the web browser is based on MJPG streamer for streaming captured video from camera placed in remote location. The MJPG streamer is cross-compiled and loaded in to the Raspberry pi board to act as a web streaming server. The server sporadically get videos from camera through the non-public network, such videos are transmitted from camera to the server. We conclude that real time video monitoring using ARM we tend to get better performance and we can transmit video using wire and also possible for wireless hence long distance transmission is possible.

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