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Department of Electronics – Wayamba University of Sri Lanka

NOVEL PERSON DETECTION TRIGGERED WIRELESS HIGH DEFINITION SECURITY CAMERA

M.B.P.B. Bandara*, Y.A.A. Kumarayapa

Department of Electronics, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka
*p.b.bandara@ieee.org**

ABSTRACT

Nowadays security camera systems occupy a large space inside buildings because their servers are bulky in nature. This research study proposes and implements a solution for this problem. A compact computer with limited resources and inherent software is matched with server possibilities and hence used as a compact server. This somewhat novel concept reduces the bulky nature of present day server systems as well the proposed local implementation reduces the cost of such important security systems. This system uses Linux operating system (OS) and a streaming server for the overall video sharing process. Wi-Fi or Ethernet media can be used to communicate with the external detector components in real-time scale. This lightweight system is based on a tiny computer called Raspberry Pi. This compact processing system is tactically used to host the streaming process and to communicate with the camera, with new software based modifications and with the implementation of region-of-interest (ROI) detecting novel software platform for better user friendly graphical user interfaces (GUIs) design. Since the streaming of the video starts by ROI detection the resource needs are less compared to ordinary systems[1].

Keywords: Raspberry Pi, Real-time Streaming, Image/Video Signal Processing / Transmission, Acorn reduced instruction set computing (RISC) Machine (ARM) Architecture

1. INTRODUCTION

Nowadays almost every security camera system uses a large server with a network. In order to solve this problem a compact computer with a network is used in this research study. This requires software platform for receiving/transmitting video data. Instead of using system architecture with several processors and bulky servers, in this research study a single 700MHz processor based compact computer and a high definition (HD) camera are used for

the whole streaming process and a Wi-Fi router is used for the networking process. This processor is based on ARM architecture. ARM architecture is a reduced instruction set architecture which is developed by Acorn computers Ltd (later ARM Co.) [2]. This ARM processor is an application specific architecture which is used in this research study for computing needs. Raspberry Pi is a lightweight computer system with an ARM processor and with a 512 mega bytes of random access memory (RAM) [3]. This is capable of running on an operating system suitable for ARM architecture and hosting a Webserver. This architecture provides programming capabilities in order to expand its functionality. Also the Raspberry Pi computer system has general purpose input output (GPIO) port that can be completely controlled by the developed software. The processing power of the compact computer is only required by the video sharing component (streamer) and the ROI detector. The advantage of connecting a compact computer to the proposed security system is that it can serve as an immediate agent for an HD camera; i.e. the HD camera can act as an IP camera module with WLAN or LAN networking feature and also it has video processing capability which can be economical and feasible solution for real-time monitoring.

2. EXPERIMENTAL

This light weight computer is based on an operating system which offers Linux kernel and Linux compatibility for few software designs. This software includes streaming capability and capability to process images. Fig 1 shows the flow chart for the function of the proposed module.

The HD camera modules with high resolutions (can be bought for nearly Rs: 2000/= in Sri Lanka) can be directly connected to the compact computer via its CSI (Camera Serial Interface) port [4]. In order to configure the camera to work in the raspbian operating system, the camera feature should be enabled first using the basic input/output settings (BIOS). Initialization of parameters is required by the camera module to record the video stream. HD camera and connected compact computer alone can be a video recorder but it does not provide video sharing or processing since video sharing is not included in default. In order to achieve video sharing, a video streamer is used which hosts the recording video through a protocol that can be viewed remotely. This streamer can be programmed using a software programming language (ex. C++/C). Here, the advantage is that the video stream can be processed programmatically. In this project, video processing has considered as advantageous

for triggering input (such as streaming starts with person detection). This will not occupy the total bandwidth of the local area network (LAN). For the verification of proposed system and data experimental conditions are streamed through Category 5 (CAT5) LAN and through a Wireless LAN (WLAN). For these experiments bandwidths of the network feature is important. The bandwidths of two LAN protocols and the face detection time are considered here for the system feasibility evaluation purposes.

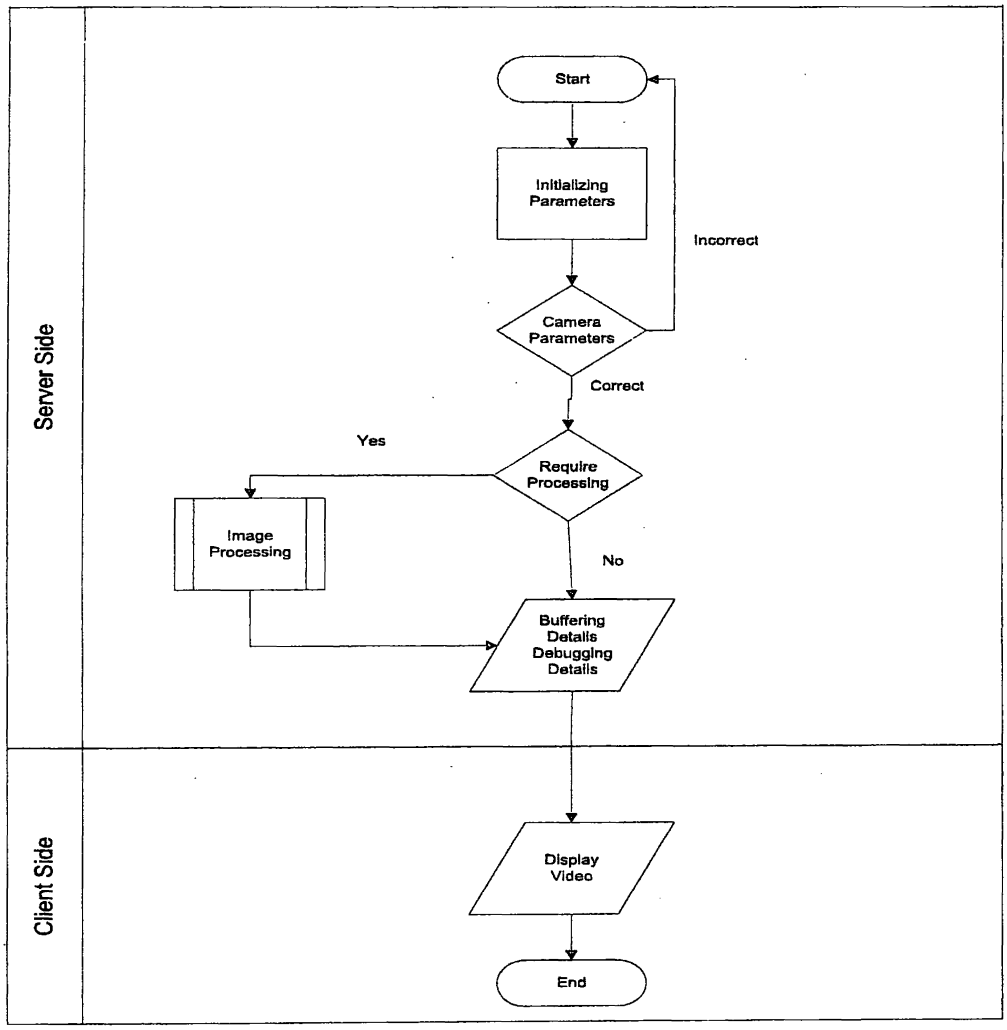

Figure 1: Flow chart of the implementation of proposed system

3. RESULTS AND DISCUSSION

3.1 Available bandwidth for CAT5 LAN in the proposed system

In table 1 the bandwidth for five times are obtained for a CAT5 Ethernet network.

Table 1: Bandwidth data through a CAT5 LAN in proposed system

Term	Speed(Mbits/s)
1	94.7
2	94.7
3	94.8
4	95
5	94.7

These bandwidth data are obtained using ping command and the time taken for a single ping.

3.2 Available WLAN bandwidth for the proposed system

These bandwidth data usually changes with respect to the quality of the wireless adapters used with our proposed system. In general, these bandwidths relate nearly to the other wireless technologies.

Table 2: Bandwidths through a WLAN using 11N adapter in proposed system

Term	Speed(Mbits/s)
1	13.3
2	13.5
3	13.2
4	13.3
5	13.6

3.3 Image processing time measurements

Image detection time is important when streaming the video since processed each image should be sent to the network. The shared video stream has a delay of nearly 1-10 seconds. This is because the face detection time in this system is comparatively a significant number. Following table shows a list of ROI detection time in this compact computer for few frames in 320x240 resolutions.

Table 3: Obtained ROI detection time for the proposed novel system

Frame	Speed(Mbits/s)
1	316.143 ms
2	315.175 ms
3	312.001 ms

4	320.629 ms
5	318.168 ms

3.4 Quality of Received Video

The data compression of the recorded video stream using our proposed system is h264 scheme. As usual the delay of the video stream is nearly 1 second for the resolution of 640x480. When the resolution increases the delay is also increase. Since the open source libraries for raspberry pi does not support high frame rate processing, all the image processing are done with frame rate of 15frames/second. Fig 2 shows the video frames captured while streaming the recording video. When the frame rate increases to 30 frames/second the compact computer restarts due to resource insufficiency. The delay for 1920x1080 video streams is nearly 7 to 10 seconds. For a high speed processing for high precision security purposes and higher frame rates this system would require higher processing power. This would be achievable with new raspberry pi models. Since the security camera does not consider about the delay attached with it, this is nearly possible outcome for a low volume using HD security camera.

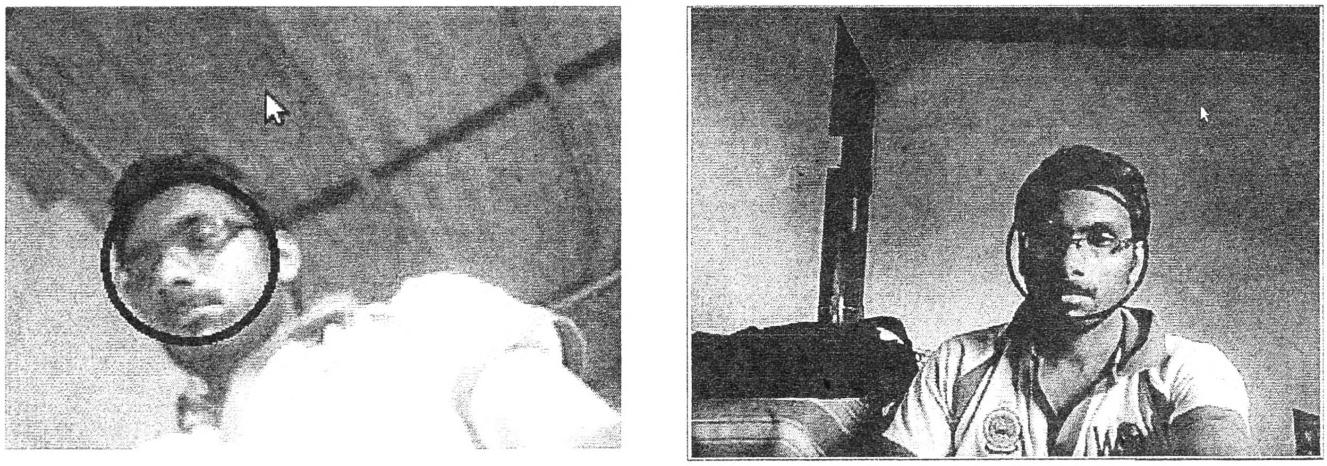

Figure 2: Video frames captured while streaming through WLAN using proposed novel system

4. CONCLUSION

Even though, the study shows a relatively slow streaming. This can be used as a HD video sharing security camera with minimal space and minimum power which includes ROI detection since this system has processing capability. This proposed system features person detection and would be feasible for video storage since processed video/images occupy less storing space in the hard disk(in megabytes). Since the streaming process is to be started with

person detection/ROI detection the rest of the video is not necessary to store for further analysis.

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