Home Automation Using Embedded Web server

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Abstract—Security has been a major concern nowadays. Contionuous reports of theft and roberry have been on news. Also the after theft identification of robbers too is a big problem.Hence we have made a system wherein we provide the user to access the activities going on at his home or office. Our system would also notify the end user for any unusual activity happening and also save the unusual activity on the server for the user to access.We have made the entire setup on a embedded platform. We have used a Pandaboard having TI OMAP 4460 cortex A9 multicore processor.The board is specifically used for image processing applications.The system we have made will detect any kind of motion using a USB camera and detect the face whether it is known or unknown face.If the detected face is unknown then it will call the cops or any other number provided by the user and will also save the video after motion is detected and upload it on the server with the date and time of the detected motion.The user can also access the live stream of the images if he has acsess to internet facility.The user can also access all the features using mobile phone too.

Index Terms—Image processing , Pandaboard es , Open CV , SIFT algorithm , Web Server , Motion detection , Face detection , Security , HTML , CGI-scripting

I. INTRODUCTION

Security has been a major issue nowadays. One can find latest technological innovations being employed to protect not only houses but also offices, buildings, and warehouses etc. Nobody likes to be robbed of his precious possessions and hence opting for a secure system makes sense. Also the fact that, crime rate has kept increasing further emphasizes the need of upgrading the home security. With changing times, even petty thieves have acquired new skills to rob your belongings. Most of the urban cities and metros are witnessing increased rate of crimes and that requires for installation of a safe and secure system to protect your valuables, family and home.

People are always worried about what would be the condition of their homes and offices when they are not there. Hence here we are trying to make a system which would provide the user to access the activities going on at his home or office or any other important place of his choice. Our system would also notify the end user for any unusual activity happening.

In [1] basic idea of integrating web server for controlling house resources is proposed. In [2] and [3] idea of developing an interactive web page(HTML page) is given. Above ideas were based on a personal computer. But in [4] using ARM processor for making a web server is proposed. In our paper we have used web server along with many image processing techniques to enhance the security. A motion detection algorithm is used to detect any motion or unusual activity happening on a particular place, followed by a face detection algorithm to notify user only when any unknown person strikes.

II. SYSTEM DESCRIPTION

We have made a embedded system with hardware and software interface.We have used Pandaboard es as the embedded hardware and loaded Ubuntu 11.10 as Operating system on that and used Open CV for developing image processing algorithms.

A. Hardware Implementation

Figure 1 shows the hardware implementation of the project. The usb camera is connected to the board to capture the image and the gsm modem is used to notify the user.The internet connection is used to upload the video on the server.
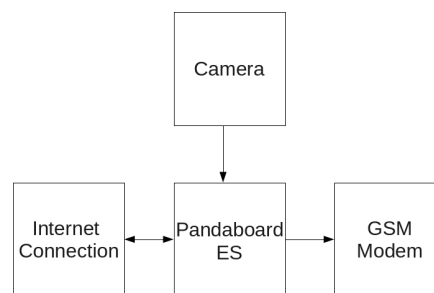

Fig. 1.   Hardware implementation block diagram

B. Software implementation

The software implementation flow diagram is as shown in Figure 2 .The camera captures the image and gives it to the board for processing . After processing if results are inappropriate then the call is made to the user and also the viseo is saved in .avi format.
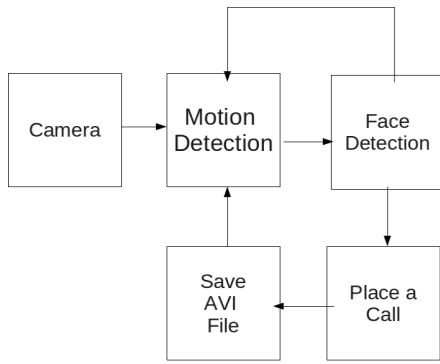
Fig. 2. Software implementation block diagram

III. WEB SERVER

An embedded HTTP server is a component of a software system that implements the HTTP protocol.

A. Introduction to HTML

Hyper-text Markup Language (HTML) is the main markup language for web pages. HTML elements are the basic building-blocks of webpages. HTML is written in the form of HTML elements consisting of tags enclosed in angle brackets (like <html>), within the web page content. HTML tags most commonly come in pairs like <h1> and </h1>, although some tags, known as empty elements, are unpaired, for example <img>. The first tag in a pair is the start tag, the second tag is the end tag (they are also called opening tags and closing tags) [5].

B. Introduction to CGI Scripting

The Common Gateway Interface (CGI) is a standard method for web server software to delegate the generation of web pages to executable files. Such files are known as CGI scripts; they are programs, often stand-alone applications, usually written in a scripting language [6].

C. Apache Webserver

The Apache HTTP Server, is web server software notable for playing a key role in the initial growth of the World Wide Web. In 2009 it became the first web server software to surpass the 100 million website milestone. Apache was the first viable alternative to the Netscape Communications Corporation web server (currently named Oracle iPlanet Web Server), and since has evolved to rival other web servers in terms of functionality and performance[citation needed]. Typically Apache is run on a Unix-like operating system. [7]

IV. INTRODUCTION TO IMAGE PROCEESING ALGORITHMS

Image processing algorithms are used to enhance the security of a particular place. Based on the results of various Image Processing algorithm it initiates various alarms and actions. All the image processing algorithms are developed using OpenCV library in Ubuntu(Linux).

A. Introduction To OpenCV

Open Source Computer Vision Library (OpenCV) focuses on real-time vision for implementing projects and by providing computer vision and machine learning infrastructure. The library is written in C and C++ and runs under Linux, Windows and Mac OS X. OpenCV was designed for computational efficiency and with a strong focus on real-time applications. The OpenCV library contains over 500 functions that span many areas in vision, including factory product inspection, medical imaging, security, user interface, camera calibration, stereo vision, and robotics. Basic structure of OpenCV is as follows:

The CV component contains the basic image processing and higher-level computer vision algorithms; ML is the machine learning library, which includes many statistical classiers and clustering tools. HighGUI contains I/O routines and functions for storing and loading video and images, and CX Core contains the basic data structures and content. Basic structure of OpenCV is shown in Figure3.
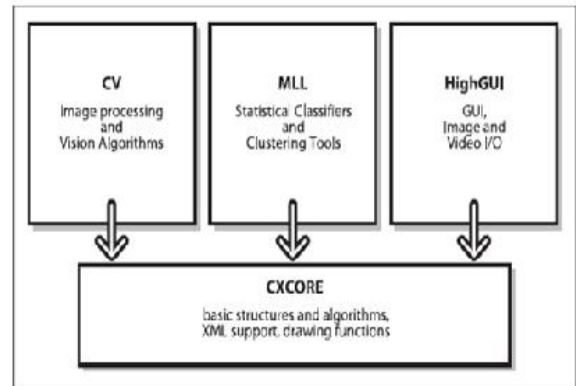

Fig. 3. Structure of OpenCV

B. Motion Detection

There are many approaches for motion detection in a continuous video stream. All of them are based on comparing of the current video frame with one from the previous frames or with something that we'll call background.

But background may change with the time of the day. Hence comparing an image with the constant background may result in inappropriate result. Hence comparison of current frame with the previous frame is done. But it wont be able to detect very slow motion. To overcome shortcomings of above methods we have compare current frame(i) with the frame (i-4) [9] [10].

C. Gray Level Grouping

Gray level grouping is a very efficient algorithm for contrast streching of a dark image. Linear contrast streching algorithms are not automatic and users are required to enter appropriate parameter depending on an image to get the best output. Histogram equilization technique and adaptive histogram equilization though are automatic, it may produce washed out

effect. Hence to overcome short-comings of above inefficient methods gray level grouping has been employed to enhance the contrast of dark images. It aids user to detect motion even in the night time so that special night cameras or IR illuminators are not required for detection in night time [8].

D. Face Detection using SIFT feature

Face recognition is essential in many applications, including mugshot matching, sur- veillance, access control and personal identification, and forensic and law enforcement applications. In this problem, we have a database of a face images for a group of people. Then, given an unknown face image, we want to answer the question: "which person in our database does this image belong to?" Many algorithms and techniques have been proposed for solving such a problem. Our project proposes a new approach based on Scale Invariant Feature Transform (SIFT) [11] [12].

V. ROLL OF LINUX AND SHELL SCRIPTING

A. Introduction to Linux

Linux is a Unix-like computer operating system assembled under the model of free and open source software development and distribution. The defining component of Linux is the Linux kernel, an operating system kernel first released October 5, 1991 by Linus Torvalds.

You can use Linux as Server OS or as stand alone Os on your PC. (But it is best suited for Server.) As a server OS it provides different services/network resources to client. Server OS must be:

- Stable.
- Robust.
- Secure.
- High Performance.

B. Introduction to Shell Scripting

Computer understand the language of 0's and 1's called binary language. In early days of computing, instruction are provided using binary language, which is difficult for all of us, to read and write. So in Os there is special program called Shell. Shell accepts your instruction or commands in English (mostly) and if its a valid command, it is passed to kernel. Shell is a user program or it's a environment provided for user interaction. Shell is an command language interpreter that executes commands read from the standard input device (keyboard) or from a file. Shell is not part of system kernel, but uses the system kernel to execute programs, create files etc. Shell script defined as:

"Shell Script is series of command written in plain text file. Shell script is just like batch file is MS-DOS but have more power than the MS-DOS batch file."

We have used shell scripts as an interface between a mobile device and a system. Also we have employed shell script for switching between various OpenCV programs.

C. Communicating with Mobile

Basically to communicate with the mobile with PC or any other standalone system, AT command set is used. These AT commands are sent to the mobile via shell scripts. AT commands are the instructions used to control a modem. Shell scripts generally contains serial input output commands to communicate to mobiles or a GSM equipment.

D. Hardware Used

The PandaBoard is a low-power, low-cost single-board computer development platform based on the Texas Instruments OMAP4430 system on a chip (SoC). The PandaBoard ES is a newer version based on the OMAP4460 SoC, with the CPU and GPU running at higher clock rates.

The PandaBoard features a dual-core 1 GHz ARM Cortex-A9 MPCore CPU, a 304 MHz PowerVR SGX540 GPU, a C64x DSP, and 1 GB of DDR2 SDRAM. The PandaBoard ES uses a newer SoC, with a dual-core 1.2 GHz CPU and 384 MHz GPU. Primary persistent storage is via an SD Card slot allowing SDHC cards up to 32 GB to be used. The board includes wired 10/100 Ethernet as well as wireless Ethernet and Bluetooth connectivity. Its size is slightly larger than the ETX/XTX Computer form factor at 4 4.5 in (100 110 mm). The board can output video signals via DVI and HDMI interfaces. It also has 3.5 mm audio connectors. It has two USB host ports and one USB On-The-Go port, supporting USB 2.0.

We have ported Ubuntu 11.04 and OpenCV-2.3.1 on the board [13] [14].

VI. RESULTS

This chapter displays results of image processing algorithm used and a snapshots of web page designed for web server.

A. Web Server

When user visits the site i.e when user enters the IP address of a web server in the address bar of the browser, log in page of the server appears as shown below.
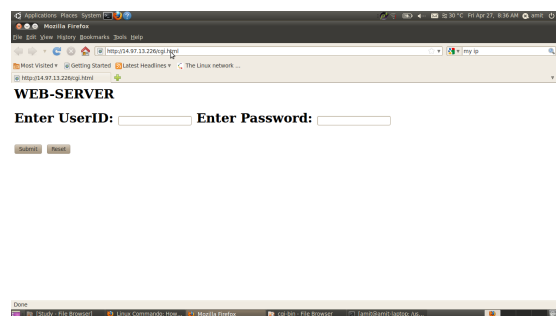

Fig. 4.   Login Page of server

a) : After entering the proper credentials user is allowed to access the server data,stored avi files and gets access to the push buttons meant for placing a call to cops and to view the live streaming.
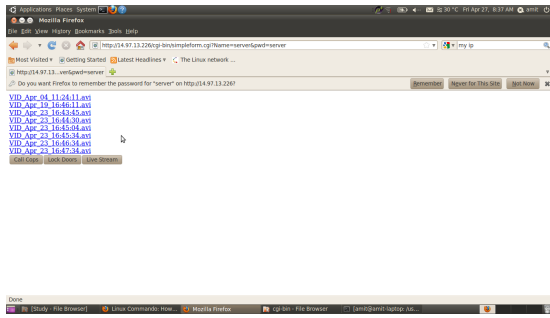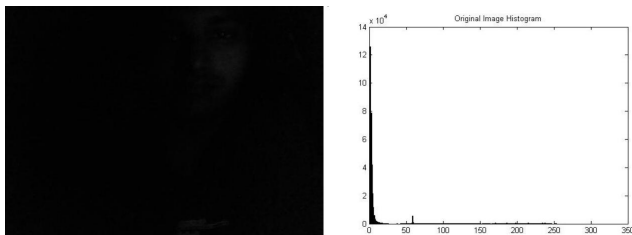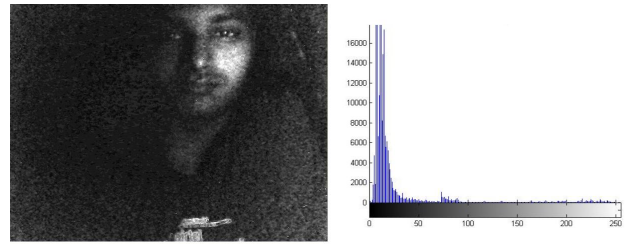
Fig. 9. Resultant GLG image and its histogram

C. Face Detection

Using the Face detection algorithm we differentiate between knowing and unknowing faces and then notify the user for any unknowing intruder detection.
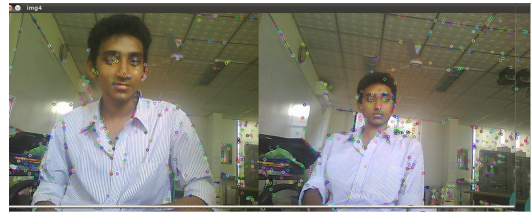

Fig. 10. Generated key point image

SIFT algorithm (Shift Invariant Feature Transform) is used for face detection and the image above shows the generated keypoint using the algorithm
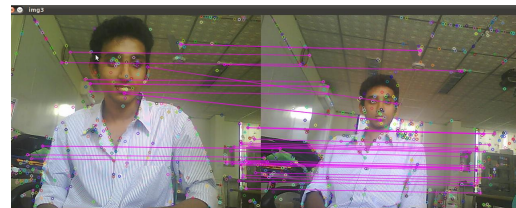

Fig. 11. Matched keypoint image

VIII. CONCLUSION

In this paper we have shown low cost and a feasible solution to the increasing security problems. Since a user can use any USB based web-camera for surveillance and any mobile equipment can be used as a GSM modem, this system is affordable for a normal user also. With this system user is always assured of safety of a particular place. User can view live as well as stored footages through any internet browser on a PC or a mobile supporting internet services. User gets notified via a call whenever any unknown person is detected.

REFERENCES

[1] Helder Adao, Rui Antunes, and Frederico Grilo,"Web-Based Control & Notification for Home Automation Alarm Systems", World Academy of Science, Engineering and Technology 37 2008.
[2] Manouchehr Ghahramanian Golzar,HamidReza Tajozzakerin, "A New Intelligent Remote Control System for Home Automation and Reduce Energy Consumption", 2010 Fourth Asia International Conference on Mathematical/Analytical Modelling and Computer Simulation.

Fig. 5. Structure of OpenCV

VII. IMAGE PROCESSING

A. Motion Detection

Two different images for motion detection are shown below and the result of the algorithm is shown.

Fig. 6. motion1

Fig. 7. Result

B. Gray Level Grouping

Following results shows results of applying gray level grouping on an image.

Fig. 8. Original Image and its histogram

[3] M. Can Filibeli, Oznur Ozkasapa M. Reha Civanlar, "Embedded web server-based home appliance networks", Journal of Network and Computer Applications 30 (2007) 499514

[4] V.Billy Rakesh Roy, Sanket Dessai, and S. G.Shiva Prasad Yadav, "Design and Development of ARM Processor Based Web Server",International Journal of Recent Trends in Engineering (IJRTE), Volume 1, Number 4, May 2009

[5] http://www.rewritables.net/htmltagchart.html.

[6] http://www.cgiscripting.com/

[7] http://httpd.apache.org/

[8] ZhiYu Chen, Senior Member, IEEE, Besma R. Abidi, Senior Member, IEEE, David L. Page, Member, IEEE, and Mongi A. Abidi, Member, IEEE, "Gray-Level Grouping (GLG): An Automatic Method for Optimized Image Contrast EnhancementPart I: The Basic Method", IEEE Transactions on image processing, VOL. 15, NO. 8, AUGUST 2006.

[9] http://www.codeproject.com/Articles/10248/Motion-Detection-Algorithms.

[10] Karan Gupta, Anjali V. Kulkarni, "Implementation of an Automated Single Camera Object Tracking System Using Frame Differencing and Dynamic Template Matching"

[11] David G. Lowe, "Distinctive image features from scale-invariant keypoints", International journal of computer vision, 60, 2004.

[12] F. Samaria and A. Harter, "Parameterisation of a stochastic model for human face identification", In 2nd IEEE Workshop on Applications of Computer Vision, 1994.

[13] http://pandaboard.org/node/13530/

[14] http://sites.google.com/site/andrewssobral/pandaboard