Samaritan – Video Surveillance System

CS F424 Software for Embedded Systems

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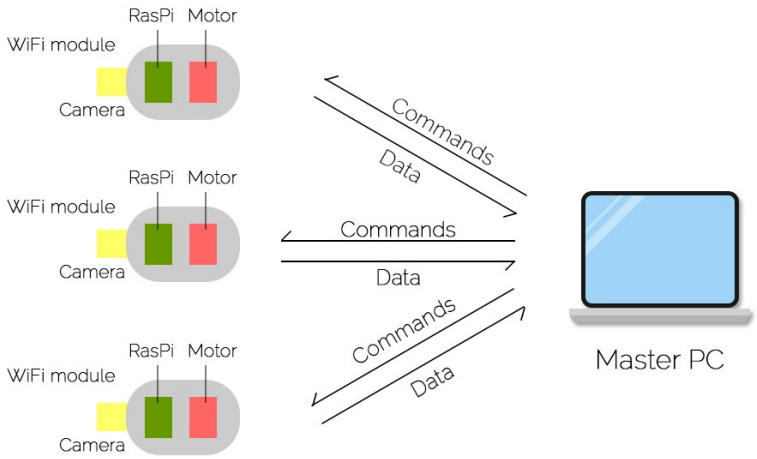
Abstract:

Objective of this project is to design and implement an Intelligent Surveillance System named Samaritan. This system consists of an Embedded system and PC - based system. We propose an embedded system which alerts the administrator in the presence of illegal intruders. We will be designing a PC - based intelligent surveillane system that detects motion depending on a threshold value for motion and alerts the administrator/owner through Gmail. This system is implemented on an embedded system consisting of an ARM processor (Raspberry Pi Zero) which has sufficient amount of RAM.

Our device sends (serial) the captured frame to master PC where all the further processing (Video construction, Motion Detect) is carried out.



Project Description

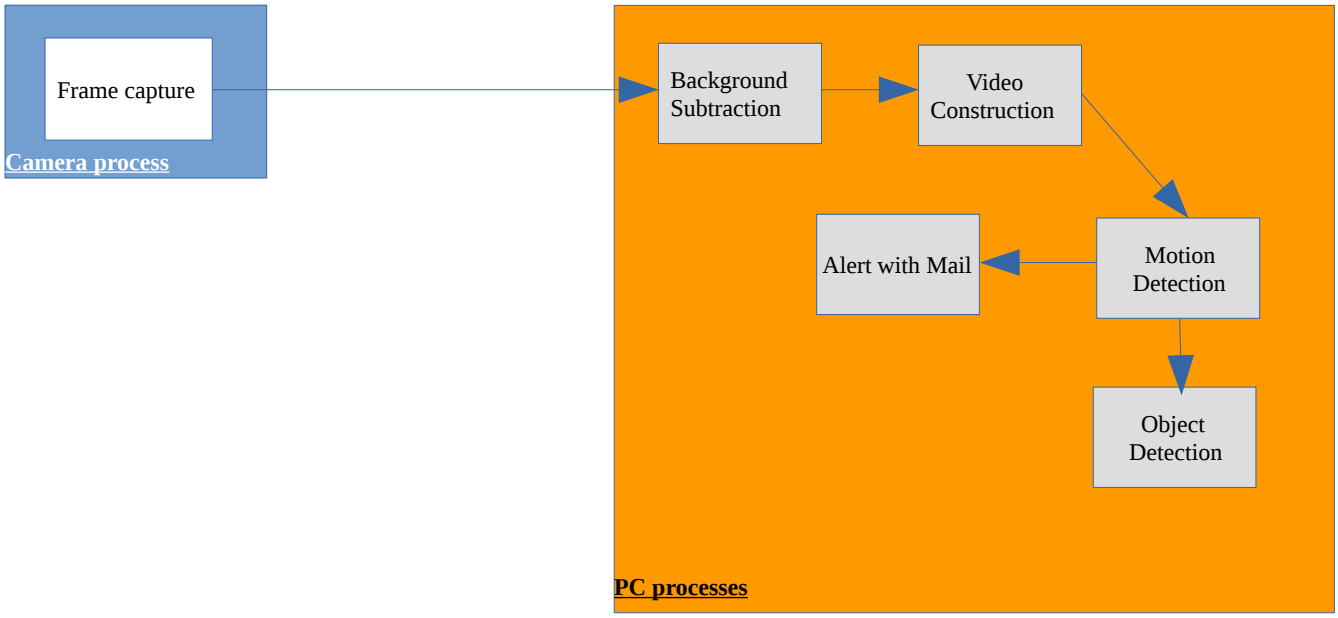
Tracking and recognizing objects using video sequence is an important topic in computer vision field and has a variety of potential applications.

Unlike a multimedia system, the output of a surveillance system is not always an image sequence, but could also be the positions of humans, image content features and so on. Therefore, the architecture of video surveillance system should differ greatly depending on what its objective and outputs are.

Several other researchers proposed varieties of embedded image processing systems. Even in systems combined with a PC, many of the applications embed the image processing part in their camera modules but in Samaritan we propose to do all the image processing part on PC so that the only job of our camera device would be to transmit captured frames in real time thereby removing any delays possible and making it cost efficient.

In the below table we show the merits and demerits of Embedded Imaage processing and PC based Image processing,

	Embedded Image processing	PC based Image processing
Merit	- Each camera device is independent	- Less cost of Camera device - Perform complex computations - All camera devices are connected
Demerit	- Less worthy of the money spent	- Camera devices attached ca be increased



Flow Diagram

Timing Constraints:

We have to make sure that the captured frame reaches the master PC in the best time possible (1/4th of a second). Each instruction from PC to the device has to reach in less than 1/100th of a second. To avoid delay in streaming the video to PC we are only sending frames to main PC to construct video on PC.

Power Consumptions:

The device needs continuous power supply. Following are the power speifications,

Raspberry Pi	5V
Stepper Motor	3.3V
Motor Driver	12V - 40V

Hardware & Cost:

Raspberry Pi 2 Model B	Rs. 2800
USB Webcam	Rs. 350
Stepper Motor driver	Rs. 250
2 Phase Stepper motor	Rs. 300
USB Wifi Adapter	Rs. 400
TOTAL	**Rs. 4100**

Size:

As this device is placed in a corner of a room, we will be limiting its size to dimensions 10cm x 10cm x 15cm.

Hardware Description

Raspberry Pi 2 Model B:

We are using Raspberry Pi as main processing for device which records and transmits data to main PC. This has 1GB RAM and is loaded with Raspbian OS in an 8GB SD Card. This has 900 Mhz quad core ARM Cortex-A7 processor and also has an embedded GPU (VideoCore 4 @ 250 Mhz).

8 GB SD Card:

This is required to load Raspbian OS in Raspberry Pi.

Stepper Motor Driver:

This requires input power supply of 12-40v and which can provide max 5v o/p voltage and 4A current so that stepper motor can work effectively.

Stepper Motor:

Two phase Bipolar motor (Generic Nema 17 3D Two-phase 4-wire Stepper Step Stepping Motor 1.8Deg) Stepper motor help us to move the position of camera by certain angle as per the project requirement.

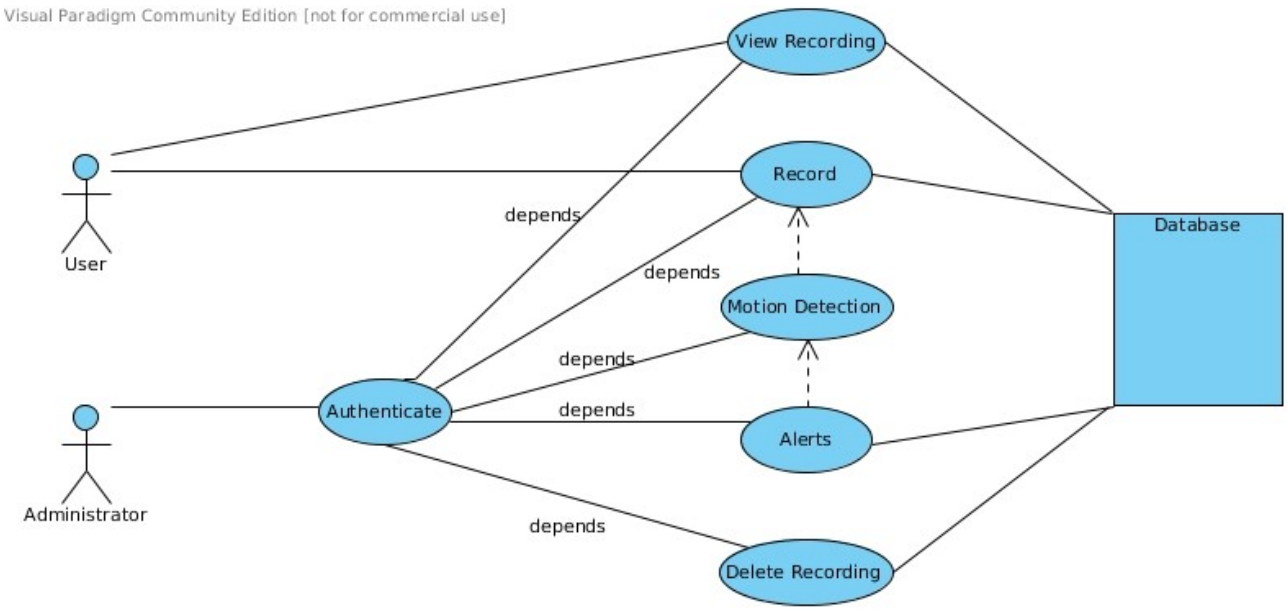
USB Wifi Adapter:

02.11N Wireless USB Adapter required to send the captured data wirelessly to our base station.It requires 5V continuous power supply .It works in frequency range of 2.4-2.8 Ghz and it can provide at max.130 MBps speed.

USB Webcam:

Logitech HD Webcam C270 will continuously capture the images and send it frame by frame to our base station wirelessly with help of Wifi.

Use Case Diagram:



Specifications:

Use Case Name	Alerts
Assumptions	This device is used only in good lighting conditons. Administrator has a basic knowledge of computers.
Pre Conditions	Camera is recording and communicating with PC properly and in Real Time.
Post Conditions	Samaritan has to record and alert if there is an illegal motion detected.
Primary Actor	Administrator OR User
Secondary Actor	Database for recordings (PC's HDD Storage)
Trigger	If there is any motion.
Success Flow	Camera device captures frames and send them to PC.
	PC constructs a video from the received frames.
	PC keeps on monitoring the video to see if there any Motion.
	If motion is detected then it alerts the administrator via Alarm & Gmail.
	Intruder is then prosecuted.
Alternate Flow	a. If the Camera device is damaged by intruder then Alerts are activated.
	b. Multiple tries of failed authentication trigger Alerts.
	c. If in dark conditions then it shows “Dark Alert”.
Future Additions	a. Camera device searches for any motion and always centres the moving object.
	b. Infrared imaging can be used to activate alerts in dark conditons.

Work Phases

Phase 1:

Establish 2-way communication link between device and PC so that the device is transmitting the captured frame correctly and ensure that this transmission is happening in real time.

Phase 2:

Integrate Stepper Motor with the device. Software modules for Video construction and filtering.

Phase 3:

Software modules for Motion detection and Email alert.

Phase 4:

Additional software modules for video capture in dark conditions.

Phase 5:

Final testing of all modules.