

SmartCam

Motion Capture Video Recorder Using Raspberry Pi

Mansoor Ali

2016459

CCT (College of Computing Technology)

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Introduction:

This is the Project Proposal draft document. In this Document I have highlighted the problem that my project aim is to solve. I have also describe about the target Market for my project and also use Michael Porter Five forces model to analyze my project according to business perspective. I have also discuss about the Hardware, Software and languages, I am going to use in order to build my project final prototype. I have also added project timeline at the end of this document, the timeline describe about the timeframe for tasks required to do to make final prototype and how I will accomplish that tasks.

Problem Area:

CCTV cameras are working fine from numbers of decades and use of these cameras is increasing day by day. But, these cameras have some disadvantages too i.e. security, data storage, notification. There is no need to record a video if it cannot stop burglary on the spot. Attackers can damage the cameras or put some sort of spray on camera lens to disturb its functioning and user will not get any alert. Cyber attackers can easily hack the entire network of an organization by injecting Distributed denial of service DDoS attacks to CCTV systems as they are not very secure or some does not support SSL/TLS encryption. Any insecure device connected to the internet is the main target for attackers to enter into target network and this can put a lot of important data at huge risk. Notification is also an issue, when it comes to CCTV cameras. Unlike other intrusion detection systems such as smoke alarms, fire alarms etc. CCTV cameras are not programmed to notify the administrator, if any incidents occur. CCTV cameras just record the specified area in there range and the administrator will have to check all the recording to catch the culprit, in case any disturbance occurred in their absence. For storing videos CCTV systems need external hard drives or some sort of cloud storage platform and that need some extra cost, which is also an issue for small businesses or home owners who are looking for cheap security system in order to get some discounts on insurance. A research done by cloudview a company who transform visual that in a way to make it accessible and manageable state different vulnerabilities of CCTV DVR systems and those vulnerabilities are: No Oversight, firmware updates, and port forwarding etc. These are the issues that need to be consider and need some attention or IT professional to look after these systems and that cost a lot to hire someone to look after CCTV systems and check if there any security breach in those systems.

Solution:

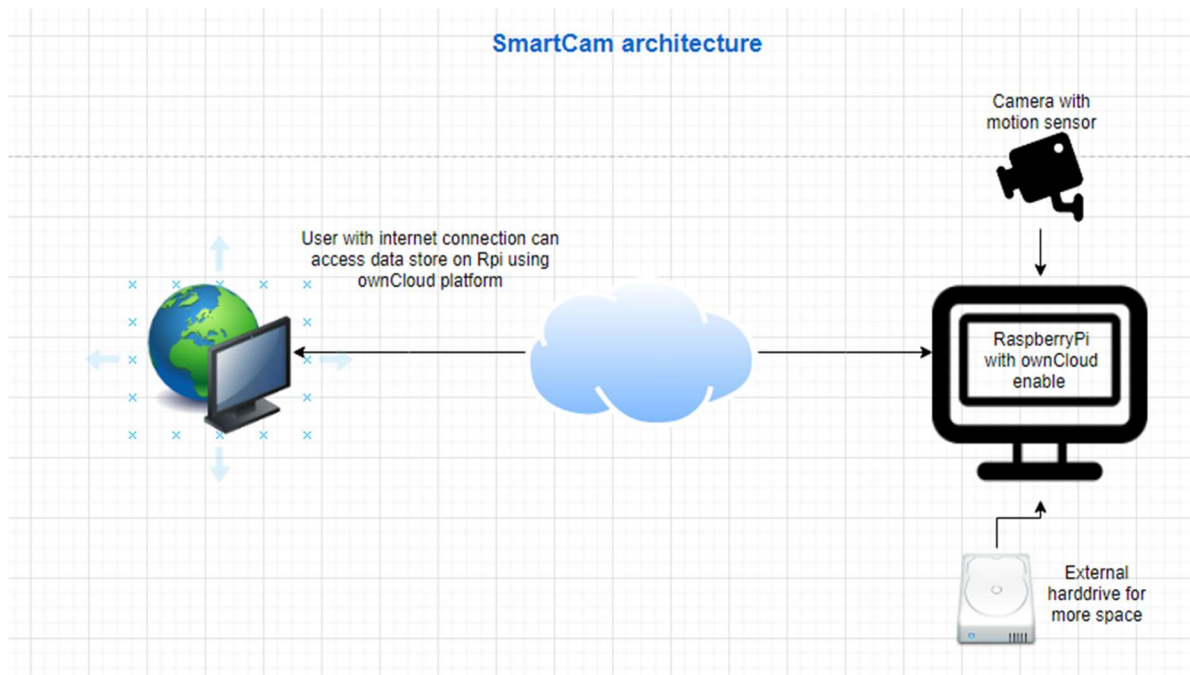


Figure 1: Project Architecture

I came up with the solution of SmartCam in order to overcome issue arise by CCTV cameras. The SmartCam will be built using Raspberry Pi, PIR motion sensor, and a camera Module. Upon successful completion of this system, it will be able to capture pictures, record videos only if any motion occurs and also, the Raspberry Pi the base of this system will be programmed to notify the administrator of this System. In order to deal with data storage problem, I have solution which is OwnCloud. It is a service that can be enabled on Raspberry Pi freely and the Raspberry Pi will act as Server and the individuals (admins) can access data (pictures/videos) stored on it remotely. . If the individual wanted to keep all of its content and require big storage media, so OwnCloud also allow adding external hard drive to act as cloud service Admins will also be able to delete not usable content in order to free device space. Raspberry Pi runs on Operating system Raspbian, which is Linux based and very secure and also its an open source project and a lot of work is going on to make this device able to give us full advantage of it. There are a lot of IOT based projects that are built using Raspberry Pi and are doing incredible jobs.

Target Market:

Once I have the final prototype, that is "A camera using Raspberry Pi who capture pictures videos only when some motion/movement occur" it will be very useful for Home owners who need some security cameras in their homes and don't want to spent a lot on electricity and storage i.e. CCTV cameras runs 24/7 in order to record video and use a lot of electricity. So, the home owners can have a secure home using this prototype and in that way they can get some discounts from insurance company if they want to have insurance for their houses. My final prototype will also be very useful for small businesses, who need some security camera to monitor their office remotely and don't want to spent a lot on management of these IT equipment's. Big companies who need a lot of security cameras in order to monitor the company's building will not be able to get benefit from this prototype as this will be based on

one camera, but later upon successful completion of this project, the concept can be extended to add more cameras and motion sensors to make it useful for big companies. Especially, for security companies who have different sites to look after, will be able to use this extended prototype and can reduce cost spent on employee's they hire.

Porter 5 Forces

Michael E. Porter in an interview with Tom Stewart state that "Basic idea of competitive forces starts with notion that competition is often looked at too narrowly by managers" (Michael, 2008). The five forces model is an analyzing tool for almost all businesses to analysis where does the business stand and where it can be in near future. The five forces on which business can be analyzed are:-

1. Rivalry of existing competitors
2. Threat of new Entrants
3. Threat of substitute products
4. Bargaining power of customers
5. Bargaining power of suppliers

These five forces can be used by any business/industry to gain competitive advantage and succeed in the market. I have used these five forces model to analyze my idea and below is detailed analysis of my final prototype using porter five forces.

Rivalry of existing competitors

This section is about the competitors who are already in the industry and it is tough to compete with them as they are doing very well in that specific industry. In terms of my plan there are CCTV cameras provider who offer incredible services, but to overcome security issue CCTV systems need to be replaced or update to stay in this industry and this need some cost that will be an issue for competitors. There are some competitors who offer smart cameras that work using motion sensor but in terms of security are not very secure or can be easily hacked. My product is unique and highly secure so it cannot be the tough competition with competitors.

Threat of new Entrants

This part is to analyze about new entrants in that specific market. For example, how easy is to enter in this industry can be analyzed. In regards to my product design, new entrants can easily enter and start making similar devices as products I am using in this project are open source and can be used by anyone with some little uniqueness in their work.

Threat of substitute products

This section looks deep into existing similar products and it can be used to analyze that how different the coming product will be from existing products. In my scenario, there are some motion capture small cameras that work when some motion occur, but that small devices does not support high level of security or encryption of users data. My idea is to secure users data and keep it confidential that's the reason I am using Raspberry Pi which supports high level of encryption for remote access. This can be advantage to my idea as there is no such threat of substitute products.

Bargaining power of Customers

This section can be used to analyze the bargaining power of customers. For

example if there are very similar products that offer almost same functionality in a cheaper price than the bargaining power of customers will be definitely strong. According to my plan, my product is to provide privacy to user data and latest layer of encryption. The bargaining power of customers will not be very strong if they are aware of privacy they need. Some people are curious about privacy but many don't even know about that. And bargaining power of customers will be little strong when it comes to my product but that will goes to decline or weak bargaining power, when people will came to know about privacy of their data.

Bargaining power of suppliers

All businesses need some suppliers of raw materials in order to make their finish product. And if the industry is very huge the bargaining power of suppliers will be less strong, but if there are only few suppliers than the business have to listen to those suppliers and their bargaining power will be strong. My finished product will be based on three devices; raspberry pi, sensor, camera module. And according to research done there are many suppliers of these products nationally and internationally and all offer products with competitive prices. So, the bargaining power of suppliers of above mentioned products will not be very strong and this can be beneficial to my finish product.

Five Forces Conclusion

I have used Michael Porter five forces model to analyze my finish product and realize that there are some points that need to be focused in order to gain huge competitive advantage. For example, bargaining power of customers will be strong as huge number of people are not aware of privacy they need and are only looking for cheap products. But this issue can be overcome through some privacy awareness messages and as field of technology grows, people will be aware of that in coming future. In other areas like suppliers, new entrants, competitors and substitute products, my product position is quite strong and is able to gain competitive advantage.

Hardware:

This section is about hardware components that are used to build the SmartCam.

Raspberry Pi 3 B



Figure 2: Raspberry Pi Device

I have use Raspberry Pi 3 B to build my project. This small credit card size device work exactly as desktop computer, and will act as the main device on which I will be working in order to accomplish my project goal. In order to interact with it we only need to add mouse, keyboard and monitor. It use micro SD card, that work as hard drive of this small device and the operating system will be loaded into this hard drive. The operating system “Raspbian” can be downloaded freely from Raspberry Pi official website. This is not the latest version of Raspberry Pi, as there is a fourth edition of Raspberry Pi as well and that is quite similar to it except the processor speed, support different size of RAMs and support smaller HDMI ports for display.

According to Raspberry Pi foundation the specification of model 3 B is specified below:-

- 1GB RAM
- Quad Core 1.2GHz Broadcom BCM2837 64bit CPU
- BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board
- 100 Base Ethernet
- 40-pin extended GPIO
- 4 USB 2 ports
- 4 Pole stereo output and composite video port
- Full size HDMI
- CSI camera port for connecting a Raspberry Pi camera
- DSI display port for connecting a Raspberry Pi touchscreen display
- Micro SD port for loading your operating system and storing data
- Upgraded switched Micro USB power source up to 2.5A

Motion Detector

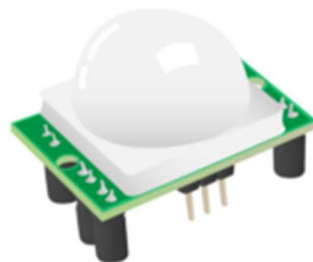


Figure 3: PIR motion capture sensor

In this project, I am going to use PIR passive infrared motion sensor. These are mostly useful in burglar alarm systems. It emits infrared radiations, when the temperature of object/organism is above absolute zero (-273.15 C). Infrared radiations wavelength cannot be seen by human eye, but if any disturbance occur, it can be detected by motion sensors. This have nothing to do with movement of things, it works by adjusting itself to infrared signature (temperature disturbance) of room it is in and then start watching for changes. Any movement

occur will disturb the infrared signature (temperature) and then PIR sensor will detect this disturbance and we can program it to do something with this disturbance.

These can be used with lights, security cameras, and smoke detectors etc. For my project I will be using this module with raspberry pi, in order to capture motion and camera will also be added to Rpi to start taking pictures/videos.

Camera Module

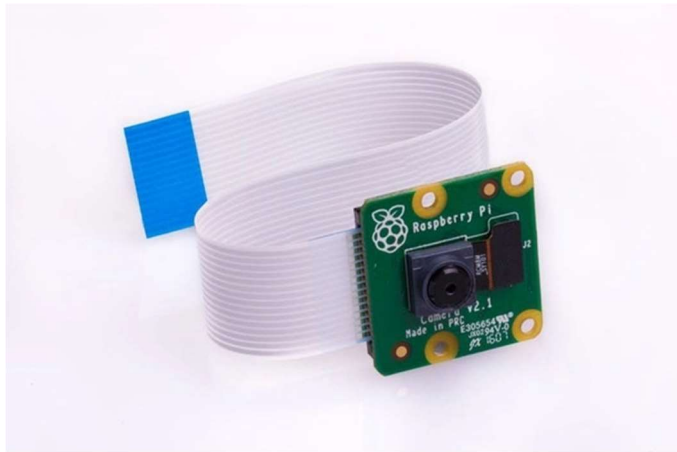


Figure 4: Raspberry Pi Camera ModuleV2

The Rpi Camera Module V2 is the second version of module introduced in April 2016. It has 8 megapixel Sony camera that aid in taking high quality pictures or record videos. CSI port on raspberry pi can be used to connect this camera via a 15cm long ribbon cable. This camera module work on all versions of Rpi 1, 2, 3, and 4 except Rpi 0. According to Raspberry Pi official website this camera is very popular in making home security applications and wildlife traps. I will be using this module with Rpi 3B in order to achieve my project goals. There are numerous libraries that are built for it including Picamera python library, which I will be using to get full benefits of camera module.

Software

Raspbian OS

Raspbian is the Operating system supported on Raspberry Pi. It is like a Linux OS and easy to use in order to interact with Rpi. It has plenty of pre-installed software for education, programming and general use. It also supports programming languages like java, python, scratch and Sonic Pi etc. It can be downloaded from Raspberry Pi website and can be installed on your Raspberry Pi so that you can interact with Raspberry Pi. I have already installed this in my Rpi in order to interact with the device.

Programming Languages

Python

Python is an object-oriented, interpreter, high-level programming language. Python is very simple, easy to learn syntax emphasizes readability and therefore reduces the cost of

program maintenance. I am going to use this language in my project to make camera module work according to my desire using the PiCamera python library. I will write codes/commands in python to access Camera module in order to record videos when some motion occur. Python provides features of dynamic typing and dynamic binding, which make it very attractive for Rapid application development, as well as for use as a scripting. Most of the programmers fall in love with Python because of the increased productivity it provides and the edit-test-debug cycle is incredibly fast. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

Cloud Computing

Cloud Computing has made a significant presence in the field of technology and has become one of the most important and growing area in IT sector. The process of storing data and providing different services through internet is an on-demand facility and it benefit both individual users and big companies. According to Connor, M. (2018) users can benefit from cloud computing in several matters:

- Enhanced security and compliance (security of data is enhanced)
- Mobility (employees can work from home with the help of internet)
- Increased Collaboration (easy access to edit files and share documents anytime, anywhere)
- Cloud Storage (Access data anywhere using internet)
- Cost Reduction (reduce cost of hardware and provide pay as you go services)

Considering all these amazing benefits of cloud computing, a cloud based platform will be used in order to store data and access it remotely.

OwnCloud

As an alternative to Google Drive, iCloud, One Drive, OwnCloud offers security and privacy of your data and allows you to access it remotely from anywhere using internet. It can provide you extra layer of security as users don't need to relay on different cloud vendors and allow users to make their own cloud platform free of cost. With free desktop client and ownCloud app users can access their data at anytime from anywhere. OwnCloud is one of the best program for running a cloud storage system on Raspberry Pi. Once configure the OwnCloud service on Raspberry Pi, we can access data stored on the drive of raspberry pi remotely. An external hard drive can be added to Raspberry Pi to provide a fully functional and secure cloud platform in free of cost. OwnCloud platform will be used in my project in order to access data (videos/pictures captured when motion occur) stored on Raspberry pi from any device connected to internet.

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Project Timeline:

Week 7/28Oct First meeting with supervisor, Start working on plan.

Week 8/4Nov 1. Plan Finished for semester 1 and have brief overview of semester 2 plan.

2. took book from library about Raspberry Pi projects and have little overview

3. Download Raspbian and ask a friend to bring Rpi to college in next class.

Week 9/11Nov 1. Finalize plan after supervisor meeting and got Rpi from college (supervisor)

2. Draft of first Chapter, Table of content(at least will have idea about semester 1 submission)

3. Read and learn how to configure motion sensor on Rpi using Rpi guide book

Week 10/18Nov 1. Must install Raspbian in Raspberry Pi and try to get motion sensor from college and try to use that with Rpi using knowledge gain from Rpi guide

2. Also need to finalize camera module that I will be using and order that ASAP, must finalize the project architecture that can be included to chapter 1 draft.

3. Start working on project proposal according to table of content (first need to focus on introduction, problem, problem solution etc.)

4. Semester 2 timeline in detail as per supervisor valuable suggestion.

Week11/25Nov

1. Motion sensor should be working fine at this stage (if could not configure previously, must need to done the end of this week)

2. After architecture design identify programming language that will be useful for project and start learning that.

3. Add technologies going to use in project (their description, working and how that technology will help me in my project).

Week12/2Dec

1. Read more related projects and compare with work done by me, and if something more efficient is found try to append that in project proposal.

2. Using Rpi guide book learn how to access camera module and how to make picture and videos with it.

3. learn python basics as it will be needed to configure Camera module.

Week13/9Dec

1. Finalize first deliverable for submission as submission date will be by the end of this week expectedly

2. Make sure to cite References used in project and cite that properly and also label images used in document if not done yet.

3. Test camera module if receive by this week and add documentation of experiment in Proposal draft.

Week14/16Dec

1. proof reading of Deliverable 1 before submission

21-Dec-19

until

Exam period

24-Jan-20

Exam period

Exam period

Holidays until
16Feb

No extra work require during this time as I will be out of country for some time, but if any task missing from semester 1 should be completed in this time.

Semester 2 Starts

Week1/17Feb

1. If not tested the Camera module test that in this week.
2. Make Rpi OwnCloud enabled and test it by storing data in Rpi and access it on other device.

Week2/24Feb

1. Test both sensor and camera module together and make camera able to take pic/video when motion occur.
2. If not successful in capturing video when motion occur then do some troubleshoot research and make a report what happen and why is happening.

Week3/2Mar

1. Once successful in capturing video when motion occur, test that at different times and make it to store videos with different names i.ee (name videos with Time.)
2. Also Access storage data on some other device using OwnCloud which must need to be tested and enabled on Rpi before this week as already specified in earlier weeks task..

Week4/9Mar

1. Start writing final report, Document the experiments.
2. Add external hard drive to Rpi and enable OwnCloud service on it.

Week5/16Mar

1. Start working on Diagrams (Methodology), i.e use Case diagram, Activity Diagram, Sequence Diagram.

2. Core task need to be done before this week as specified already for previous weeks, research on how to make Rpi to send some sort of notification if any motion occur.

Week6/23Mar

1. Do practical to make Rpi able to send notification if motion occur (make some simple app where user can login and see notifications)
2. Write the final prototype made so far, (if become successful in sending notifications it can be added later on the final prototype document.)

Week7/30Mar

1. Focus on Final document and its enhancement and also add research done in order to send notification message.
2. This week also do some work on making Rpi able to send noftifications /messages (it will enhance the project functionality).

Week8/6Apr

Feedback for semester1 draft will be received by this time, So try to make changes in final document if something missing.

Week9/13Apr

Near end of semester there may be pressure of other subjects assignments, so practical work should be done before April and leave this month to work on Documentation and experiments.

Week10/20Apr

Finalize the Document and Show working model to supervisor and document to seek advices and implementations if needed.

Week11/27Apr

If any suggestions from supervisor change and add that functionalities to project final art craft and also Make a presentation file for final presentation.

Week12/4May

End of Semester. Submission expected this week. Read the finalize document to find mistakes if any and try to make it Efficient. Also need to record video if asked.