UNMANNED AERIAL VEHICLE WITH NIGHT VISION FOR TRACKING INTRUDER

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ABSTRACT

Nowadays there are a lot of theft are happening everywhere and it is dangerous for a person to chase after the intruder because maybe the intruder might have a weapon and harm us. There wasn't any other way to track the intruder other than chasing to inform the authority the location where the intruder is. The aim of this project is to find one of the solutions to overcome this project by using Unmanned Aerial Vehicle (UAV) with night vision camera for tracking the intruder. This project mainly focus on the amount of ground light intensity needed and the distance of night vision camera which placed on UAV can detect the shadow of intruders. Besides that, to investigate whether the UAV can detect the intruders with the following path it travels with a specific amount of ground light. Last but not the least, to investigate does the UAV interrupts the signal, data transfer and clear image of intruder using the night vision camera. The experimental result will be analysed.

ABSTRAK

Saban hari, makin banyak bilangan kecurian yang berlaku dan ia amat berbahaya jika seseorang mengejar pencuri itu kerana berkemungkinan dia mempunyai senjata yang boleh mengancam kita. Pada ketika ini, tiada cara yang lain untuk menjejaki kemana pencuri itu berlari supaya memberitahu lokasi pencuri itu kepada pihak berkuasa. Tujuan utama projek ini adalah untuk mencari salah satu jalan penyelasaian dengan menggunakan *Unmanned Aerial Vehicle (UAV)* dengan kamera *night vision* untuk mengesan dan menjejaki pencuri itu. Projek ini fokus terhadap jumlah cahaya persekitaran yang diperlukan dan juga jarak yang diperlukan antara kamera *night vision* yang dipasang pada UAV dan pencuri itu agar boleh dikesan dan menjejakinya. Selain itu, untuk mengkaji bahawa UAV itu boleh mengesan dan mengekori seseorang itu. Akhir sekali adalah untuk mengkaji adakah apabila UAV diterbangkan ia boleh menggganggu isyarat untuk kamera dan bolehkah ia menunjukkan gambaran yang jelas dengan kamera *night vision* itu. Keputusan eksperimen ini akan dianalisa.

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LIST OF ABBREVIATIONS

LoG	Laplacian Of Gaussian
.BAS	Basic Language (file name extension)
.BMP	Bitmap Picture (file name extension)
.CAP	Capture (file name extension)
.DAT	Data (file name extension)
.DBF	Database (file name extension)
.ENC	Encoded (file name extension)
INT	Integer + Internal + Interrupt + International (organization Domain-name) [Internet]
JPEG	Joint Photographic Experts Group
.LBR	Library (file name extension)

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Nowadays CCTV with night vision camera is popular among the people because by using the camera they being able to capture the video of the intruders and hand it over to police in order to arrest the thief. Since CCTV is fixed as static is could not be used as mobilized device whereby to follow the path of the intruder goes. In current era, Unmanned Aerial Vehicle is being very popular because it can be fly high above and can get the aerial view of certain location regardless how dangerous the place it is. Mostly photographers are using this UAV to capture some images of volcano also. Since people are getting familiar to use the UAV, so by fixing a night vision camera it may capture the footage of the surrounding at night. This can be one of the ideologies where can be apply with some programming where the camera can detect and track the intruder. So that from the live streaming video, the person can follow the path where the intruder does goes and report to the authority.

1.2 PROBLEM STATEMENT

Nowadays there are a lot of theft are happening everywhere and it is very dangerous for a person to chase after the intruder because maybe the intruder might have a weapon and harm us. This scenario often happens at the swiftlet's bird nest farm, since the bird nest is expensive the intruder trying to steal it at night. Therefore, there isn't any other solution to track the intruder other than chasing to inform the authority about the location where the intruder went. CCTV is not much efficient because it is fixed as

static camera at corner of the house or building so if the intruder ran from the focus of the CCTV, then we could not capture any footage of the intruder.

1.3 OBJECTIVE

Basically, this project is listing two main objectives. The objectives are a guideline and goal in order to complete this project. This project is conducted to achieve the following:

i. To analyze the amount of ground light intensity needed and the distance of night vision camera which placed on UAV and intruder so that can detect and track.

ii. To investigate whether the UAV can detect the intruders with the following path it travels with a specific amount of ground light.

iii. To investigate does the UAV interrupts the signal, data transfer and clear image of intruder using the night vision camera.

1.4 SCOPE OF WORK

In this project, the wireless night vision camera is programmed by using the OpenCV, Cygwin Terminal, Ubuntu and also Roborealm software to capture the footage of intruder and track under specific amount of ground light intensity while flying with UAV at specific height.

1.5 OUTLINE OF THESIS

This thesis consists of five chapters. In first chapter, it discuss about the objective and scope of this project. While Chapter 2 will discuss about the theory and literature reviews that have been done. It well discuss about type of camera, some programming part that can be used to interface with the camera.

In Chapter 3, it will discuss more on the methodology hardware and software implementation of this project. The result and discussion will be presented in Chapter 4. Last but not least, Chapter 5 discusses the conclusion of this project and future work that can be done.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This part will explain the research information that is related to completing this project. All the research sources are from books, journals, some articles and website.

2.2 LITERATURE REVIEW

Allen Chiang, Jonathan Chu and Siwei Su [1] is the one invented the Intruder Detecting System where the project use LabVIEW with NI Vision to build an intruder detecting system algorithm to capture the presence of an intruder. This project is developed which only detect the intruder whereas the pets are not detected because the system is programmed to detect intruder has been detected. The images is then analyzed through frame comparison and convert to binary images that represent change, and then filtered through few image refining VI's, which will enhance the detection results.

Figure 2.1: Original image

Figure 2.2: Image after the subtraction of subsequent frames.

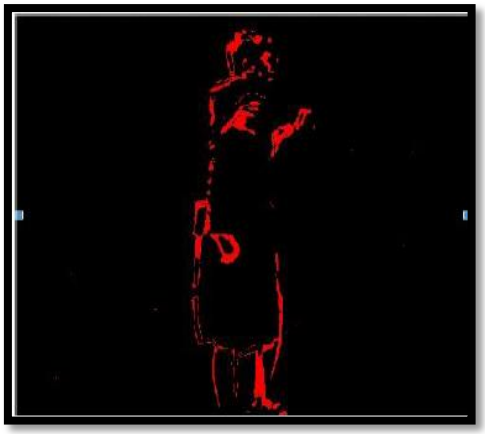


Figure 2.3: Converted into binary image

Figure 2.4: Image after filtering

Jun-Ting Wu, Jiann-Der Lee, Jong-ChihChien and Chung-Hung Hsieh [2] is the one created the nighttime vehicle detection at close range using vehicle lamps information is another project where using the algorithm to detect vehicle in the nighttime by the surrounding of vehicle lamp. The algorithm will calculate the intensity of diffuse lights, then uses the information to detect the location of vehicle lamp. This project also uses LoG operator and diffuse light intensity map for nighttime car light source sensing and detection.

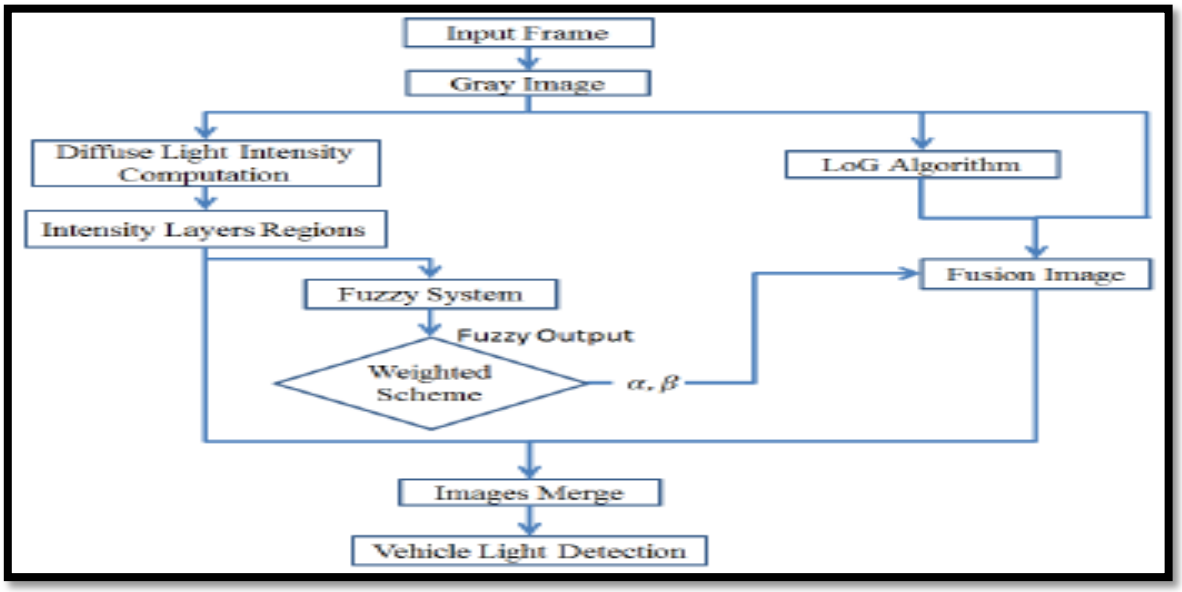


Figure 2.5: Flowchart of the nighttime car detection method

(a) Original image (b) LoG method (c) The propose method

Figure 2.6: Result of LoG method and the proposed method

Mi Ra Jeong, Jun-Yong Kwak, Jung Eun Son, ByoungChulKo, Jae-Yeal Nam [3] is the one produced the Fast pedestrian detection using a night vision system for safety driving is a project where fast pedestrian-detection algorithm for thermal images by using energy symmetry and oriented center-symmetric local binary pattern (OCS-LBP) features based on luminance saliency. Energy symmetry is based on luminance saliency which is used as the filter to remove the objects and to reduce the pedestrian classification time. The algorithm method is applied to various thermal images captured in vehicles, and its detection performance is good than that of other methods.

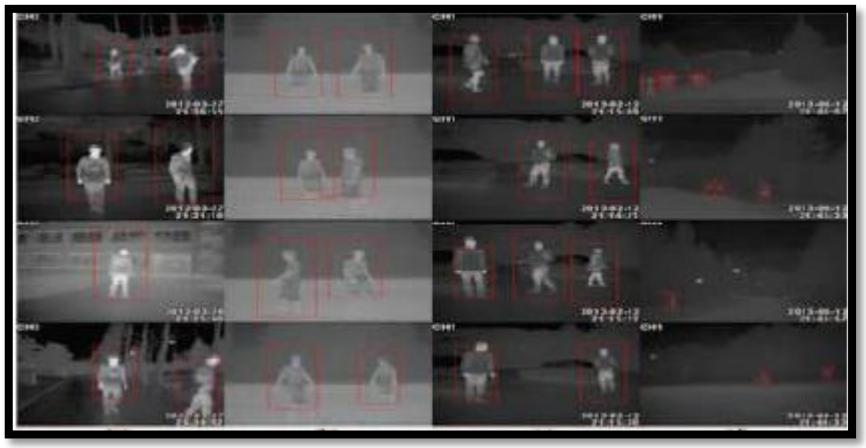


Figure 2.7: Sample of pedestrian detection

M. Kimura, R. Shibasaki, X. Shao, and M. Nagai[4] is the one invented the Automatic extraction of moving objects from UAV-borne monocular images using multi-view geometric constraints [4] is another project where the objective of it is to detect dynamic objects in the images captured by small UAV. Firstly, the epipolar constraint which requires static point to be on the corresponding epipolar lines in the subsequent image. Secondly, flow vector bound constraint where it restricts the motion of fixed points along the epipolar lines. The UAV-borne camera, requires when applying these constraints, its estimated by using vision-based SLAM method, PTAM.

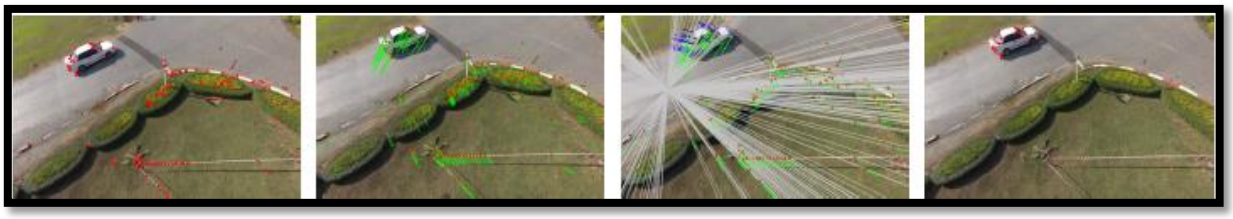


Figure 2.8: The Process of moving object detection and results images of each step

Alberto Pérez, Pablo Chamoso, Víctor Parra, Antonio Juan Sánchez[5] is the person created the Ground vehicle detection through aerial images taken by a UAV [5] is the final project would be included in this literature review. In this project conjunction of artificial vision and Unmanned Aerial Vehicles (UAV) has been emerged. This system is capable of detecting vehicles on ground through the aerial images which taken by the UAV in real time. Furthermore, this system provides the possibility to autonomously guide the UAV to keep in track of a vehicle that has been previously detected.

Figure 2.9: Screenshot of the developed software during a flight where the yellow car (in the frame) is the objective to track.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

In this project, OpenCV will be used as the medium to run the programming which we compiled in Ubuntu terminal where Ubuntu is a software which is similar to Windows known as Linux.

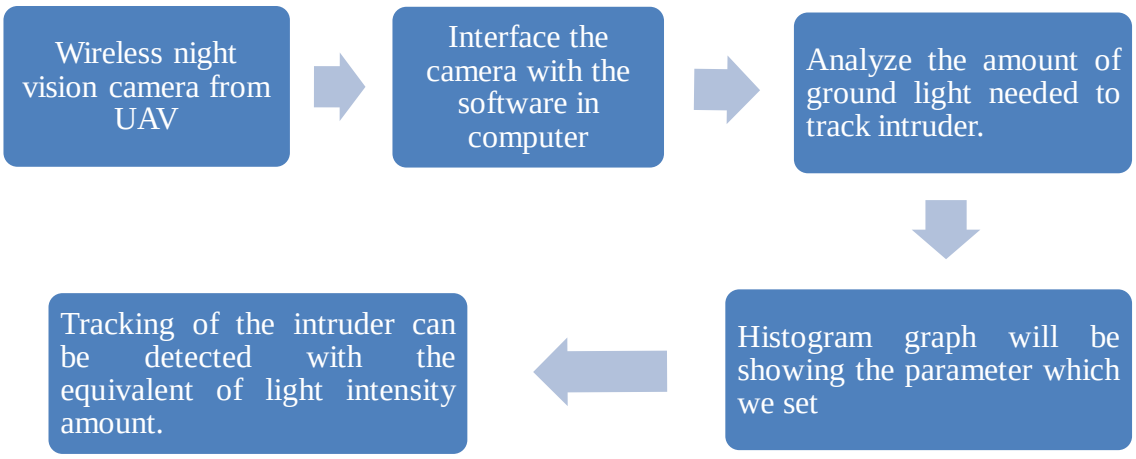


Figure 3.1: Block diagram of UAV with night vision camera for tracking intruder.

The image of the intruder can be seen from the video captured by the night vision camera which attach to the unmanned aerial vehicle (UAV). The main objective is to detect the present of the intruder at dark environment basically at night. The parameter for the detection is should be set which is known as the amount of ground light needed for the detection because when there is totally dark, the images captured are not

precise and clear, thus a small amount of ground light intensity are required in order to track the intruder.

3.2 FLOW CHART

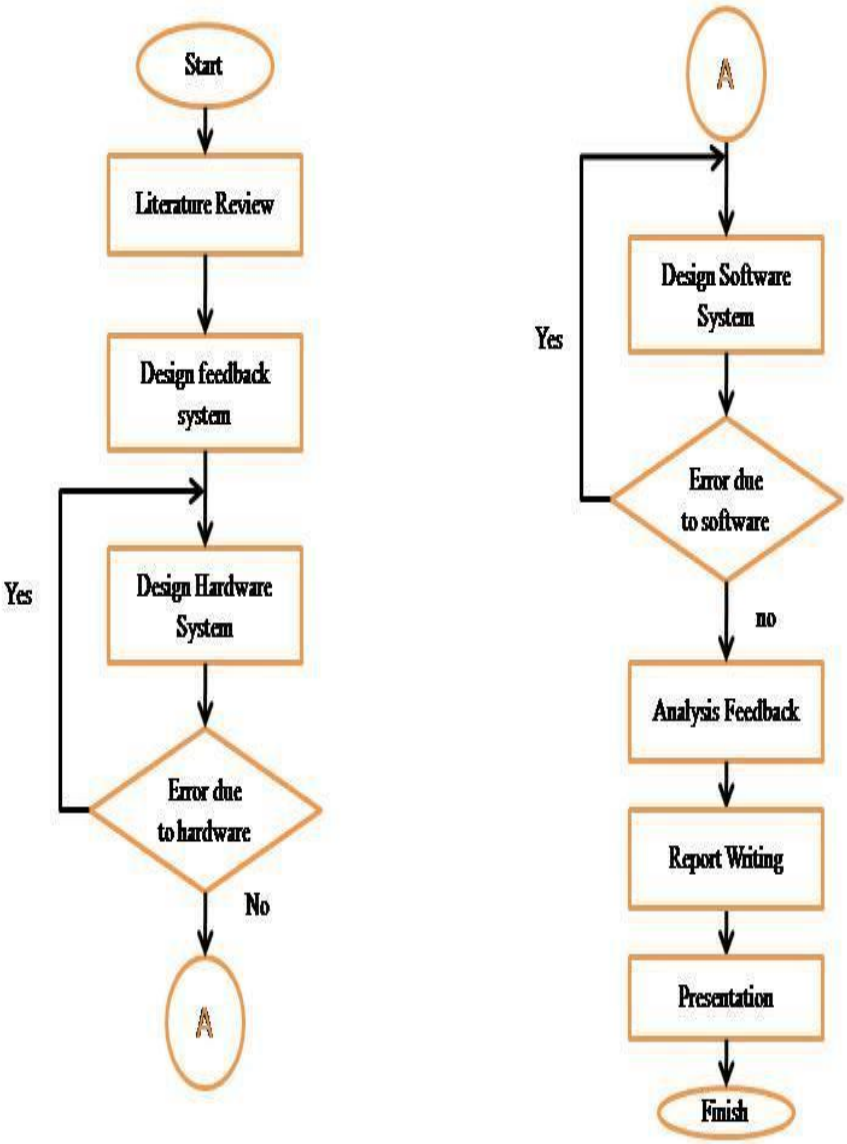
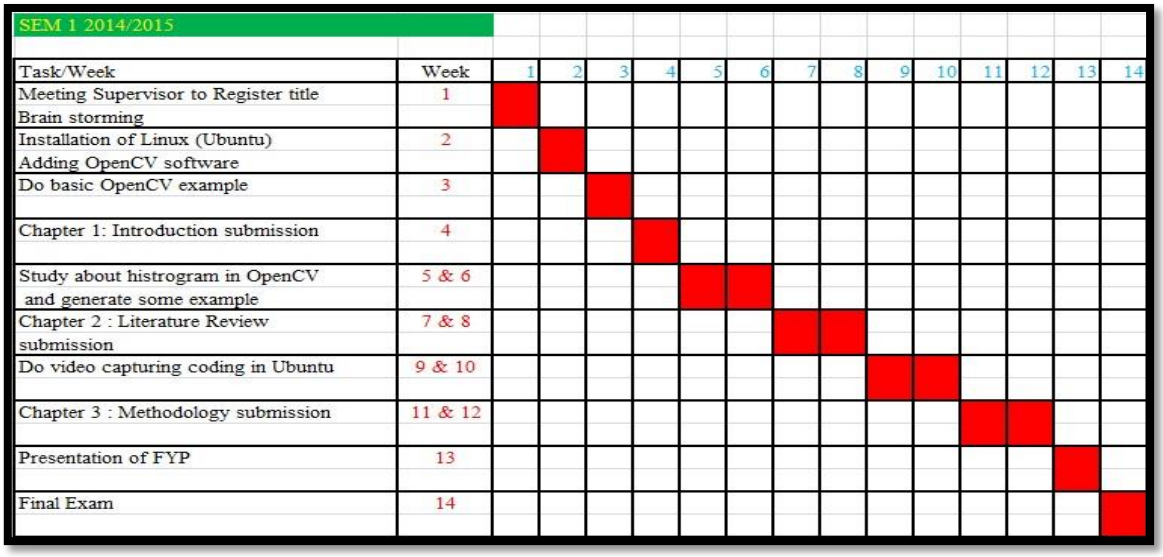


Figure 3.2: Flow chart

3.3 GANTT CHART

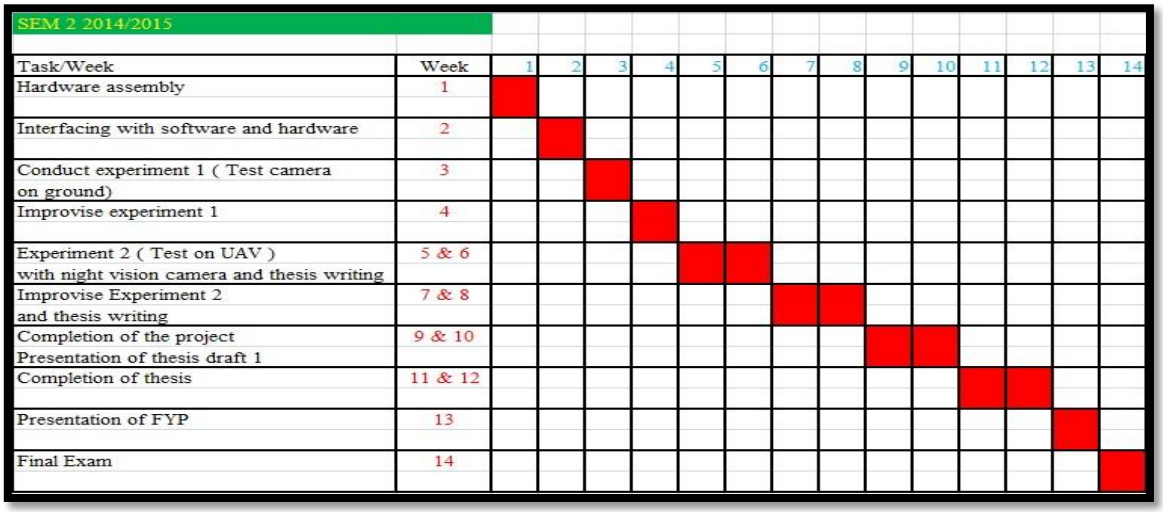
Semester 1

Table 3.1: Semester 1 Gantt chart



Semester 2

Table 3.2: Semester 2 Gantt chart



3.4 HARDWARE AND SOFTWARE IMPLEMENTATION

This section will discuss about components that had been used included Ubuntu Software, OpenCV software, wireless night vision camera, batteries and UAV.

3.4.1 Ubuntu Software

Figure 3.3: Ubuntu software

Linux was already known as an enterprise server platform in 2004, but there is no free software for most computer users. So, Mark Shuttleworth created a small team of developers from one of the most well-known Linux projects – Debian – and set to create an user friendly Linux desktop: Ubuntu. The vision of Ubuntu is part social and economic where free software are available for everybody in the same terms and finance through a portfolio of services provided by Canonical. Besides that, it is very secure because the build in Firefox web browser which we can surf safely and the data will stay protected due to the built-in firewall and virus protection. Furthermore, if there is a potential vulnerability appears, Ubuntu provide an automatic updates which we can install in a single click.

Moreover, Ubuntu is fast software where it can loadvery fast on any computer, but it's super-fast on latest computers. There isn't any unnecessary program or trial version of software will slow down our computer. We can boot up at any time and open the browser within a second. Besides that, it is very compatible because it works intelligently with a range of devices. Just plug in the MP3 player, printer or camera and it can run straightaway. No installation CDs is needed and Ubuntu support with Windows files too, so we can open, share and edit Microsoft Office documents without any stress.

3.4.2 OpenCV Software

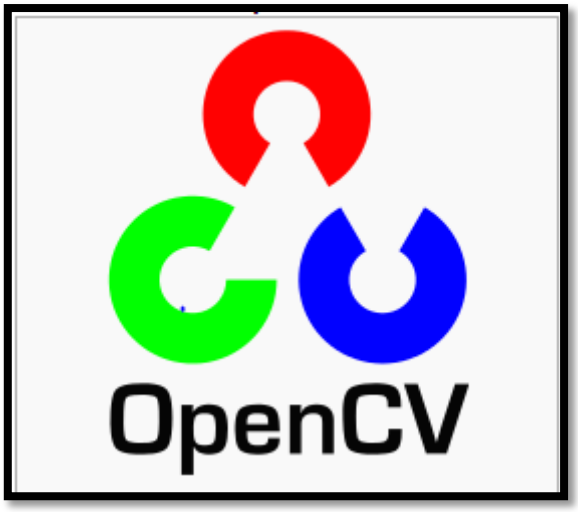


Figure 3.4: OpenCV software

OpenCV (Open Source Computer Vision Library) is an open source for computer vision and computers learning software library. OpenCV was created to give a common infrastructure for computer vision applications and to increase the speed of machine perception in the commercial products. OPenCV library has more than 2500 algorithms, which has a comprehensive set of both state-of-the-art computer vision and machine and classic learning algorithms. These algorithms can be utilized to recognize and detect faces, identify objects, track camera movements, classify human actions in videos, produce 3Dpoint clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, extract 3D models of objects, find similar images from an image database, follow eye movements, remove red eyes from images

taken using flash, recognize scenery and establish markers to overlay it with augmented reality, etc.

OpenCV's deployed uses span the limit from stitching street view images, detect intrusions in surveillance video in Israel, monitoring mining equipment at China, helping robots for navigating and pick up objects in Willow Garage, detecting of swimming pool drowning accidents at Europe, running interactive art at Spain and New York, checking runways for debris at Turkey, inspect labelling on products in factories around the world on to fast face detection in Japan. It has C++, C, Java, Python, and MATLAB interfaces and supports Windows, Android, Linux, and Mac OS. OpenCV focuses mostly towards real-time vision applications besides that take advantage onSSE instructions and MMX when it is available. A full-featured OpenCL andCUDAinterfaces are being developed now. There are over 500 algorithms and almost 10 times as many functions that generated or support those algorithms. OpenCV is originally written in C++ and has a template interface that works seamlessly with STL containers.

3.4.3 Night Vision Camera

Figure 3.5: Camera and receiver

Night vision is the ability to see thingsin low light conditions. Either by biological or using technology, night vision has made possible by a combination of two techniques. Firstly, sufficient spectral range and followed by sufficient intensity range. Human beings have poor night vision compared to animals because the human eye lacks a tapetumlucidum. When comes to the spectrum range, night-useful spectral range techniques can detect radiation that is invisible to a human vision. Human's eye vision is confined to a small part of the electromagnetic spectrumcalled visiblelight.It is enhanced with spectral range that allows the viewer to take advantage of non-visible sources of electromagnetic radiation.

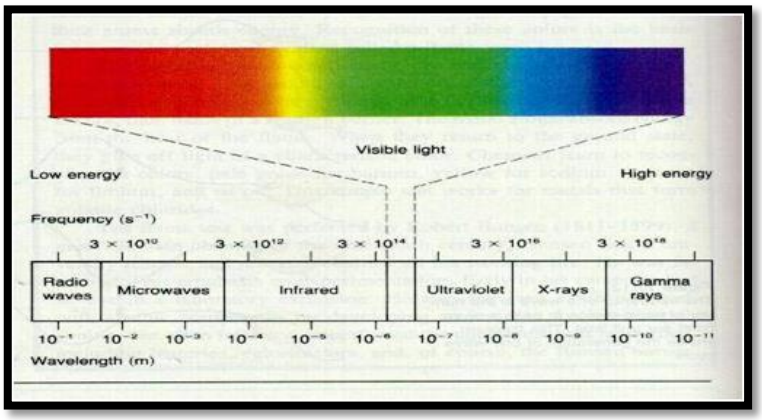


Figure 3.6: Spectrum of light

Infrared night-vision combined with infrared illumination of spectral range between 700 to 1,000 nm (it is just below the visible spectrum of the human eye vision) with CCD cameras sensitive to this light. Active infrared night-vision systems can't cooperate with the illuminators that produce high levels of infrared light, these resulting images that are typically high resolution than other night-vision technologies. Besides that, lately active infrared night vision is commonly found in factories, housing area and government security applications, where it creates effective night time imaging under low-light conditions. There are few features need to be considered when we need to purchase the night vision camera because night vision video camera has infrared vision where the distance of the infrared vision extends for which means allowing the camera to capture images.