A

Seminar Report

on

NIGHT VISION TECHNOLOGY

Submitted in Partial Fulfillment of the Requirements for the Degree of

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in

Computer Engineering

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Submitted by

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GOVERNMENT COLLEGE OF ENGINEERING , JALGAON - 425 001 (MS) **DEPARTMENT OF COMPUTER ENGINEERING**

CERTIFICATE

This is to certify that the seminar entitled ***NIGHT VISION TECHNOLOGY***, submitted by **Pratik Astak Koparkar** in partial fulfillment of the degree of *Bachelor of Engineering* in *Computer Engineer ing* has been satisfactorily carried out under my guidance as per the requirement of Government College Of Engineering , Jalgaon.

(Prof. D.V.Chaudhari)

HoD of Department in Computer Department

(Prof. G M Malwatkar)

Principal

Examinar

DECLARATION

I hereby declare that the Seminar entitled, “NIGTH VISION TECHNOLOGY ” was carried out and written by me under the guidance of Mr. D. V. Chaudhari, Department of Computer Engineering. This work has not been previously formed the basis for the award of any degree or diploma or certificate nor has been submitted elsewhere for the award of any degree or diploma.

Place: Jalgaon

Date : PRATIK ASTAK KOPARKAR

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ABSTRACT

This paper describes the various Night vision techniques. "Night Vision" is referenced as technology that provides us with the miracle of vision in total darkness and the improvement of vision in low light environments. This technology is an amalgam of several different methods each having its own advantages and disadvantages.

The most common methods described here are Low-Light Imaging, Thermal Imaging and Illumination.This paper also give brief idea about various night vision device (NVD) that allows images to be produced in levels of light approaching total darkness, it also explains various applications where night vision technology is used to solve various problems due to low light conditions.Whether by biological or technological means, night vision is made possible by a combination of two approaches: sufficient spectral range, and sufficient intensity range. Humans have poor night vision compared to many animals, in part because the human eye lacks a tapetum lucidum.

A night vision device (NVD) is an optical instrument that allows images to be produced it levels of light approaching total darkness. They are most often used by the military and law enforcement agencies, but are available to civilian users. The term usually refers to a complete unit, including an image intensifier tube, a protective and generally water-resistant housing, and some type of mounting system. Many NVDs also include sacrificial lenses, IR illuminators, and telescopic lenses. Night vision devices were first used in World War II, and came into wide use during the Vietnam War. The technology has evolved greatly since their introduction, leading to several "generations" of night vision equipment with performance increasing and price decreasing.

Table of Contents

1.INTRODUCTION

Night vision technology, by definition, literally allows one to see in the dark. Originally developed for military use, it has provided the United States with a strategic military advantage, the value of which can be measured in lives. Federal and state agencies now routinely utilize the technology for site security, surveillance as well as search and rescue. Night vision equipment has evolved from bulky optical instruments in lightweight goggles through the advancement of image intensification technology.

The first thing you probably think of when you see the words night vision is a spy or action movie you've seen, in which someone straps on a pair of night-vision goggles to find someone else in a dark building on a moonless night. And you may have wondered "Do those things really work? Can you actually see in the dark?" The answer is most definitely yes. With the proper night-vision equipment, you can see a person standing over 200 yards (183 m) away on a moonless, cloudy night! Night vision can work in two very different ways, depending on the technology used.

1.1 Image enhancement

This works by collecting the tiny amounts of light,including the lower portion of the infrared light spectrum, that are present but may be imperceptible to our eyes, and amplifying it to

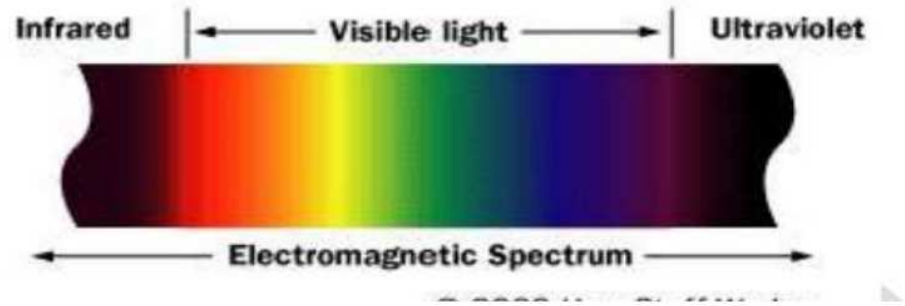
the point that we can easily observe the image.

1.2 Thermal imaging

This technology operates by capturing the upper portion of the infrared light spectrum, which is emitted as heat by objects instead of simply reflected as light. Hotter objects, such as warm bodies, emit more of this light than cooler objects like trees or buildings**.**

2. THEORY

In order to understand night vision, it is important to understand something about light. The amount of energy in a light wave is related to its wavelength: Shorter wavelengths have higher energy. Of visible light, violet has the most energy, and red has the least. Just next to the visible light spectrum is the infrared spectrum.

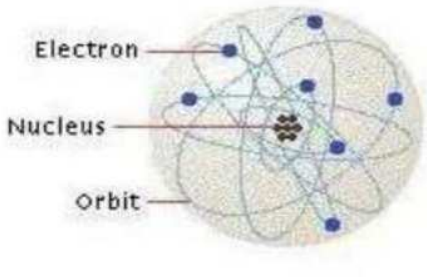


Infrared light can be split into three categories:

- Near-infrared(near-IR) - Closest to visible light, near-IR has wavelengths that from 0.7 to 1.3 microns, or 700 billionths to 1,300 billionths of a meter.
- Mid-infrared (mid-IR) - Mid-IR has wavelengths ranging from 1.3 to 3 microns. Both near-IR and mid-IR are used by a variety of electronic devices, including remot controls.
- Thermal-infrared (thermal-IR) - Occupying the largest part of the infrared spectrum, thermal-IR has wavelengths ranging from 3 microns to over microns.The key difference between thermal-IR and the other two is that thermal-IR is emitted by an object instead reflected off it. Infrared light is emitted by an object because of what's happening at the atomic level.

Atoms are constantly in motion. They continuously vibrate, move and rotate. Even the atoms that make up the chairs that we sit in are moving around. Solids are actually in motion!Atoms can be in different states of excitation. In other words, they can have different energies. If we apply a lot of energy to an atom, it can leave what is called the ground State energy level and move to an excited level. The level of excitation depends on the amount of energy applied to the atom via heat, light or electricity.

Atoms



Atoms are constantly in motion. They continuously vibrate, move and rotate. Even the atoms that make up the chairs that we sit in are moving around. Solids are actually in motion! Atoms can be in different states of excitation. In other words, they can have different energies.

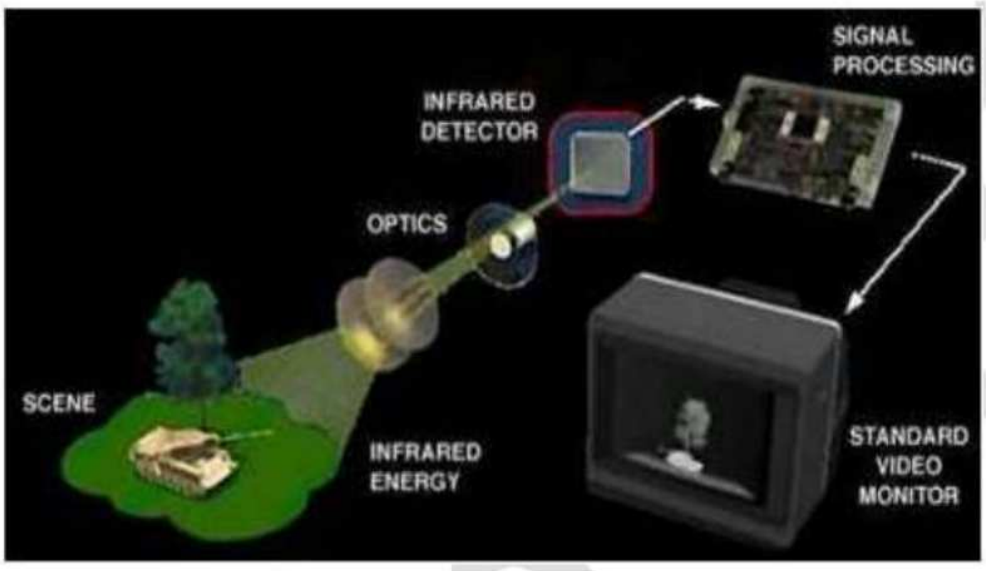
If we apply a lot of energy to an atom, it can leave what is called the ground-state energy level and move to an excited level . The level of excitation depends on the amount of energy applied to the atom via heat, light or electricity.An atom consists of a nucleus (containing the protons and neutrons) and an electron cloud .

Think of the electrons in this cloud as circling the nucleus in many different orbits. Although more modern views of the atom do not depict discrete orbits for the electrons, it can be useful to think of these orbits as the different energy levels of the atom. In other words, if we apply some heat to an atom, we might expect that some of the electrons in the lower energy orbitals would transition to higher energy orbitals, moving farther from the nucleus.

3.THERMAL IMAGING

3.1 Here's how thermal imaging works:

- A special lens focuses the infrared light emitted by all of the objects in view.
- The focused light is scanned by a phased array of infrared-detector elements.
- The detector elements create a very detailed temperature pattern called a thermogram.
- It only takes about one-thirtieth of a second for the detector array to obtain the temperature information to make the thermogram.
- This information is obtained from several thousand points in the field of view of the detector array.The thermogram created by the detector elements is translated into electric impulses.
- The impulses are sent to a signal-processing unit, a circuit board with a dedicated chip that translates the information from the elements into data for the display.
- The combination of all the impulses from all of the elements creates the image, and the signal-processing unit sends the information to the display, where it appears as various colors depending on the intensity of the infrared emission.



Basic components of thermal-image system

3.2 There are two common types of thermal- imaging devices:

- **Un-cooled**- This is the most common type of thermal-imaging device. The infrared-detector elements are contained in a unit that operates at room temperature. This type of system is completely quiet, activates immediately and has the battery built right in.

- **Cryogenically cooled-** More expensive and more susceptible to damage from rugged use, these systems have the elements sealed inside a container that cools them to below 32 F (zero C). The advantage of such a system is the incredible resolution and sensitivity that result from cooling the elements. Cryogenically-cooled systems can "see" a difference as small as 0.2 F (0.1 C) from more than 1,000 ft (300 m) away, which is enough to tell if a person is holding a gun at that distance!

4. IMAGE ENHANCEMENT

Image-enhancement technology is what most people think of when you talk about night vision. In fact, image-enhancement systems are normally called night-vision devices (NVDs).NVDs rely on a special tube, called an image-intensifier tube, to collect and amplify infrared and visible light.

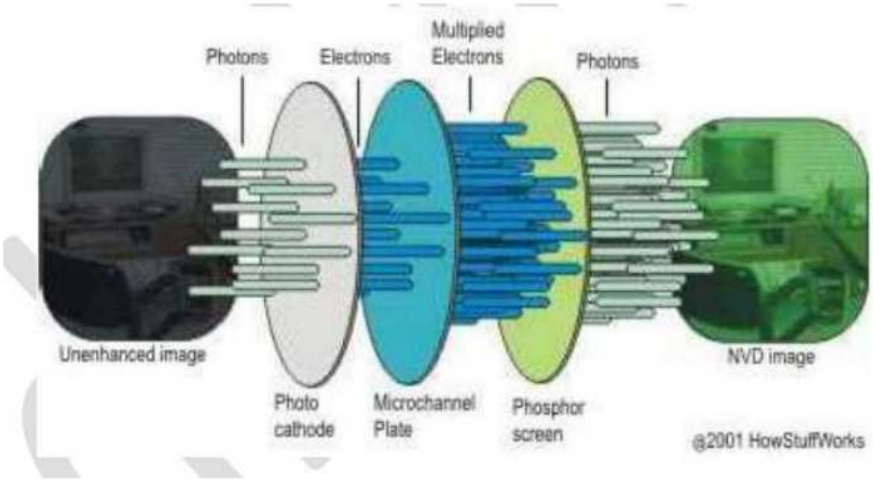


Image Intensifier tube

Here's how image enhancement works:

- A conventional lens, called the objective lens, captures ambient light and some near-infrared light.
- The gathered light is sent to the image-intensifier tube. In most NVDs, the power supply for the image-intensifier tube receives power from two N-Cell or two "AA" batteries. The tube outputs a high voltage, about 5,000 volts, to the image-tube components.
- The image-intensifier tube has a photocathode, which is used to convert the photons of light energy into electrons.
- As the electrons pass through the tube, similar electrons are released from atoms in the tube, multiplying the original number of electrons by a factor of thousands through the use of a micro channel plate (MCP) in the tube. An MCP is a tiny glass disc that has millions of microscopic holes (micro channels) in it, madeusing fiber-optic technology. The MCP is contained in a vacuum and has metal electrodes on either side of the disc. Each channel is about 45 times longer than it is wide and it works as an electron multiplier.

5.GENERATION

5.1 Generation 0

The earliest (1950's) night vision products were based on image conversion,rather than intensification. They required a source of invisible infrared (IR) light mounted on or near the device to illuminate the target area.

5.2 Generation 1

The "starlight scopes" of the 1960's (Vietnam Era) have three image intensifies tubes connected in a series. These systems are larger and heavier than Gen 2 and Gen 3. The Gen 1 image is clear at the centre but may be distorted around the edges. (Low- cost Gen 1 imports are often mislabeled as a higher generation.

5.3 Generation 2

The micro channel plate (MCP) electron multiplier prompted Gen 2 development in the 1970s. The "gain" provided by the MCP eliminated the need for back- to-back tubes - thereby improving size and image quality. The MCP enabled development of hand held and helmet mounted goggles.Second-generation image intensification significantly increased gain and resolution by employing a micro channel plate.

5.4 Generation 3

Two major advancements characterized development of Gen 3 in the late 1970s and early 1980s: the gallium arsenide (GaAs) photocathode and the ion-barrier film on the MCP. The GaAs photocathode enabled detection of objects at greater distances under much darker conditions. The ion-barrier film increased the operational life of the tube from 2000 hours (Gen 2) to 10,000 (Gen 3), as demonstrated by actual testing and not extrapolation.

5.5 Generation 4

It was developed in early 2000's and also known as "filmless and gated" technology .Some of its characteristics are as:-

- It shows significant improvement in both high-and low-level light environments.
- No ion barriers are present there in MCP so it is convenient to produce multiple numbers of electrons.
- Responds quickly to different lightning conditions present in the surrounding view in the area.
- Background noise are reduced up to a greater extent because of the absence of the ion barrier.
- Enhances signal to noise ratio and as signal to noise ratio is directly proportional to the resolution of the NVD's so resolution gets increased.
- Images are less distorted and brighter due to the better SNR and greater reduction in noise.

6. CHARACTERISTICS OF NIGHT VISION

- **Textures, Light and Dark**

Objects that appear light during the day but have a dull surface may appear darker, through the night vision unit, than objects that are dark during the day but have a highly reflective surface. For example, a shiny dark coloured jacket may appear brighter than a light colored jacket with a dull surface.

- **Depth Perception**

Night vision does not present normal depth perception.

- **Fog and Rain**

Night vision is very responsive to reflective ambient light; therefore, the light reflecting off of fog or heavy rain causes much more light to go toward the night vision unit and may degrade its performance.

- **Honeycomb:-**

This is a faint hexagonal pattern which is the result of the manufacturing process.

- **Black Spots:-**

A few black spots throughout the image area are also inherent characteristics of all night vision technology. These spots will remain constant and should not increase in size or number. See example below of an image with black spots.

7.EQUIPMENT

Night-vision equipment can be split into three broad categories:

- **Scopes** - Normally handheld or mounted on a weapon, scopes are monocular (one eye-piece). Since scopes are handheld, not worn like goggles, they are good for when you want to get a better look at a specific object and then return to normal viewing conditions.

- **Goggles** - While goggles can be handheld, they are most often worn on the head. Goggles are binocular (two eye-pieces) and may have a single lens or stereo lens, depending on the model. Goggles are excellent for constant viewing, such as moving around in a dark building.

- **Cameras** - Cameras with night-vision technology can send the image to a monitor for display or to a VCR for recording. When night-vision capability is desired in a permanent location, such as on a building or as part of the equipment in a helicopter, cameras are used. Many of the newer camcorders have night vision built right in.

8. APPLICATION

Military:- In the military it is used to keep eyes on unwanted activities and unwanted things at the border or at a specific area.

Law enforcement:- It is used by the government officers to look after the details of a place at night where we are unable to see at night.

Hunting:- In forests it is very difficult to see the things at dark night so by using this device one can identify the object in dark night also.

Wildlife observation:- For taking care of the wildlife animals and to keep observation on illegal activities in wildlife this is used.

Surveillance:-In this night vision cameras are mounted around a factory or house to get aware from the surroundings at dark night also.

Navigation :-Used to show the way and also to show the obstacles in path. This is mainly observed in automobiles and ships.

Hidden-object detection:-By using thermal imaging process it is possible to detect the things buried under earth surface.

9. BIOLOGICAL NIGHT VISION

In biological night vision, molecules of rhodopsin in the rods of the eye undergo a change in shape as light is absorbed by them.

The peak rhodopsin build-up time for optimal night vision in humans is 30 minutes, but most of the adaptation occurs within the first five or ten minutes in the dark. Rhodopsin in the human rods is insensitive to the longer red wavelengths of light, so many people use red light to preserve night vision as it will not deplete the eye's rhodopsin stores in the rods and instead is viewed by the cones.

Some animals, such as cats, dogs, and deer, have a structure called tapetum lucidum in the back of the eye that reflects light back towards the retina, increasing the amount of light it captures.

In humans, only 10% of the light that enters the eye falls on photosensitive parts of the retina.

Their ability to see in low light levels may be similar to what humans see when using first or perhaps second generation image intensifiers.

10. ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGE

- An increase in nighttime situational awareness for pilots as this helps them to see the things clearly at a distance and reduce the risk of accidents.

- This would markedly decrease the possibility of collisions with terrain or man-made Obstructions.

- It does permit the user to see objects that normally would not be seen by the unaided eye. Improved vision conditions of dusk and darkness helps to see in the severe condition which naked eye can't see.

- Highlighting of illuminated, heat-emitting objects as pedestrians, cyclists, deer, Etc.

10.2. DISADVANTAGES

- **Lack of color discrimination** :-As most of the cases the output image is green so there is no color discrimination is there in the image obtained in the display.

- **Neck strain and fatigue** :- Night vision goggles are mounted on the helmet which one have to wear on head. So there is a chance of neck strain and fatigue.

- **High initial cost to purchase** :- As high resolution cameras are used so initial cost for installing this device is high.

- **Need for recurrent training** :- Before using these devices one have to properly get training about the use of these devices so that they can use those devices more efficiently.

- **Decreased field of aided view** :- This technique is used to cover a specific area only so extra field of view cannot be added.

12.CONCLUSION

Through a night vision device we can see the object in a dark environment. We have seen four generation of this device and seen different ranges. Initially this device was used by the military but now it is also available for civilians. The innovation and implementation of the night vision system has a great impact on automotive usage such as saving many lives from death and reducing accidents at night. In the NIGHT VISION SYSTEM of automobiles which gave us the knowledge about the whole system. By the study of the system we got familiarized with the technology used in the BMW NIGHT VISION SYSTEM. Also understood how to utilize the BMW NIGHT VISION feature. Finally, we came to know the benefits of having this technology in the vehicle which can be used to avoid accidents. On the basis of that we conclude that automatic pedestrian warning, in the form of highlighting the pedestrians on the night vision display, is generally helpful in increasing detection distance and accuracy.In this we have described various night vision technologies which are available and also its working in order to avoid various low light problem, this shows that how efficiently a soldiers can work efficiently during night also wildlife observer can work during dark and also shown how surveillance can be kept in low light condition this summarize a various generations of night vision technology.

13. REFERENCES

1. www. night vision.com
2. http://www.nightvision.com/military/militaryhome.html
3. http://www.atncorp.com/HowNightVisionWorks
4. Www.Wikipedia.Org
5. Studymafia.org
6. Morovision.Com/How_thermal_imaging_works.Htm
7. En.Wikipedia.Org/Wiki/Night_vision