***NIGHT VISION TECHNOLOGY***

A SEMINAR REPORT

Submitted by:

**Pratik Solanke**

IBSS COLLEGE OF ENGG

***ABSTRACT***

A night vision device (NVD) is an optical installment that allows images to be produced in 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. NVDs are mounted appropriately for their specific purpose, with more general- purpose devices having more mounting options. For instance, the AN/PVS-14 is a monocular night vision device in use with the US military as well as by civilians. It may be mounted on the user's head for hands free use with a harness or helmet attachment, either as a monocular device, or in aligned pairs for binocular "night vision goggles" which provide a degree of depth perception as do optical binoculars. The AN/PVS-14 may also be attached to a rifle using a Pica tinny rail, in front of an existing telescopic or red dot sight, or attached to a single-lens reflex camera. Other systems, such as the AN/PVS-22 or Universal Night Sight, are designed for a specific purpose, integrating an image intensifier into, for example, a telescopic sight, resulting in a smaller and lighter but less versatile system.

TABLE OF CONTENTS

ABSTRACT

1. INTRODUCTION

 1.1 ABOUT NIGHT VISION

 2. NIGHT VISION APPROACHES

 2.1 SPECTRAL RANGE 2

 2.2 INTENSITY RANGE 2

3. NIGHT VISION DEVICE

3.1 DEFINITION 3

3.2 EXAMPLES 4

3.3 WORKING

3.3.1 IMAGE INTENSIFY

3.3.2 THERMALE

4. GENERATIONS

4.1 GENERATION 0

4.2 GENERATION 1

4.3 GENERATION 2

4.4 GENERATIONS

4.4 OMNIBUS-VII

4.5 OTHER TECHNOLOGY

4.6 GEN 4 OVER GEN 3

5. RANGE OF DIFFERENT GENERATION

6. NEW NIGHT VISION PRODUCT

7. HIGH PERFORMANCE NIGHT

8. VISION DEVICE

9. HUNTING WITH NIGHT VISION

10. DEVICE

11. USAGE

12. CONCLUSION

13. REFERENCE

**Night Vision Technology**

INTRODUCTION

1.1 ABOUT NIGHT VISION

Night vision is the ability to see in a dark environment. 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 does not have a tapetum lucidum. The tapetum lucidum (Latin: "bright tapestry", plural tapeta lucida) is a layer of tissue in the eye of many vertebrate animals, that lies immediately behind or sometimes within the retina. It reflects visible light back through the retina, increasing the light available to the photoreceptors. This improves vision in low-light conditions, but can cause the perceived image to be blurry from the interference of the reflected light. The tapetum lucidum contributes to the superior night vision of some animals. Many of these animals are nocturnal especially carnivores that hunt at night, and their prey. Others are deep sea animals. Although some primates have a tapetum lucidum, humans do not. Division of Computer Engineering.

**NIGHT VISION APPROACHES**

2.1 SPECTRAL RANGE

Night-useful spectral range techniques make the viewer sensitive to types of light that would be invisible to a human observer. Human vision is confined to a small portion of the electromagnetic spectrum called visible light. Enhanced spectral range allows the viewer to take advantage of non-visible sources of electromagnetic radiation (such as near-infrared or ultraviolet radiation). Some animals can see well into the infrared and/or ultraviolet compared to humans, enough to help them see in conditions humans cannot.

2.2 INTENSITY RANGE

Sufficient intensity range is simply the ability to see with very small quantities of light. Although the human visual system can, in theory, detect single photons under ideal conditions, the neurological noise filters limit sensitivity to a few tens of photons, even in ideal conditions. Many animals have better night vision than humans do, the result of one or more differences in the morphology and anatomy of their eyes. These include having a larger eyeball, a larger lens, a larger optical aperture (the pupils may expand to the physical limit of the eyelids), more rods than cones (or rods exclusively) in the retina, a tapetum lucidum, and improved neurological filtering. Enhanced intensity range is achieved via technological means through the use of an image intensifier gain multiplication CCD, or other very low-noise and high-sensitivity array of photo detectors.

**NIGHT VISION DEVICE**

3.1 DEFINITION

A night vision device (NVD) is an optical instalment that allows images to be produced in 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. NVDs are mounted appropriately for their specific purpose, with more general-purpose devices having more mounting options. For instance, the AN/PVS-14 is a monocular night vision device in use with the US military as well as by civilians. It may be mounted on the user's head for hands free use with a harness or helmet attachment, either as a monocular device, or in aligned pairs for binocular "night vision goggles" which provide a degree of depth perception as do optical binoculars. The AN/PVS-14 may also be attached to a rifle using a Picatinny rail, in front of an existing telescopic or red dot sight, or attached to a single-lens reflex camera. Other systems, such as the AN/PVS-22 or Universal Night Sight, are designed for a specific purpose, integrating an image intensifier into, for example, a telescopic sight, resulting in a smaller and lighter but less versatile system.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. Division of Computer Engineering.

3.2 Some examples:

Night Vision Goggle

Division of Computer Engineering

Binocular

Simple Binocular

3.3 **Working of night vision device** :

Night Vision technology consists of two major types: image intensification (light amplification) and thermal imaging (infrared).

3.3.1 Image Intensification (light amplification) :

Most consumer night vision products are light amplifying devices. Light amplification is less expensive than thermal, however, higher-end and more effective night vision tubes can become more expensive. Light amplification technology takes the small amount of light, such as moonlight or starlight, that is in the surrounding area, and converts the light energy (scientists call it photons), into electrical energy (electrons). These electrons pass through a thin disk that's about the size of a quarter and contains over 10 million channels. As the electrons travel through and strike the walls of the channels, thousands more electrons are released. These multiplied electrons then bounce off of a phosphor screen which converts the electrons back into photons and lets you see an impressive nighttime view even when it's really dark. All image intensified night vision products on the market today have one thing in common: they produce a green output image. Like the one your see to your right . But that's where the similarities end.

ELECTRONS PHOTONS

3.3.2 Thermal Imaging :

In order to understand thermal imaging, 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

Ultraviolet

Spectrum of light

Infrared light can be split into three categories:

1. Near-infrared (near-IR) - Closest to visible light, near-IR has wavelengths that range from 0.7 to 1.3 microns, or 700 billionths to 1,300 billionths of a meter.

2. Mid-infrared (mid-IR) - Mid-IR has wavelengths ranging firÃƒÂ§ Both near-IR and mid-IR are used by a variety of eh remote controls.

 3. Thermal-infrared (thermal-IR) - Occupying spectrum, thermal-IR has wavelengths rangi microns.

The key difference between thermal-IR and the other two is that thermal-IR is emitted by an object instead of reflected off it. Infrared light is emitted by an object because of what is happening at the atomic level. 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 signal-processing unit sends the information to the display, where it appears as various colors depending on the intensity of the infrared emission. The combination of all the impulses from all of the elements creates the image. 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 coolÃƒÂ¡ (zero C). The advantage of such a system is the incredible res^Hro^ÃƒÂ¼ÃƒÂ±^ result from cooling the elements. Cryogenically-cooled sys^K<6aSr''see" a difference as'jr,^ small as 0.2 F (0.1 C) from more than 1,000 ft (300 m)^ft^iÃƒâ€“Ef\*Wgh\*qÃƒÃƒâ€žfeÃƒÅ¸ Ãƒâ€¡? person is holding a gun at that distance.. ,^M ^ ..\_\_.â€ .,-...

VERSION

ADDS NO

WATERMARK Si

***GENERATIONS***

4.1 Generation 0

The first night vision devices, the Ml and M3 infrared night sighting devices, also known as the "sniperscope" or "snooperscope", were introduced by the US Army in World War II, and also used in the Korean War, to assist snipers. They were active devices, using a large infrared light source to illuminate targets. Their image intensifier tubes function using an anode and an S-l photocathode made primarily of silver, cesium, and oxygen to accelerate the electrons. Parallel development of night vision systems by AEG occurred in Nazi Germany, and by the end of World War II, it had equipped approximately 50 Panther tanks, which saw combat on both the Eastern and Western Fronts, and produced the "Vampire" man-portable system for infantry soldiers equipped with Sturmgewehr 44 assault rifles.

4.2 Generation 1 (GEN I]

First generation passive devices, introduced during the Vietnam War were an adaptation of earlier active Gen 0 technology, and rely on ambient light instead of an infrared light source. Using an S-20 photocathode, their image intensifiers produce a lighamplification of around lOOOx, but are quite bulky and require moonlight to function properly.

Examples:

Â¢ AN/PVS-2

4.3 Generation 2 (GEN II]

Second generation devices featured an improved ima, channel plate (MCP) with an S-25 photocathode, res especially around edges of the lens. This leads to incr light environments, such as moonless nights. Lightl Also improved were image resolution and reliability.

4.3 Generation 3 (GEN III]

Third generation night vision systems maintain the MCP from Gen II, but now use a photocathode made with gallium arsenide, which further improves image resolution. In addition, the MCP is coated with an ion barrier film for increased tube life. The light amplification is also improved, to around 30000-50000x

Examples:

AN/PVS-7

NVS-7

AN/PVS-14

NVS-14

XD-4, auto gated or not

4.4 Omnibus-VII

The US Army Night Vision and Electronic Sensors Directorate (NVESD) (http://www.nvl.army.mil/) is part of the governing body that dictates the name of the generation of night vision technologies. Although the recent inÃƒÂ§ associated with the GEN-III OMNI-VII components is imp rest yet authorized the use of the name GEN-IV for these comp GEN-III OMNI-VII devices can differ from standard ways. First, an automatic gated power supply system allowing the NVD to instantaneously adapt to changing removed or greatly thinned ion barrier, which decreases usually rejected by the Standard GEN III MCP, hence resulting in less image noise and the ability to operate with a luminous sensitivity at 2850K of only 700, compared to operating with a luminous sensitivity of at least 1800 for GEN III type image intensifiers. The disadvantage to a thin or removed ion barrier is the overall decrease in tube life from a theoretical 20,000 hrs mean time to failure (MTTF) for Gen III type, to 15,000 hrs MTTF for GEN IV type. However, this is largely negated by the low numbers of image intensifier tubes that reach 15,000 hrs of operation before replacement. It is important to note that while the consumer market classifies this type of system as "Generation 4", the United States military describes these systems as Generation 3 Auto gated tubes (GEN-III OMNI-VII). Moreover, as auto gating power supplies can now be added to any previous generation of night vision, 'autogating' capability does not automatically class the devices as a GEN-III OMNI-VII, as seen with the XD-4. Another point to note is that any postnominals appearing after a Generation type (ie: Gen II +, Gen in +) does not change the generation type of the device, but instead indicates a supposed advancement(s) over the original specification's requirements. Examples:

AN/PVS-22

NVS-22

XR-5 Autogated

4.5 Other technologies

Panoramic Night Vision Goggles in testing

The US Air Force is experimenting with Panoramic Night Vision Goggles (PNVGs) which double the user's field of view to around 95 degrees by using four 16 mm image intensifiers tubes, rather than the more standard two 18 mm tubes. They are in service with A-10,MC-130 Combat Talon and AC-130U Spooky aircrews. In 2007 Xenonics Holdings, using newly patented technology, offered the first digital night seeing system, a hand held monocule device with 2-8X zoom capability branded Supervision. The PSQ-20, manufactured by ITT seeks to combine thermal imaging with image intensification, as does the Northrop Grumman Fused Multispectral Weapon Sight. 4.6 Gen 4 over Gen 3 Gen 4 technology improves night operational effectiveneSgifÃƒÂ³sQrcmtary users of night iZr^ '^te^mtÃƒÂ¼ktjon ) & vision goggles and other night vision devices. The signal-to-noise ratio than Gen 3, resulting in bett^ffla"g^ quality under low-light conditions. The gated power supply fixier improves image resolution under high light conditions, and the reduced halo Ã‚Â«agnizes inter^OTcferrorn\*mrgtit light sources. These improvements also substantially increase the detection range of the systems.

Gen 3

Omni TV

Gen 4

%

Improvement

Photoresponse (A(iA/Im)

1800

1800

-

Signal-to-Noise Ratio

21.0

25.0(ground)

20% Higher

26.0(air)

24% Higher

Resolution(lp/mm)

64

64

-

Halo (mm)

1.25

0.75

40% smaller

Reliability(hours)

10,000

10,000

-

RANGE IMPROVEMENT

Relative direction ranges

PVS-7 System

Overcast Starlight Conditions (-lxl0E-5 tc)

Vehicle Size Target, 30% Contrast

DIFFERENT DETECTION RANGE

Gen 2

Gen 3 Gen 3 Gen 3

SuperGen 2 OMNI OMNI OMNI Gen IV

I and II III IV

Detection

Range(m)

170

270

240

290

360

430

%

Improvement

over Gen II

0%

60%

40%

70%

110%

153%

**Range of different generations :**

There are many different variables that can effect the distance that you can see with a Night Vision device. First, what are you trying to see? Are you looking for another boat on the water or are you looking for a rabbit in the woods? The larger the object the easier it is too see. Plus, are you trying to see details (what we call recognition range) or are you just trying to see if something is there or maybe you will just see movement but won't be able to 100% determine who or what it is. This is called detection range. Second. Another variable is lighting conditions. The more ambient light you have (starlight, moonlight, infrared light) the better and further you will be able to see You can always see further on a night where the moon and stars are out then if it is cloudy and overcast. We typically state that you can tell the difference between a male and a female or a dog and a deer at about 75 to 100 yards. However, if you were looking across an open field and there was a half moon out you could see a barn or a house 500 yards away. Remember, that the purpose of an NVD is to see in the dark not necessarily a long Way slike a binocular

NEW NIGHT VISION PRODUCT

ATN Night Vision Weapon sights - the world's most complete line of professional night vision sights is proud to introduce a new flagship product line - the ATN MARS Series. Mars, the Roman God of War inspired the fabled legions to overcome any obstacle in their path on the road to success. The ATN MARS Series will do the same for modern warriors. Inspired by ATN's quest for technical perfection, the MARS Series represents the latest in night vision technology combined with rugged reliability. ATN Night Vision rifle scopes - the world's most complete line of professional night vision scopes is proud to introduce a new flagship product line - the ATN MARS Series. Mars, the Roman God of War inspired the fabled legions to overcome any obstacle in their path on the road to success. The ATN MARS night vision series will do the same for modern warriors. Inspired by ATN's quest for technical perfection, the MARS night vision series represents the latest in night vision technology combined with rugged reliability.

**ATN NIGHT VISION**

The ATN MARS night vision riflescopes are versatile coming equipped with two magnification options; a fast 4x lens or a powerful 6x lens. Both units feature specially designed night vision optics using only the purest grades of heavy glass and computer enhanced optical designs to create multi-element, high-speed, multi-coated lenses for ultra-fast light transmission and resolution beyond current military standards. All optical lenses used in the MARS night vision rifle scopes are individually hand fitted. The ATN MARS night vision rifle scopes utilize the highest quality MX10160 type hand-selected image intensifier tubes (IIT) taking advantage of the latest night vision technology. The ATN MARS night vision scopes are available with a wide array of UT configurations to satisfy any requirements and specifications. All image tubes used in the MARS night vision series are of new manufacture. Some of the tube configurations available are: Â¢ New ITT Pinnacleâ€žÂ¢ Image Intensifier tubes with data record sheet. Â¢ 3rd generation configurations are available with Figure of Merit (FOM) image tubes in 1600 and 1250 FOMs. Â¢ G4 Filmless, autogated tubes which maximize functionality in all lightning conditions, ensuring superb performance, outstanding clarity and combat reliability. The MARS night vision riflescopes feature rugged one-piece CNC milled construction from solid aerospace-quality aluminum billet and titanium inserts. The ATN MARS night vision scopes give the weapon operator 50% more (45mm!) eye relief and offers superior performance over other manufacturer's models in regards to windage and elevation adjustment The MARS is the only night vision scope in the A illuminated two-color, variable intensity reticle that ca: in all lighting condition. This proprietary ATN feature amber) of the projected reticle depending on operati and is one of many things setting the MARS nigh competition.

The MARS night vision scopes are the ideal nighttime shooting solution for Military, Police, target shooting, varmint hunting or for anyone in the market for a superior night vision riflescope.

Features:

* Powerful 4x, 6x magnification
* Superior quality Multi-coated lenses
* Precision windage and elevation adjustments
* Tactical digital remote control
* Waterproof and submersible to 66 feet for 1 hour
* Piccatiny or 7/8" Weaver-style rail mount included
* Unit accepts either, (1) 3V CR123A or (1) AA battery for maximum flexibility
* Nitrogen-purged for resistance to internal fogging
* Free military grade hard case included
* Limited two-year Warranty

**HIGH PERFORMANCE NIGHT VISION DEVICE**

LOMOÃ‚Â® is proud to introduce our extensive family of Night Vision Scopes. These products are a blend of LOMO's 80-year tradition of Old World craftsmanship in high quality optics, with a New World market-driven, innovative approach to design, engineering and ergonomics.

Hunting With Night Vision Devices

Hunting at night and/or in the dark never seemed easy until Night Vision Devices were made available in the market. With these devices, hunters can now get a better and clearer view of what lurks in the dark. How Night Vision Devices Make You an Invisible Hunter Basically, night vision devices or NVD aids you in hunting by gathering light from the stars, the moon, and other light sources and focusing it on the front lens so as to give you a clearer image of what lurks in the dark. In its simplest form, the night vision devices gather light and then directs this light into the photocathode tube which converts the photons to electrons. After the electron conversion, a host of chemical and electrical process multiplies the number of electrons present. After magnification, the electrons are hurled on a phosphorus screen and the electrons are then converted into light. This process allows you to see the image that is shown in a green-hue scene. Night Vision Device options for Night Hunting There are many units of night vision devices that hunters can opt to use. A Night Vision Device may belong to its 1st, 2nd, 3rd or 4th generation type. Note that each generation only varies according to the type of light intensifier tube that is used for the device. First generation Night Vision Devices are the most prominent these days. They are relatively cheaper than the other units and are thus the most recommended types for conventional use. Note that first generation Night Vision Devices makes use of the process and the lighting equipment described above. Second Generation Night Vision Devices pose a slight advantage t> units primarily because they have micro-channel plates (MCP^^ v \_ glass tubes, MCPs provide better amplification of the elec^^wijtymk photocathode. As a^\_ , result, it gives the hunters a brighter and sharper night \^^mmgt thjÃ‚Â»peir\*ojLÃ‚Â»,wpngjoQc/^ O As for the Third Generation Night Vision Devices, JhM tÃ‚Â»ovide brighter and sharper ^" m VERSION images than the MCPs of the second generation pi^arily because of the Gallium .Arsenide present in their photocathode tubes. Ion barrier films were also installed in these third generation devices, thereby increasing the tube's operating power. Last but definitely the best of the units, the Night Vision Devices of the Fourth Generation are far more beneficial than their previous forms primarily because of the Gated Filmless Tubes. These tubes have increased the NVDs ability to detect target at distant ranges and improve the resolution of the image even at exceptionally low light levels. Night Vision Device Sight Range

Note that Night Vision Devices were made to allow you to see in the dark, not to let you see in far and wide sight ranges. When using NVDs, there are many factors to consider when assessing the distance that the device allows you to view. First, consider the available lighting. Note that the Night Vision Devices amplifies existing light so you can see things. If the moon or the stars provide ambient lighting, then you can probably see farther than what you can if there are no stars for the night. Also, take note of the size of the object you are trying to see. The larger the object, the greater you have of seeing it. Also, consider what are you trying to see about the object- is it its details (requires recognition range) or just its movement (shown through a detection range).

**USAGE**

Night vision devices were originally developed for military use, but have since spread into other areas, such as security and police work, rescue outfits and various amateur uses (for example animal watching or hunting)Night vision goggles have been especially praised by the pilots of rescue helicopters, as they eliminate the need for a 'sterile light environment' (i.e. a dark cabin to allow the pilot to let his eyes naturally adjust to night-flying conditions). This will for example allow a medic in the cabin to work on a patient under bright lights while retaining the pilot's ability to fly safely under night conditions .There are mainly three devices used in night vision via monocular, binocular , and night vision goggles . The monocular device was first used by USA militry in world war II. The second one binocular was used first in vietnam war

**CONCLUSION**

First night vision is specified and then night vision device is mentioned . Few example of night vision device is given . then working has been mentioned . we have seen the four generation of night vision device and the range of four generations has been mentioned . Table chart is provided for this .Finally we have seen usage of night vision devices .We find that night vision device is useful in both the conditions whether in the presence of ambient light or in case of overcast or cloudy whether .There are so many devices available in the market but in all these devices one thing is common : they produce green light . So in overcast and cloudy whether the performance of night vision devices decreased means the detection range is decreased compared to ambient light such as moonlight or starlight.

**REFERENCES**

1 WWW.WIKIPEDIA.ORG

2HTTP://EZINE ARTICLES.COM/7HUNTING-WITH-NIGHT-VISI0N-

DEVICES&ID=1405 691

3.WWWMOROVISIONCOM/HOWJTHERMALJMAGING\_WORKS.HTM

4.WWWGOOGLE.CO.IN

5. http://WWW.ATNCORP.COM