ABSTRACT:

The advancement in science is making what we may have thought of as impossible, probable. Humans may become invisible as the extra terrestrials which are considered to be probably invisible. A new technology provides a way to this. In this paper a scientific technology that is used to implement this idea is presented. The optical camouflage technology is one of the famous scientific technologies which helps in the invention of a new type of cloak called the invisible cloak. This is one of the big revolutions created in the area of virtual reality. It is just a concept of reflection of light by the cloak. The person who wears this cloak will feel as just what he feels with the ordinary cloaks but the person will be invisible to the outside environment. This is the main advantage of this cloak. There are many other interesting features present in this paper about this cloak.

CHAPTER 1 : INTRODUCTION:
Although *optical* is a term that technically refers to all forms of light, most proposed forms of optical camouflage would only provide invisibility in the visible portion of the spectrum.

The research on the concept of invisibility was started in 1977 and was very successfully accomplished in 2003. Initially Professor Tachi from the University of Tokyo said that he had first had the idea of developing something to make objects invisible in 1977. But the image was flat and unrealistic. He came up with retro-reflective material which causes the coat to act as a screen and gives a transparent - or invisible - effect. Similarly, Duke University is using microwave beam deflection, making it appear almost as if nothing were there at all. If you’ve seen the movie “Harry Potter” then you may recognize the idea of an invisibility cloak.

### CHAPTER 2: OPTICAL CAMOUFLAGE:

Optical camouflage is a hypothetical type of active camouflage currently only in a very primitive stage of development. The idea is relatively straightforward: to create the illusion of invisibility by covering an object with something that projects the scene directly behind that
object. Optical camouflage is a kind of active camouflage which completely envelopes the wearer. It displays an image of the scene on the side opposite the viewer on it, so that the viewer can "see through" the wearer, rendering the wearer invisible. Although optical is a term that technically refers to all forms of light, most proposed forms of optical camouflage would only provide invisibility in the visible portion of the spectrum. Prototype examples and proposed designs of optical camouflage devices range back to the late eighties at least, and the concept began to appear in fiction in the late nineties.

CHAPTER 2.1 : Components of the Optical Camouflage:

Optical camouflage doesn't work by way of magic. It works by taking advantage of something called augmented-reality technology. Augmented-reality systems add computer-generated information to a user's sensory perceptions. Most augmented-reality systems require that users look through a special viewing apparatus to see a real-world scene enhanced with synthesized graphics. They also require a powerful computer. Optical camouflage requires these things, as well, but it also requires several other components.

- A garment made from highly reflective material
- A video camera
- A computer
- A projector
- A special, half-silvered mirror called a combiner; which is the viewing screen

CHAPTER 2.2 : The Cloak:
OPTICAL CAMOUFLAGE

It is made up of retro-reflective material. It has an observer that receives more of the reflected light and therefore sees a brighter reflection. It can be seen far away and outside in bright sunlight.

CHAPTER 2.3 : Other components:

- The camera captures the digital video behind the person with the cloak.
- The computer synthesizes the graphics and superimposes them on a real-world image.
- The projector shines a light beam through an opening controlled by a device called an iris diaphragm.
- The combiner (special mirror) is used to both reflect the projected image toward the cloak and let light rays bouncing off the cloak to return to the viewer’s eye.
CHAPTER 3: CONCEPT OF INVISIBILITY CLOAK:
1. The cloak that enables optical camouflage to work is made from a special material known as retro-reflective material.

2. A retro-reflective material is covered with thousands and thousands of small beads. When light strikes one of these beads, the light rays bounce back exactly in the same direction from which they came.

3. To understand why this is unique, look at how light reflects off of other types of surfaces. A rough surface creates a diffused reflection because the incident (incoming) light rays get scattered in many different directions. A perfectly smooth surface, like that of a mirror, creates what is known as a specular reflection -- a reflection in which incident light rays and reflected light rays form the exact same angle with the mirror surface. In retro-reflection, the glass beads act like prisms, bending the light rays by a process known as refraction. This causes the reflected light rays to travel back along the same path as the incident light rays. The result: An observer situated at the light source receives more of the reflected light and therefore sees a brighter reflection.
CHAPTER 4 : WORKING:
Once a person puts on the cloak made with the retro-reflective material, here's the sequence of events:

- A digital video camera captures the scene behind the person wearing the cloak.
- The computer processes the captured image and makes the calculations necessary to adjust the still image or video so it will look realistic when it is projected.
- The projector receives the enhanced image from the computer and shines the image through a pinhole-sized opening onto the combiner.

- The silvered half of the mirror, which is completely reflective, bounces the projected image toward the person wearing the cloak.
• The cloak acts like a movie screen, reflecting light directly back to the source, which in this case is the mirror.

• Light rays bouncing off of the cloak pass through the transparent part of the mirror and fall on the user's eyes. Remember that the light rays bouncing off of the cloak contain the image of the scene that exists behind the person wearing the cloak.

• The person wearing the cloak appears invisible because the background scene is being displayed onto the retro-reflective material. At the same time, light rays from the rest of the world are allowed reach the user's eyes, making it seem as if an invisible person exists in an otherwise normal-looking world.

CHAPTER 4.1 : Key Challenges:

• Practicality smaller computer integrated replacement of projector combiner.

• Purchase patent or license.

• High costs.

• Very small cameras and projectors

CHAPTER 5 : MUTUAL TELEXISTENCE:
CHAPTER 5.1 : How mutual telexistence works:
• Human user A is at one location while his telexistence robot A is at another location with human user B.

• Human user B is at one location while his telexistence robot B is at another location with human user A.

• Both telexistence robots are covered in retro-reflective material so that they act like screens.

• With video cameras and projectors at each location, the images of the two human users are projected onto their respective robots in the remote locations.

• This gives each human the perception that he is working with another human instead of a robot.

• Right now, mutual telexistence is science fiction, but it won't be for long as scientists continue to push the boundaries of the technology.

CHAPTER 6 : REAL WORLD APPLICATIONS:
• Doctors performing surgery could use optical camouflage to see through their hands and instruments to the underlying tissue.

• Providing a view of the outside in windowless rooms is one of the more fanciful applications of the technology, but one that might improve the psychological well-being of people in such environments.

• Pilots landing a plane could use this technology to make cockpit floors transparent. This would enable them to see the runway and the landing gear simply by glancing down.

• Drivers backing up cars could benefit one day from optical camouflage.

A quick glance backward through a transparent rear hatch or tailgate would make it easy to know when to stop.

CHAPTER 7: OPTICAL CAMOUFLAGE SEEN IN:

☐ Ghost in the Shell.

☐ 2000 video game Deus Ex.
□ 2002 James Bond movie Die Another Day

□ Metal Gear Solid and Halo video game series.

□ The video game Phantom Crash.

□ The Predator movie.

CHAPTER 8 : ADVANTAGES & DISADVANTAGES

ADVANTAGES:
Optical Camouflage can be used on surgical globes or equipments so they don’t block surgeon’s view during delicate operations.

In aviation, cockpit floors could become 'invisible' to assist pilots during landing.

DISADVANTAGES:

⚠️ The weak point of this technique is that the observer needs to look through a half-mirror.

⚠️ The current system needs a half-mirror and projectors, which were fixed on the ground.

CHAPTER 9 : CONCLUSION:

Now all of us have had a small tour of the interesting world of optical camouflage. A lot of interesting thing have been done and already we have seen that anyone can be almost invisible
with this technology. Though we are still facing challenges with practicality, licensing and high costs the future promises us a lot more. To make an object literally vanish before a person's eyes, a cloak would have to simultaneously interact with all of the wavelengths, or colours, that make up light. That technology would require much more intricate and tiny meta-material structures, which scientists have yet to devise. Research work is going on and soon we will have even more astonishing results.