



Invisibility through Active Optical Camouflage

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Abstract— *This paper explains kind of active camouflage system namely optical camouflage. This optical camouflage uses retro-reflective projection technology basically augmented reality system, which includes a projector with small iris and a retro reflective screen. This concept basically explains how to make a object invisible or transparent, which is done by projecting the scene behind the object on it.*

Keywords— *active camouflage, retro-reflective projection, iris.*

I. INTRODUCTION

Different ways have been given to integrate the usual space. Different methods have been researched for making objects, creatures invisible or transparent. One of the most dreaming topics is about displaying a virtual object into reality or making objects virtually transparent, as in H.G Wells "Invisible Man". An effort has been made in this paper to describe how this can be made possible using camouflage technique i.e OPTICAL CAMOUFLAGE.

II. TYPES OF CAMOUFLAGE

Camouflage is basically a method which makes a otherwise visible organism or object to remain indifferent from the surrounding environment.

Natural Camouflage

In nature, it can be seen very often that animals blend into the surrounding environment to hide from predators and survive. It is the best method which these creatures have adopted by inheritance.

Military Camouflage

This can be seen in military warfare when men, helicopters have been digitally printed with broad patterns so as to misguide the enemy, intend to daunt enemy. The Britishers in 1857 forced by the casualties to dye their clothes with a light muddy colour i.e. khaki.

III. THEORY

Mackey's statement is the most important among the others in the theory of optical camouflage- an exact match with the environment's colours is less crucial than patterning of regions of colour themselves. Hence camouflage should be broken up firstly and conceal the structural lines of the object which are hiding. Therefore the patterns on masking cloth and vehicles are constructed to misguide the human eye by breaking the structural lines and edges. This is disruptive camouflage.

The opposite of camouflage is making a person or object more visible and easier to recognize for example with retro reflectors and high visibility clothing. Creating complete optical camouflage across the visible light spectrum would require a coating or suit covered in tiny cameras and projectors, programmed together visual data from a multitude of different angle and project the gathered images outwards in an equally large number of different directions to give the illusion of invisibility from all angles. For a surface subject to bending like a flexible suit, a massive amount of computing power and embedded sensors would be necessary to continuously project the correct images in all directions. This would almost certainly require sophisticated nanotechnology, as our computers, projectors, and cameras are not yet miniaturized enough to meet these conditions.

IV. RESEARCH BACKGROUND AND RELATED WORK

A) OPTICAL CAMOUFLAGE:

Its kind of active camouflage, basically what we do is project the background image on the object itself, resulting the human sees it to be transparent. The term optical is although refers to all forms of light but here in most cases of optical camouflage it will result in invisibility in the visible portion. Here a camera is placed behind the object which captures background image and transmits it to computer for image processing. The quality of processed image, camera, retro-reflective coat effects the results but by late nineties convincing illusions were seen using this method.



B) RETRO REFLECTIVE PROJECTION TECHNOLOGY (RPT):

Optical camouflage uses technology RPT/Xtal vision which uses optical projection, while using STHMD(See through head mounted display) to blend virtual and real environments. The operator will observe image of the object which is actually located behind the object. This contradicts the intuition of depth, since the projected image of the object located behind another object in one's field will be obstructed. This is called occlusion, to solve this problem we use RPT technology these are-

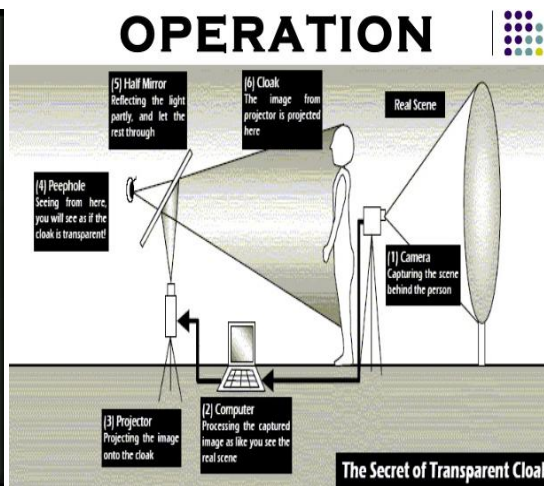
1. Use a object which is covered by retro reflective material.
2. Projector should be placed optically conjugated with observer's eye by using half mirror.
3. Projector's iris should be made as small as possible (pin hole).

This leads to the following:

The image of virtual object is projected through pin hole, image is reflected by half mirror at a right angle and retro reflected by the screen.



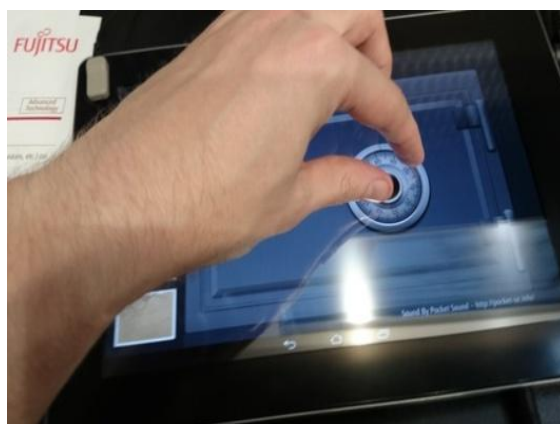
XTAL VISION



V. RESULT

Haptic Display

Haptic display (real object) hiding the virtual object but by using optical camouflage technique we can make object transparent whereas the operator's hand is not made transparent hence it suggests that this technique can be selectively used.



Invisible Cloak

Here we can see the truck image which is actually behind the man ,but due to the optical camouflage this image is seen and we can observe partially through the coat although he does not becomes transparent fully or invisible but still truck can be seen .



VI. CONCLUSIONS

A optical camouflage system is developed -

- 1.This can be used in Stealth technology to make airplane invisible to radars.
- 2.As a security instrument,which can protect national strategic resources from theft by blending the view withsurrounding enviornment or making them virtually invisible.
- 3.Used on surgical globe instruments so they don't block surgeon's view during delicate operations.
- 4.In flights, if the floors are made transparent the pilot can easily see the runway during landing.
5. Creating a truly realistic optical illusion would likely require Phase Array Optics, which would project light of a specific amplitude and phase and therefore provide even greater levels of invisibility.

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