A Project/Dissertation ETE Report

On

INIVISIBLE CLOAK

Submitted in partial fulfillment of the requirement for the award of the degree of

Bachelor of Technology (CSE)

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

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December, 2021

ACKNOWLEDGEMENT

We would like to express special thanks & gratitude to our guide, Mr. E Rajesh sir who gave us this golden opportunity to work on this scalable project on the topic of **"INVISIBLE CLOAK"**, which led us into doing a lot of Research which diversified our knowledge to a huge extent for which we are thankful.

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1. Abstract

In our project, we review the current state of the art of magnetic resonance imaging, and explore the various technologies available and experimental research, focusing on basic physics and basic science concepts. Here We discuss available dressing methods, including optics modification, plasmonic and mantle cloaking, transmission line networks, parallel-plate cloaking, unusual resonance methods, hybrid methods, and functional schemes, and give our opinion on the matter. and its future. We also draw parallels in the subtle studies of acoustic and elastodynamic waves, liquid waves, material waves, and thermal fluctuations, showing how ideas initiated in the field of electromagnetism have been able to unlock the potential of other sciences. Finally, rare sensor closure requests are discussed and reviewed.

2. INTRODUCTION

We will create the invisible cloak using an image processing technique called Color detection and segmentation. In order to make this project. You'll need a single-color cloth. The cloth should not contain any other color visible. Here we are using red cloth to develop this python project.
Because we are using color detection and segmentation techniques. If any other color is visible in our cloak, then we have to process the image frame for the color also. and here cloth color should be unique relative to the background. So, what is color Detection and Segmentation in Image processing, here color detection is a technique where we can detect any color in a given range of HSV color space. Image segmentation is the process of labeling every pixel in an image, where each pixel having the same label shares certain characteristics. This technique is opposite to the **"**Green Screening**"**. In green screening, we remove background but here we will remove the foreground frame. It is some step to work invisible cloak, and here we have use the python, NumPy and OpenCV.

1. Capture and store background frame.
2. Detect the defined color using color detection and segmentation algorithm.
3. Segment out the defined colored part by generation a mask.
4. Generate the final augmented output to create a magical effect.

Python - Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built-in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

Often, programmers fall in love with Python because of the increased productivity it provides. Since there is no compilation step, the edit-test-debug cycle is incredibly fast. Debugging Python programs is easy: a bug or bad input will never cause a segmentation fault. Instead, when the interpreter discovers an error, it raises an exception. When the program doesn't catch the exception, the interpreter prints a stack trace. A source level debugger allows inspection of local and global variables, evaluation of arbitrary expressions, setting breakpoints, stepping through the code a line at a time, and so on. The debugger is written in Python itself, testifying to Python's introspective power. On the other hand, often the quickest way to debug a program is to add a few print statements to the source: the fast edit-test-debug cycle makes this simple approach very effective.

NumPy - NumPy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, Fourier transform, and matrices. NumPy was created in 2005 by Travis Oliphant. It is an open-source project and you can use it freely. NumPy stands for Numerical Python. In Python we have lists that serve the purpose of arrays, but they are slow to process. NumPy aims to provide an array object that is up to 50x faster than traditional Python lists. The array object in NumPy is called ndarray, it provides a lot of supporting functions that make working with ndarray very easy. Arrays are very frequently used in data science, where speed and resources are very important. NumPy arrays are stored at one continuous place in memory unlike lists, so processes can access and manipulate them very efficiently. This behavior is called locality of reference in computer science. This is the main reason why NumPy is faster than lists. Also, it is optimized to work with latest CPU architectures. NumPy is a Python library and is written partially in Python, but most of the parts that require fast computation are written in C or C++.

OpenCV - OpenCV was started at Intel in 1999 by Gary Brodsky, and the first release came out in 2000. Vadim Isarescu joined Gary Brodsky to manage Intel's Russian software OpenCV team. In 2005, OpenCV was used on Stanley, the vehicle that won the 2005 DARPA Grand Challenge. Later, its active development continued under the support of Willow Garage with Gary Brodsky and Vadim Pisarevsky leading the project. OpenCV now supports a multitude of algorithms related to Computer Vision and Machine Learning and is expanding day by day. OpenCV supports a wide variety of programming languages such as C++, Python, Java, etc., and is available on different platforms including Windows, Linux, OS X, Android, and iOS. Interfaces for high-speed GPU operations based on CUDA and OpenCL are also under active development. OpenCV-Python is the Python API for OpenCV, combining the best qualities of the OpenCV C++ API and the Python language. OpenCV-Python is a library of Python bindings designed to solve computer vision problems. Python is a general-purpose programming language started by Guido van Rossum that became very popular very quickly, mainly because of its simplicity and code readability. It enables the programmer to express ideas in fewer lines of code without reducing readability. Compared to languages like C/C++, Python is slower. That said, Python can be easily extended with C/C++, which allows us to write computationally intensive code in C/C++ and create Python wrappers that can be used as Python modules. This gives us two advantages: first, the code is as fast as the original C/C++ code (since it is the actual C++ code working in background) and second, it easier to code in Python than C/C++. OpenCV-Python is a Python wrapper for the original OpenCV C++ implementation. OpenCV-Python makes use of NumPy, which is a highly optimized library for numerical operations with a MATLAB-style syntax. All the OpenCV array structures are converted to and from NumPy arrays. This also makes it easier to integrate with other libraries that use NumPy such as SciPy and Matplotlib.

3.SOURCE CODE

```
import cv2
import numpy as np
import time

print("""
Hlow sir Out project is ready to run.
    """)



cap = cv2.VideoCapture(0)
time.sleep(3)
background=0
for i in range(30):
        ret,background = cap.read()

background = np.flip(background,axis=1)

while(cap.isOpened()):
```

```
ret, img = cap.read()

img = np.flip(img,axis=1)

hsv = cv2.cvtColor(img, cv2.COLOR_BGR2HSV)
value = (35, 35)

blurred = cv2.GaussianBlur(hsv, value,0)

lower_red = np.array([0,120,70])
upper_red = np.array([10,255,255])
mask1 = cv2.inRange(hsv,lower_red,upper_red)

lower_red = np.array([170,120,70])
upper_red = np.array([180,255,255])
mask2 = cv2.inRange(hsv,lower_red,upper_red)

mask = mask1+mask2
mask = cv2.morphologyEx(mask, cv2.MORPH_OPEN, np.ones((5,5),np.uint8))

img[np.where(mask==255)] = background[np.where(mask==255)]
cv2.imshow('Display',img)
```

```
k = cv2.waitKey(10)
if k == 27:
        break
```

4.Problem statement

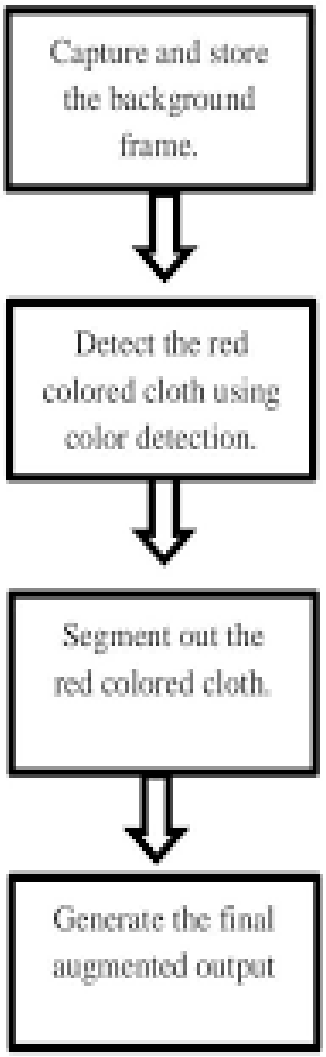
- If we talk about the problem statement, basically invisible cloak very useful for the Military and Police, people in the military could use an invisibility cloak to spy on enemies and they could find out the information directly from a source, without that source knowing. And police could spy on suspects of a crime and/or find out information about the crime.

- Here Recreation is that the invisibility cloak could be used to go anywhere you want to go place like the Superbowl, movie theaters, and concerts would be accessible without fee and you could be a fantastic hide-n-seek player.

- In today's time safety is the most important and valuable for our life invisible cloak is hide the thing like gold and etc. women or man walking in the road and they wear his/her any gold chain and if the snatchers will see and then snatch it during snatching the neck will damage for this reason people will die also so invisible cloak hide this type of things in a dangerous situation to keep them safe.

- And the lastly you could use it to find out if someone isn't true to you, such as a partner or friend.

5.METHODLOGY



Algorithm Steps:

1. **Capture, and store the background frame** -: Our main objective is to replace the red-colored cloak pixels with the background pixels to create an invisible effect in the video. So, to do that, we need to store the background image for each frame. We will dedicate a few seconds to capture and store the background. We will do this in 2 easy steps.
    - Give the camera some time to warm up
    - Capture the background in range of 60
2. **Detect the red colored cloak using color detection and segmentation algorithm -:** In this step, we will focus on detecting the red part of the image. To do that, we will convert the "**RGB** (red-blue-green) to **HSV** (hue-saturation-value)".

    Now, what does that even mean?

    - What is RGB?
      RGB is an additive color model in which **R**ed, **G**reen, and **B**lue are added to create a whole range of colors.

      The Decimal Code for RGB is as below:

      Red: rgb(255,0,0)

      Blue: rgb(0, 0, 255)

      Yellow: rgb(255,255,0)

      Green: rgb(0, 128, 0)

- What is HSV?
  HSV stands for **H**ue, **S**aturation, and **V**alue.

  Hue is the color portion of the model, expressed as a number from 0 to 360 degrees:

- **Red** falls between 0 and 60 degrees.
- **Yellow** falls between 61 and 120 degrees.
- **Blue** falls between 241–300 degrees.

Saturation encodes the intensity/purity of the color. Saturation appears as a range from 0–1, where 0 is grey, and 1 is a primary color. It can also be represented in percentage.

Value encodes the brightness or intensity of the color.

We will convert from RGB to HSV for better detection of the colors. After the conversion, it is time to specify the range of colors to detect red color in the video.

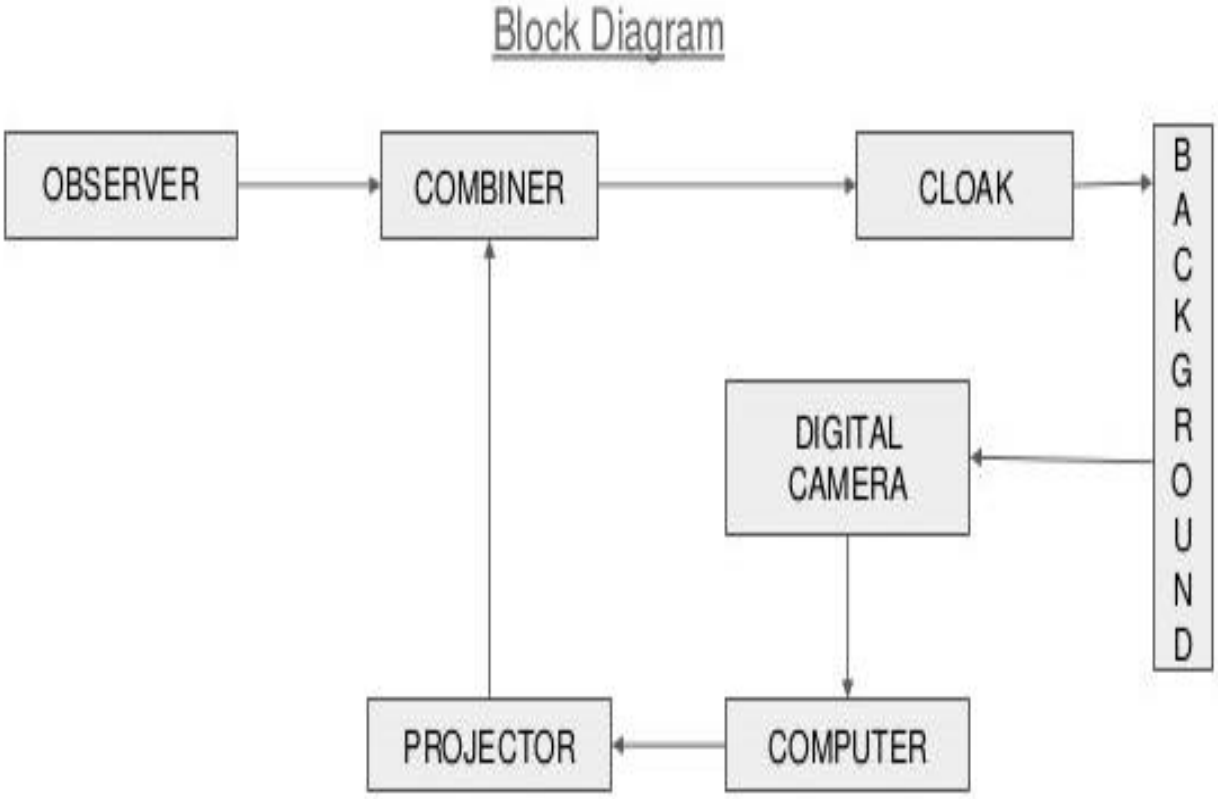
Sounds simple? Well, I was stuck at this point for some time. I was not sure what shade of red is my cloak. I tried a few ranges, but it was not working properly as it was masking either my face or the orange tee-shirt I was wearing! So, after some digging, what I have learned is below:

- OpenCV by default reads images in BGR format.
- The Hue values are actually distributed over a circle (range between 0-360 degrees) but in OpenCV to fit into 8bit value the range is from 0-180. The red color is represented by 0-30 as well as 150-180 values.
- Human skin tone falls somewhere in the red range and it is a genuine problem to differentiate the skin from cloth. Maybe a Green or Blue Cloak will work better!

3. **Segment out the red colored cloth −:** We need to generate a mask to determine the region in the frame corresponding to the detected color (red in this case). We refine this mask and then use it for segmenting out the cloth from the frame.

4. **Generate the final augmented output -:** Now, the final touch of Magic! We will replace the pixel values of the detected red color region with corresponding pixel values of the static background. Voila! You are Invisible.

5. FLOW DIGRAM



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Observer -: This is accomplished by manipulating the paths traversed by light through a novel optical material. Metamaterials direct and control the propagation and transmission of specified parts of the light spectrum and demonstrate the potential to render an object seemingly invisible. Metamaterial cloaking, based on transformation optics, describes the process of shielding something from view by controlling electromagnetic radiation. Objects in the defined location are still present, but incident waves are guided around them without being affected by the object itself. Electromagnetic metamaterials respond to chosen parts of radiated light, also known as the electromagnetic spectrum, in a manner that is difficult or impossible to achieve with natural materials. In other words, these metamaterials can be further defined as artificially structured composite materials, which exhibit interaction with light usually not available in nature (electromagnetic interactions). At the same time, metamaterials have the potential to be engineered and constructed with desirable properties that fit a specific need. That need will be determined by the particular application. The artificial structure for cloaking applications is a lattice design – a sequentially repeating network – of identical elements. Additionally, for microwave frequencies, these materials are analogous to crystals for optics. Also, a metamaterial is composed of a sequence of elements and spacings, which are much smaller than the selected wavelength of light. The selected wavelength could be radio frequency, microwave, or other radiations, now just beginning to reach into the visible frequencies. Macroscopic properties can be directly controlled by adjusting characteristics of the rudimentary elements, and their arrangement on, or throughout the material. Moreover, these metamaterials are a basis for building very small cloaking devices in anticipation of larger devices, adaptable to a broad spectrum of radiated light. Hence, although light consists of an electric field and a magnetic field, ordinary optical materials, such as optical microscope lenses, have a strong reaction only to the electric field. The corresponding magnetic interaction is essentially nil. This results in only the most common optical effects, such as ordinary refraction with common diffraction limitations in lenses and imaging. Since the beginning of optical sciences, centuries ago, the ability to control the light with materials has been limited to these common optical effects. Metamaterials, on the other hand, are capable of a very strong interaction, or coupling, with the magnetic component of light. Therefore, the range of response to radiated light is expanded beyond the ordinary optical limitations that are described by the sciences of physical optics and optical physics. In addition, as artificially constructed materials, both the magnetic and electric components of the radiated light can be controlled at will, in any desired fashion as it travels, or more accurately propagates, through the material. This is because a metamaterial's behavior is typically formed from individual components, and each component responds independently to a radiated spectrum of light. At this time, however, metamaterials are limited. Cloaking across a broad spectrum of frequencies has not been achieved, including the visible spectrum. Dissipation, absorption, and dispersion are also current drawbacks, but this field is still in its optimistic infancy.

Combiner -: Invisibility cloaks are materials that bend light around an object so no light hits it, concealing its presence. A material that can make something else disappear clearly has military potential, but other uses have been suggested - ranging from wrinkle creams to transparent cockpit floors that could help pilots when landing aircraft by revealing the runaway and landing gear.
The trouble is, the laws of physics mean that the light would have to travel incredibly quickly round the disappearance object for the cloaking material to work - faster than the speed of light. Nothing - matter, energy, light - can travel this fast under most conditions. The result is an invisibility sphere, inside which any object will vanish - but it will also be invisible itself.
It could be a while before we see - or rather, don't see - such optical camouflage put to practical use. Perczel's cloak currently manifests itself as mathematical formulae: it's a theoretical construct.
The cloak would need to be made from meta materials - artificial materials made from large molecules that can be combined to produce exactly the required properties.

Cloak -: A cloak is a type of loose garment worn over clothing, mostly but not always as outerwear for outdoor wear, serving the same purpose as an overcoat, protecting the wearer from the weather. It may form part of a uniform. Cloaks have been and are worn in countless societies. Over time cloak designs have been changed to match fashion and available textiles. Cloaks generally fasten at the neck or over the shoulder, vary in length, from hip all the way down to the ankle, mid-calf being the normal length. They may have an attached hood and may cover and fasten down the front, in which case they have holes or slits for the hands to pass through. However, cloaks are almost always sleeveless.

Background -: In the movie many of the alien uses a cloaking device to hide in plain sight, but the effect is far from perfect: The alien's attempt to conceal itself is thwarted by distortions of light bending around it. Now, researchers have built an ultrathin "invisibility cloak" that gets around this problem, by turning objects into perfect, flat mirrors. Invisibility cloaks are designed to bend light around an object, but materials that do this are typically hard to shape and only work from narrow angles — if you walk around the cloaked object, for instance, it's visible. But a new cloak avoids that problem, and is thin and flexible enough to be wrapped around an object of any shape, the researchers said. It can also be "tuned" to match whatever background is behind it — or can even create illusions of what's there, they added.

Digital camera -: Machine learning detection systems analyses video footage and identify people based on a number of factors. These factors include what people are wearing. 'Invisible cloak' attacks work against these systems. In effect, these attacks can identify what clothes can be worn to bypass detection by these systems.

This demo video shows how easy it is to manipulate these systems. Initially you can see both subjects detected by the program. However, whenever one person wears a red beanie, they disappear and the program cannot detect them.

Projector -: Machine learning detection systems analyse video footage and identify people based on a number of factors. These factors include what people are wearing. ‘Invisible cloak’ attacks work against these systems. In effect, these attacks can identify what clothes can be worn to bypass detection by these systems.

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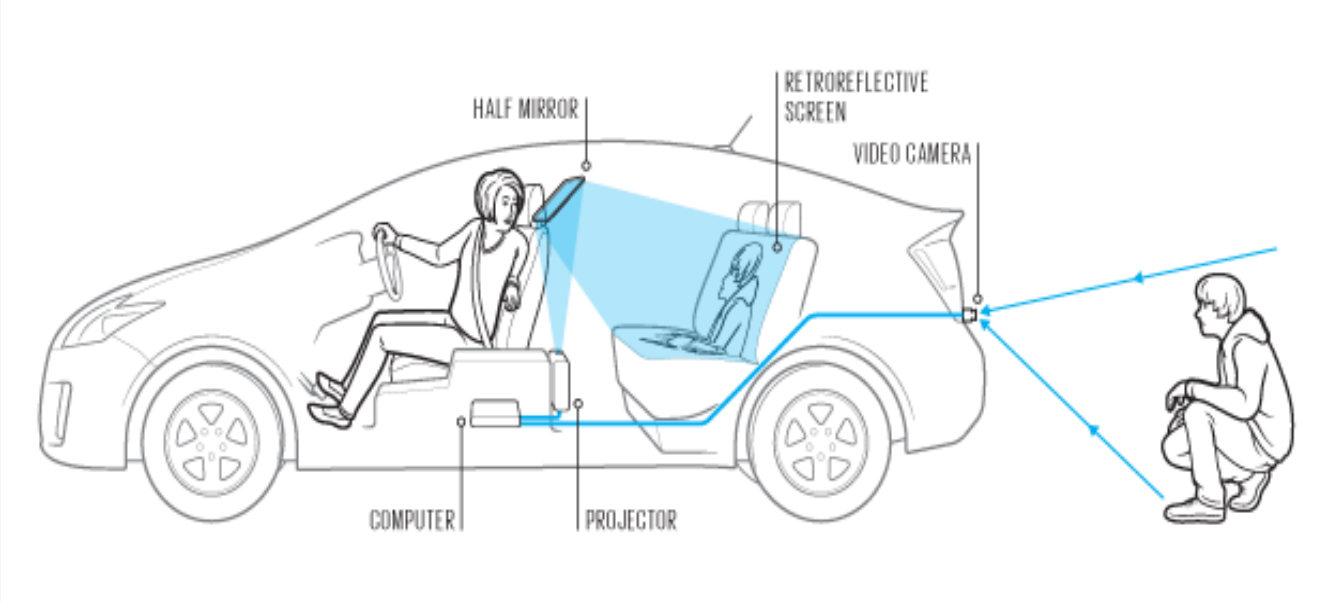

As we projection mappists are aware, projection in bright daylight is a tricky thing and requires expensive, bulky projectors. To solve this issue, the team covered the inside of the car in a retro-reflective material. Retro-reflective materials are special because they reflect incoming light in the exact direction that it comes in. This means that you can use a projector to create a display even in bright sunlight. Another issue with projection mapping is to get the correct perspective (an morphosis) requires a complex 3d model of the display surface and some tricky math. So, the team used a half-silvered mirror to effectively position the projector at the viewer’s location.

6. CONCLUSSION

A first trend, simplification of the cloak designs with calculated compromises on the cloaking performance, was illustrated as we described the evolution from the initial proposal for perfect stuttering cancellation via transformation optics to more practical designs, sacrificing for instance the phase requirement (non-Euclidean transformation cloaking), omnidirectionality (carpet cloaking) or perfect stuttering cancellation (plasmonic, mantle, TL networks, etc.). A second important trend consists of translating the science if cloaking to other physical systems where cloaks may be easier to realize, as illustrated in our review of acoustic, thermal flux, matter-waves, and liquid wave cloaking. The final trend, finding applications of cloaking with less stringent requirements than invisibility at visible frequencies, was exemplified by our review of the new possibilities enabled by cloaks in the field of non-invasive sensing After running the code, please wait for a few seconds to capture the background image. Then only, come in the frame with the red cloak to create a magical effect. Another challenge is to get an absolute red cloak. The one I am using here has some gold embroidery. So, that golden color peeks out sometimes. Also, my tee-shirt had some red flowers. Even that came into my way of being a great wizard. Jokes apart, it was fun.

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