

Cloud based Text extraction using Google Cloud Vision for Visually Impaired applications

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Abstract— As number of visually impaired people increased year by year due to accidents and biological disorders. Hence there is a need for assistive device that can help for their day to day activities. Hence, with recent advancement in the technology, we intend to implement assistive device for visually impaired person such smart reader that is capable of capturing an image from a camera and extract the text from the captured image and further to convert the text to speech as voice based output to assist the visually impaired people. The captured image is analyzed using Google Cloud Vision API Optical Character recognition (OCR). In order to extract text, we use image preprocessing methods to remove any noise or blur in the captured image so that the accuracy can be increased. Further, we include software-based text to speech to convert the text to speech as voice output. In this project we use Raspberry pi interfaced with Night vision camera and speaker to produce the converted text as voice. By applying Google Cloud vision OCR with preprocessing results in high accuracy level of the extracted text through image enhancement methods.

Keyword: Text extraction, Image enhancement, Google Cloud Vision, Optical Character recognition

I. INTRODUCTION

OCR is an electronically based conversion of various documents such as image into machine encoded format like Unicode UTF-8, UTF-16 text formats. OCR provides alpha numeric recognition text extraction from the images or documents. Now it has been one of the major researches oriented with various applications including healthcare, vehicle plate recognition etc. With advancement in the recent technology of computer vision Artificial intelligence and pattern recognition provides more accurate results in extracting text features from the image.

In recent years, OCR is been widely used to help the visually impaired person to assist them in reading the documents. Especially as book reader device to assist the visually impaired people to read the text by automatically extracting text and convert the text to speech format. In general, Optical Character Recognition (OCR) comprises translation using various algorithms such as Pattern recognition to extract the text from any documents. Nowadays, with the help of computers most of the OCR are electronically extracts the text from the documents that are in various image and readable formats such as JPG, PDF and HTML files. Therefore, OCR bridges the gap between the major gap between the man and the machine interface. Even though there are various Pattern recognition algorithms are used to extract the text from the documents sometime the text is not extracted exactly as expected due to low quality of the documents and degraded quality of the

documents especially with the old documents. OCR mainly focus on the character recognition with various document types as shown in Fig. 1. If the printed or handwritten documents are of degraded quality, then appropriated image enhancement need to be done to extract the exact text, such extraction is accomplished using computer vision Opencv and Python Image Processing Libraries.

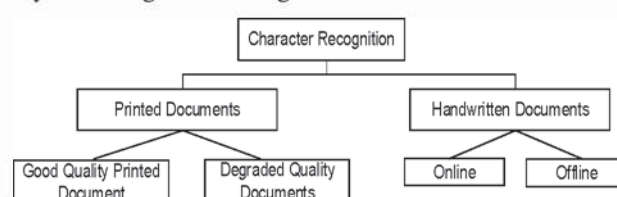


Fig. 1. Shows Character Recognition associated with various documents.

Different OCR are available in recent years such as Server OCR example Google OCR, Desktop OCR example Tesseract, Python OCR and Web OCR such as Google Cloud OCR, Amazon OCR and Microsoft OCR and the expected text extraction may vary from OCR type to another due the effective Pattern Recognition algorithms used in such OCR. In this paper, we would be focusing on preprocessing and Google Cloud OCR so as to extract text from dynamic environment like low light.

In this paper, we build a system that is capable of extracting text from any type of documents such as printed or handwritten document or captured under dynamic environment. In order to accomplish this, we intend to use Raspberry Pi with Night Vision camera and a speaker along with various software tools such as Google Cloud Vision API, Google Text to Speech (gTTS), Python Image Libraries, OpenCV and all software tools are python integrated. The document under test is captured using the Night Vision Camera to adjust brightness of the document which is under test. Further, we would be applying Image enhancement pre-processing technique to detect the edges of each character from the captured image. Upon, extracting the edges then we apply Google Cloud vision engine to extract text from the image using character recognition. The extracted text is in Unicode format such as UTF-8 or UTF-16, we use UTF-8 code. Finally, the UTF-8 Unicode text is read through Text to Speech engine such as gTTS which reads out the text to the user. Further, we use Goslate to translate one language to another language. Thereby supporting Multilanguage translation and reading capabilities and the text can be read through the speaker or headphone connected to the raspberry. For testing purpose, we use the following languages such as English, Indian languages like Tamil, Hindi etc.

This paper is organized in the following order; related works are discussed in Section II and Section III discussion on Optical Character Recognition. Section IV describes the system architecture and Section V describes pre-processing technique with image enhancement. Further the results are discussed in Section VI followed by conclusion and future work.

II. RELATED WORKS

As we know that OCR is a technique used to identify characters from various documents or file formats and further helps to identify the characters, fonts, page layouts etc. The output of extracted image varies due to degraded image and there is necessity to use appropriate image pre-processing methods to extract the text from such low-quality image. The extraction of text also depends on various OCR engine enabled with various type of Pattern algorithms incorporated in such engines. In this section we intend to summarize about various research work on OCR engine and its implementation. In paper [1], the authors has discussed about Google OCR and its interaction with Spoken Language Processing (SLP) which has tremendous real world applications. The authors in [2], discusses about a voice assisted text reading systems for visually impaired persons, such system can detect the text via camera integrated with Raspberry pi and produces the output as voice via speaker integrated to Raspberry pi. The system is limited to night vision and English language. In order to overcome the various degraded image output as in [2], the authors in [3] has incorporated various preprocessing stages binarization, de-noising, deskewing, segmentation and feature extraction to enhance the image. Further in [3] the images are tested only for the printed documents. In order to enhance the image to extract more accuracy, researchers in [4] incorporated a novel pre-processing technique such as propose a local brightness and contrast adjustment method with software-based lighting variations control for irregular distribution of image illumination. Upon applying the novel threshold, the researchers [4] uses OCR engine to extract the text.

If the images are of degraded quality then it's not possible to extract the text from the image as discussed in [3],[4]. Sometime the texts are eroded due to background light, hence in [5], the authors have worked on image processing technique to eliminate the background light that affects the text extraction. Extracted text using Tesseract OCR and compared with following OCR software such as ABBYY FineReader and HANWANG. In order analyze the extracted text with other opensource OCR Tools, the researchers in [6], compares the Tesseract OCR extracted text with the Transym OCR extracted text by considering vehicle number plate as input. Further with the increased necessity of desired language text extraction in India, the authors in [7] worked on Indian language text extraction especially with South Indian languages. Finally, to interact between man and machine authors in [8] discusses about translation of converting one language to desired languages. Further, in [9] the authors have stated that Google Cloud Vision is free from noise but in real time text extraction requires appropriate illumination to extract the text from the images. Further, in [11] and [12] the authors has worked on real time implementation of SMART book reader using Tesseract OCR without focusing on lighting conditions. In [10] describes various applications of Google Cloud Vision

in assistive technology scenarios. From the above mentioned research work in [2],[3],[4],[5],[6],[7],[8] [9], [11] and [12], the accuracy may vary due to lighting condition illuminated on the image or scanned document and sometime the data may not be encoded appropriately for translation due to inappropriate selection of OCR engine order improve the accuracy we use appropriate pre-processing image enhancement method to improvise the accuracy level of text extraction.

III. OPTICAL CHARACTER RECOGNITION

A. Introduction

Optical Character Recognition helps in dealing various problems due to optically recognition processed word, character, fonts etc. The various documents such as either offline or online document text extraction depends on the quality of the input documents as shown in Fig.1.

B. Methods of OCR

OCR involves the following stages that may convert document into ASCII code and Unicode mapped to each ASCII code. OCR engine includes the following pre-processing methods which helps to enhance the image and to extract the text. Appropriate method may be used depending on the factors such as as paper quality, resolution of the image, age of the document, and the layout of text etc.

- Binarization,
- Noise removal,
- Thinning,
- Skew Detection & Correction,
- Line, Word and Character Segmentation,
- Feature Extraction and Selection,
- Classification.

Binarization Thinning and Skew correction and Detection are applied to the scanned image to extract the line and each character or word separation. The pre-processing in document analysis helps to remove the noise due to various factor such as low quality image or lighting background illumination. Upon removal of noise, character extraction is done based on the patterns trained in the database. These databases include various parameters such as Fonts, letters, numbers, etc. Hence, there is a need for appropriate image pre-processing required in order to extract the text from very low-quality images which includes both hardware aspect such as camera with appropriate light illumination and algorithm to improve the quality of the image for end-user applications.

In the recognition stage test character will be compared with the trained dataset through various Pattern Recognition algorithm and provides best match. Further, the various components of OCR system are shown in Fig. 3. In Fig. 4, feature extraction plays a vital role in extracting the text from the test input documents. The feature extraction depends on various factors such as noise, distortions, style variations, translation, rotations of each character.

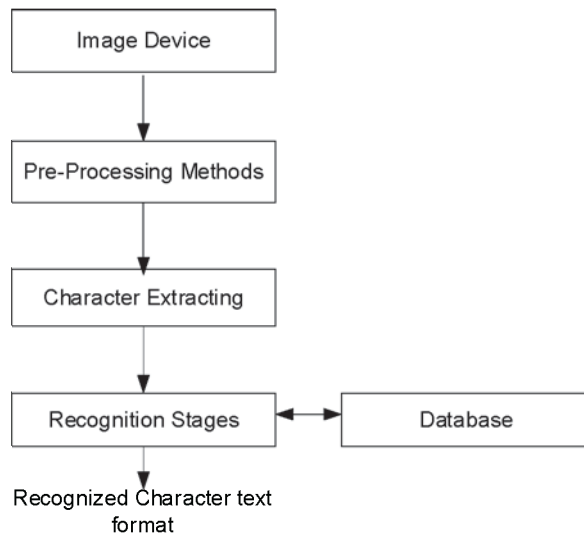


Fig. 2. General OCR system

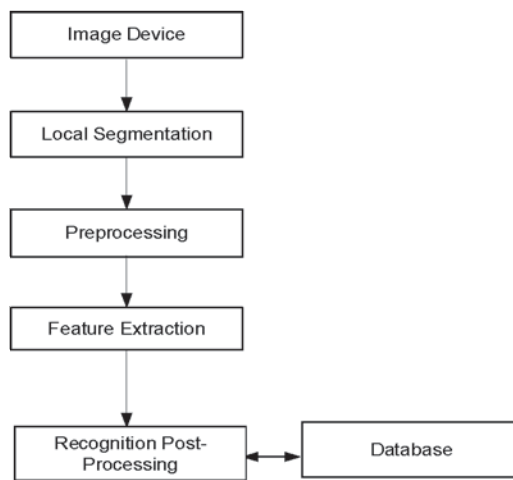


Fig. 3. Opensource OCR system

C. OCR accuracy evaluation

The accuracy of OCR is evaluated based on the recognition rate and rejection rate and error rate is determined based on the ratio between the Classified and Misclassified data rate.

IV. SYSTEM OVERVIEW

In this section we describe our SMART book reader system as shown in Fig. 4, the system includes Night vision camera to capture images from the book subjected under test. Further, the camera is interface to the Mini PC - Raspberry Pi 3 for image pre-processing using OpenCV-Python. In Mini PC is interface to HDMI supportable monitor using HDMI to VGA cable. As the Mini PC includes inbuild wi-fi which helps to connect the Mini PC to the cloud server to store the captured image in the Google drive. Further using Google Cloud Vision, we intend to access the pre-processed image as discussed in Section V to extract the text for end-user applications.

The real time implementation of our system shown in Fig. 5, that is capable of extracting text from any type of documents such as printed or handwritten document. In order to accomplish this, we intend to use Raspberry Pi with

Night Vision USB camera and a speaker along with various software tools such as Google Cloud OCR engine, Google Text to Speech (gTTS), Python Image Libraries, OpenCV and all software tools are python integrated.

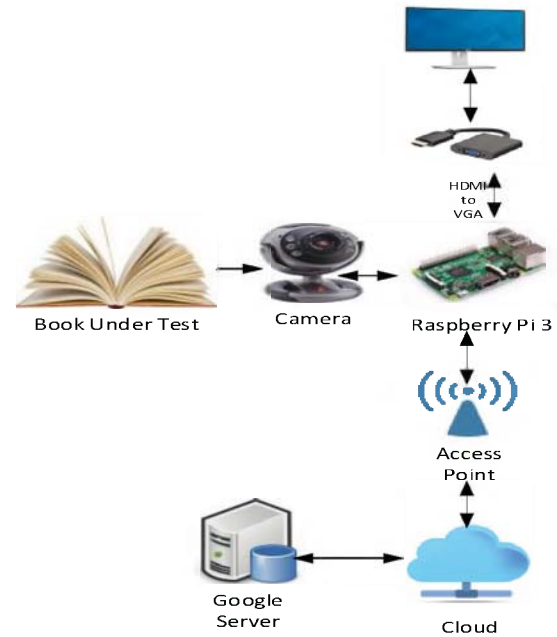


Fig. 4. SMART book reader Google Cloud OCR setup

The document under test is captured using the Night Vision Camera, intend to adjust brightness of the document which is under test. Further, we would be applying Image enhancement pre-processing technique to detect the edges of each character from the captured image. Upon, extracting the edges then we apply Google Cloud OCR engine to extract text from the image using character recognition. The extracted text is in Unicode format such as UTF-8 or UTF-16, we use UTF-8 code. Finally, the UTF-8 Unicode text is read through Text to Speech engine such as gTTS which reads out the text to the user. Further, we use Goslate to translate one language to another language. Thereby supporting Multilanguage translation and reading capabilities and the text can be read through the speaker or headphone connected to the raspberry. For testing purpose, we use the following languages such as English, Indian languages like Tamil, Hindi etc.

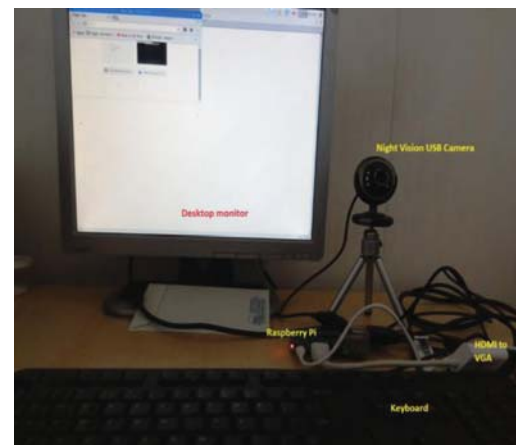


Fig. 5. shows the real time implementation of SMART Book reader with Google Cloud APIs

V. METHODOLOGY

The current system in existence is that words of any language can be typed manually and translated to any language as required. It is not possible to convert the image of an entire text book from one language to another. Some mobile applications which tried to do the above showed major errors in converting.

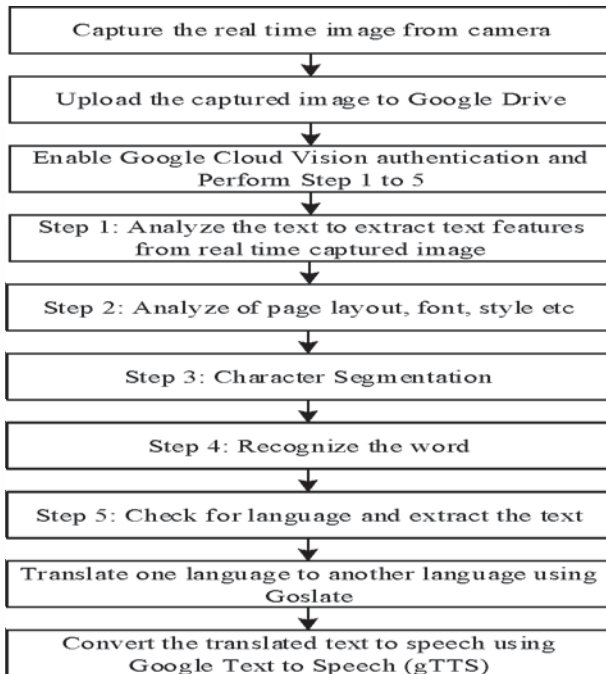


Fig. 6. Google Cloud OCR based Smart Book Reader

In this paper, we used Google Cloud Vision OCR engine to extract text from image which is shown in Fig. 6. Our system under goes the steps 1 to 5 as given in Fig. 6. The extract text is prone to error due to various factors as discussed in Section III. Further the result obtained using Google Cloud Vision OCR is discussed in result Section VI. As the tesseract OCR as discussed in [6],[11] and [12] is prone error due to low light illumination and needs appropriate pre-processing technique to compensate the errors. We use hardware-based lighting adjustment and software-based image enhancement methods to reduce error. We used Google Cloud OCR to extract the text from images, with the help of Google Cloud OCR we achieved 100% accuracy and its results are discussed in result Section VI.

VI. RESULT

In order study the accuracy of OCR engine, we tested our SMART Book Reader as shown in the Fig. 7, in the following OCR engines.

A. Tesseract OCR based Smart Book Reader

Firstly we tested using Pytesseract OCR engine as in [6],[11] and [12] on a input image obtained from real time USB Camera shown in Fig. 7. In order to enhance the image performance we used PIL image libraries to enhance the image. Even after enhancement the output is between 75% is attained and the results are shown in Fig. 8.

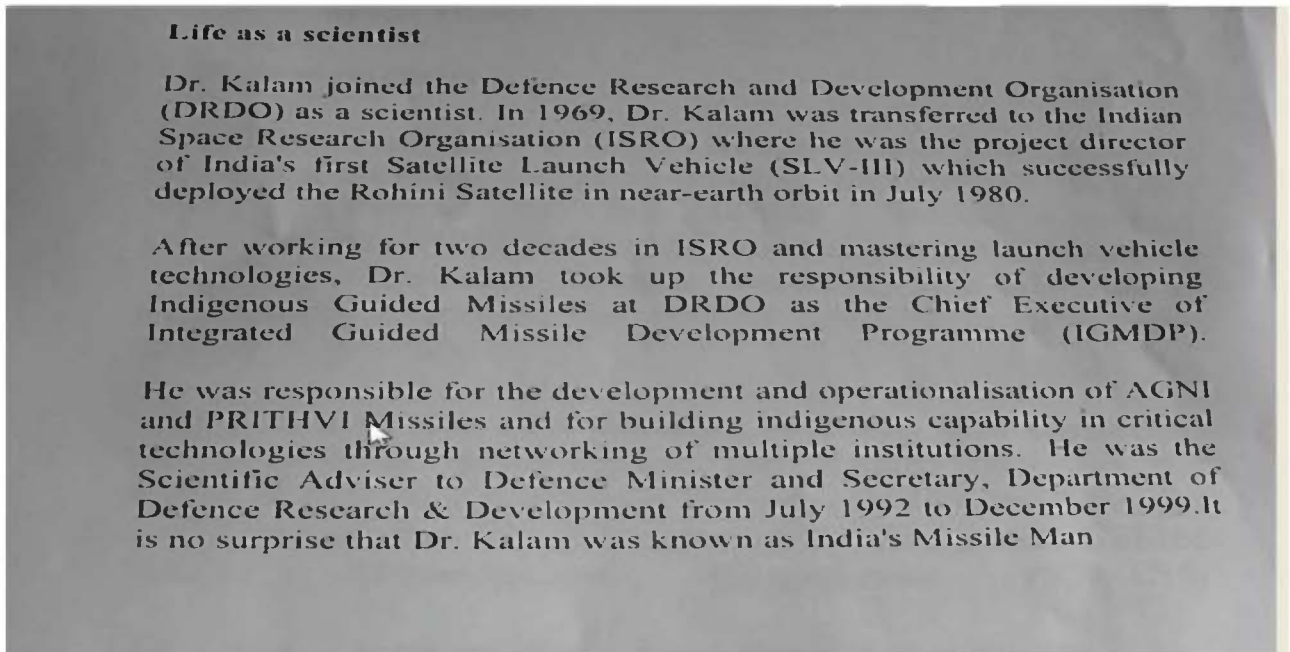


Fig. 7. Shows the input image obtained from Night Vision camera.

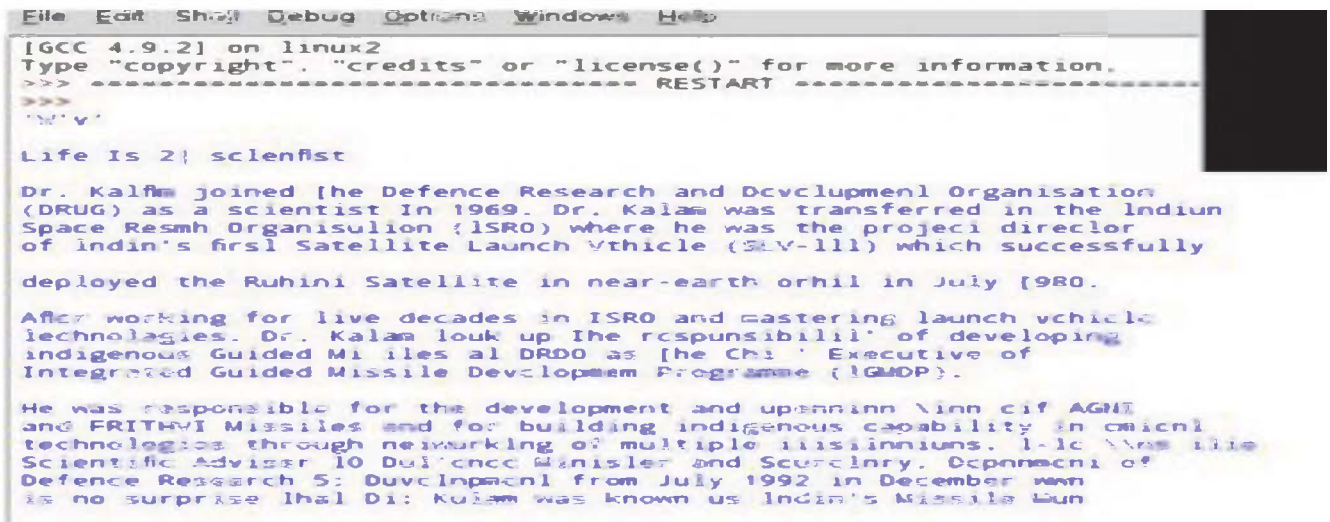


Fig. 8. shows the Tesseract OCR engine output for input image as in Fig 7.

B. Google Cloud OCR based Smart Book Reader

Secondly, we tested using Google Cloud OCR engine on an input image obtained from real time camera shown in Fig. 9 is uploaded to the Google Cloud Drive. By creating new project and enabling the Google Translation API, and Google Drive API and Google OCR API 100% output is achieved. Fig. 10 shows the real time image acquired from the camera is uploaded to Google Drive. Further, Fig. 11 shows the input image obtained from camera is uploaded to Google drive and Client authorization is obtained by linking the JSON file downloaded from google by enabling the

credential. Fig. 12 shows the real time image acquired from the camera is uploaded to Google Drive and its hyperlink to view the extracted text in any any format such as PDF, HTML, TXT etc. Google Cloud OCR engine available in Google Cloud Vision has various applications, in our paper we considered for book reading for visually impaired. As single book may consists of many pages cloud storage and computing will be more appropriate access to store and retrieve the data from the cloud. Compared to Tesseract as discussed in [6],[11] and [12], Google Cloud OCR has 100% output under dynamic environment with multilingual feasibility.

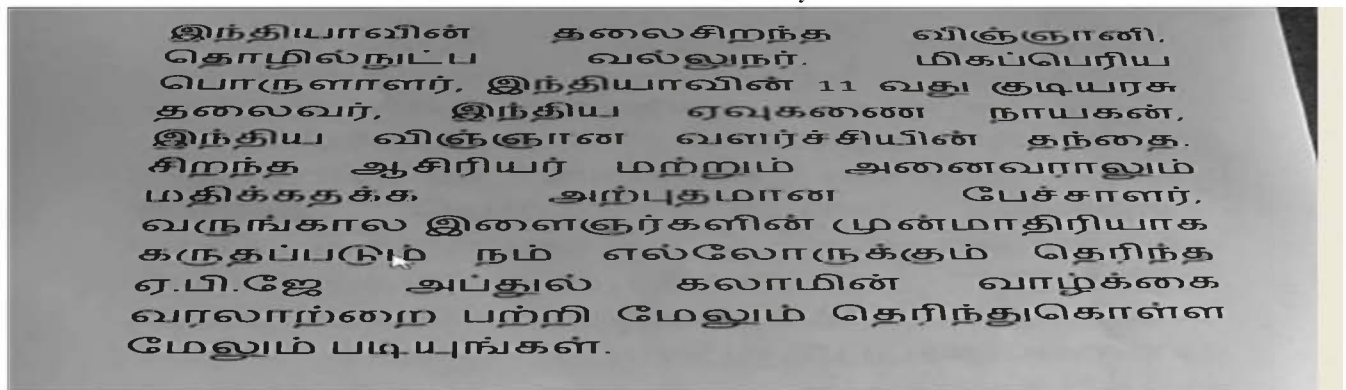


Fig. 9. shows the captured image is uploaded to Google using Authentication.

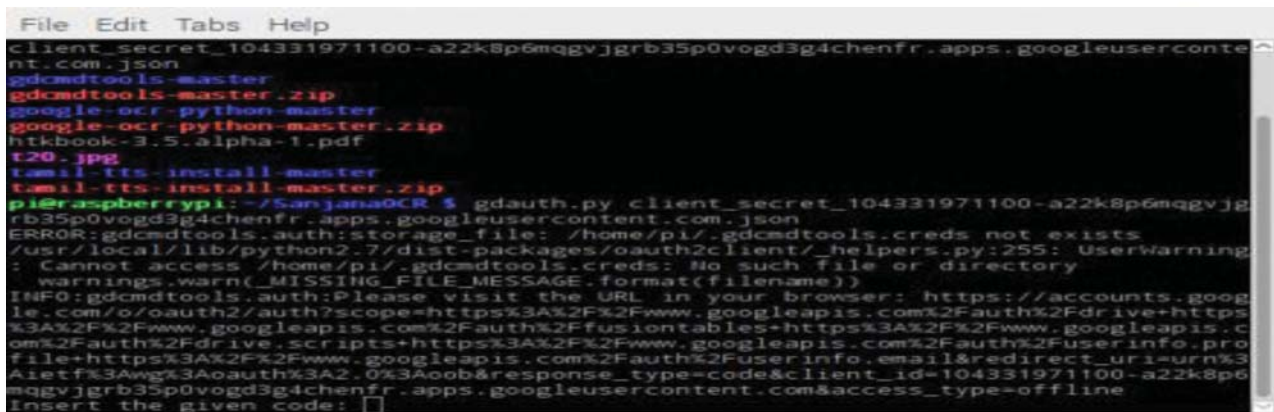


Fig. 10. shows the captured image is uploaded to Google drive


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File Edit Tabs Help
pi@raspberrypi:~/Sanjaya$ gput.py -t ocr t20.jpg
Uploading file: t20.jpg
File size: 51.1KB
id: 1SFH9dzFns1r_z7IvpA11bjQ8Y73LGq3tmeIpR7fNRU
Drive url: https://docs.google.com/document/d/1SFH9dzFns1r_z7IvpA11bjQ8Y73LGq3tmeIpR7fNRU/edit?usp=drivesdk
download url: https://drive.google.com/uc?id=1SFH9dzFns1r_z7IvpA11bjQ8Y73LGq3tmeIpR7fNRU&export=download
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Fig. 11. shows different output file format JPG,HTML, TXT, PDF



Fig. 12. shows the output in HTML format

VII. CONCLUSION

With reference to the results obtained using various OCR engines such as Tesseract OCR [6],[11] and [12] the available Google Cloud Vision API is less prone to error and noise. It is observed that the content extraction using Tesseract OCR is more prone to error with 75% and further it is difficult to decode the text to Unicode format for Text to Speech conversion using Google Text to Speech – gTTS. Further, we tested another image using Google OCR engine embedded with Google cloud platform we attained 100% accuracy. Thus, Google OCR with Google cloud platform provides more accurate and appropriate results which can be applicable various applications such as content text analysis, helps the visually impaired person to read the text using gTTS conversion into speech.

VIII. FUTURE SCOPE

As increase in new methods being implemented in OCR engine to recognition each and every character without any difficulty. With help of Google OCR we can even directly

extract the languages with optimized code thereby lowers the computational complexity in recognizing the character. Further, such system can be helpful for the visually impaired people.

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