

PORTABLE CAMERA BASED LABEL READER FOR BLIND PEOPLE

Submitted in partial fulfillment of the requirements

for the award of

Bachelor of engineering degree in Computer Science and Engineering

by

B.SRI LAKSHMI MOUNIKA (Reg No: 38110551)



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SCHOOL OF COMPUTING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC
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CHENNAI-600119**

APRIL 2022



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **B.SRI LAKSHMI MOUNIKA (Reg No: 38110551)** who carried out the project entitled "**PORTABLE CAMERA BASED LABEL FOR DISABLED PEOPLE**" under our supervision from **NOVEMBER 2021 to APRIL 2022.**

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I, B.mounika (Reg No: 38110551) hereby declare that the Project Report entitled as **“PORTABLE CAMERA BASED LABEL READER FOR DISABLED PEOPLE”** done by me under the guidance of **Dr. T. SASIKALA, M.E., Ph.D.**, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Computer Science and Engineering.

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ABSTRACT:

An OCR (Optical Character Recognition) system which is a branch of computer vision and in turn a sub-class of Artificial Intelligence. Optical character recognition is the translation of optically scanned bitmaps of printed or hand written text into audio output by using of Raspberry Pi. OCRs developed for many world languages are already under efficient use. This method extracts moving object region by a mixture-of-Gaussians-based background subtraction method. A text localization and recognition are conducted to acquire text information. To automatically localize the text regions from the object, a text localization and Tesseract algorithm by learning gradient features of stroke orientations and distributions of edge pixels in an Ada boost model. Text characters in the localized text regions are then binaries and recognized by off-the-shelf optical character recognition software. The recognized text codes are output to blind users in speech. Performance of the proposed text localization algorithm. As the recognition process is completed, the character codes in the text file are processed using Raspberry pi device on which recognize character using Tesseract algorithm and python programming, the audio output is listened.

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LIST OF ABBREVIATIONS

SCIT	Secure Confidential Information Transfer
DApps	Decentralized Application
IoT	Internet of Things

WSN	Wireless Sensor Network
PDP	Provable Data Possession
D2D	Device-to-Device
CSI	Channel State Information
EMR	Electronic Medical Records
PHI	Personal Health Information
DDoS	Distributed Denial of Service
PoW	Proof of Work
UI	User Interface
APK	Android Application Package
P2P	Peer to Peer

XRP	A Crypto Currency
NFT	Non-Fungible Token
CIA	Central Intelligence Agency

CHAPTER 1

• INTRODUCTION

In the running world, there is growing demand for the software systems to recognize characters in computer system when information is scanned through paper documents as we know that we have number of newspapers and books which are in printed format related to different subjects. These days there is a huge demand in “storing the information available in these paper documents in to a computer storage disk and then later reusing this information by searching process”. One simple way to store information in these paper documents in to computer system is to first scan the documents and then store them as IMAGES. But to reuse this information it is very difficult to read the individual contents and searching the contents from these documents line-by-line and word-by-word. The reason for this difficulty is the font characteristics of the characters in paper documents are different to font of the characters in computer system. As a result, computer is unable to recognize the characters while reading them. This concept of

storing the contents of paper documents in computer storage place and then reading and searching the content is called DOCUMENT PROCESSING. Sometimes in this document processing we need to process the information that is related to languages other than the English in the world. For this document processing we need a software system called **CHARACTER RECOGNITION SYSTEM**. This process is also called DOCUMENT IMAGE ANALYSIS (DIA).

Thus our need is to develop character recognition software system to perform Document Image Analysis which transforms documents in paper format to electronic format. For this process there are various techniques in the world. Among all those techniques we have chosen Optical Character Recognition as main fundamental technique to recognize characters. The conversion of paper documents into electronic format is an on-going task in many of the organizations particularly in Research and Development (R&D) area, in large business enterprises, in government institutions, so on. From our problem statement we can introduce the necessity of Optical Character Recognition in mobile electronic devices such as cell phones, digital cameras to acquire images and recognize them as a part of face recognition and validation.

To effectively use Optical Character Recognition for character recognition in-order to perform Document Image Analysis (DIA), we are using the information in Grid format. . This system is thus effective and useful in *Virtual Digital Library's* design and construction.

- **PURPOSE**

The main purpose of **Optical Character Recognition (OCR)** system based on a grid infrastructure is to perform Document Image Analysis, document processing of electronic

document formats converted from paper formats more effectively and efficiently. This improves the accuracy of recognizing the characters during document processing compared to various existing available character recognition methods. Here OCR technique derives the meaning of the characters, their font properties from their bit-mapped images.

- The primary objective is to speed up the process of character recognition in document processing. As a result the system can process huge number of documents with-in less time and hence saves the time.
- Since our character recognition is based on a grid infrastructure, it aims to recognize multiple heterogeneous characters that belong to different universal languages with different font properties and alignments.

- **PROJECT SCOPE**

- The scope of our product Optical Character Recognition on a grid infrastructure is to provide an efficient and enhanced software tool for the users to perform Document Image Analysis, document processing by reading and recognizing the characters in research, academic, governmental and business organizations that are having large pool of documented, scanned images. Irrespective of the size of documents and the type of characters in documents, the product is recognizing them, searching them and processing them faster according to the needsof the environment.

1.3 EXISTING SYSTEM

In the running world there is a growing demand for the users to convert the printed documents in to electronic documents for maintaining the security of their data. Hence the basic OCR system was invented to convert the data available on papers in to computer process able documents, So that the documents can be editable and reusable. The existing system/the previous system of OCR on a grid infrastructure is just OCR without grid functionality. That is the existing system deals with the homogeneous character recognition or character recognition of single languages.

- **1.4 DRAWBACK OF EXISTING SYSTEM**

The drawback in the early OCR systems is that they only have the capability to convert and recognize only the documents of English or a specific language only. That is, the older OCR system is uni-lingual.

- **1.5 PROPOSED SYSTEM**

Our proposed system is OCR on a grid infrastructure which is a character recognition system that supports recognition of the characters of multiple languages. This feature is what we call grid infrastructure which eliminates the problem of heterogeneous character recognition and supports multiple functionalities to be performed on the document. The multiple functionalities include editing and searching too where as the existing system supports only editing of the document. In this context, Grid infrastructure means the infrastructure that supports group of specific set of languages. Thus OCR on a grid infrastructure is multi-lingual.

- **1.6 BENEFIT OF PROPOSED SYSTEM**

The benefit of proposed system that overcomes the drawback of the existing system is that it supports multiple functionalities such as editing and searching. It also adds benefit by providing heterogeneous characters recognition.

- **1.7 ARCHITECTURE OF THE PROPOSED SYSTEM**

The Architecture of the optical character recognition system on a grid infrastructure consists of the three main components. They are:-

- Scanner
- OCR Hardware or Software
- Output Interface

Figure.1: OCR Architecture

- **1.8 INTENDED AUDIENCE AND READING SUGGESTIONS**

In this section, we identify the audience who are interested with the product and are involved in the implementation of the product either directly or indirectly. As from our research, the OCR system is mainly useful in R&D at various scientific organizations, in governmental institutes and in large

business organizations, we identify the following as various interested audience in implementing OCR system:-

- The scientists, the research scholars and the research fellows in telecommunication institutions are interested in using OCR system for processing the word document that contains base paper for their research.
- The Librarian to manage the information contents of the older books in building virtual digital library requires use of OCR system.
- Various sites that vendor e-books have a huge requirement of this OCR system in-order to scan all the books in to electronic format and thus make money. The Amazon book world is largely using this concept to build their digital libraries.

Now we present the reading suggestions for the users or clients through which the user can better understand the various phases of the product. These suggestions may be effective and useful for the beginners of the product rather than the regular users such as research scholars, librarians and administrators of various web-sites. With these suggestions, the user need not waste his time in scrolling the documents up and down, browsing through the web, visiting libraries in search of different books and ... The following are the various reading suggestions that the user can follow in-order to completely understand about our product and to save time:-

- It would help you if you start with Wikipedia.com. It lets you know the basic concept of every keyword you require. First learn from it what is OCR? And how does it work based on a Grid infrastructure?
- Now you can proceed your further reading with the introduction of our product we provided in our documentation. From these two steps you completely get an in-depth idea of the use of our product and several processes involved in it.
- The more you need is the implementation of the product. For this you can visit FreeOCR.com where you can view how the sample OCR works and you can try it.

1.9 PROBLEM STATEMENT:

- Traditional methods like Braille exist using which the blind people have to trace and read text, which is very slow and not very practical.
- Existing OCR systems are not automatic and require full-fledged computers to run and hence are not effective.
- Reader Mobile runs on a cell phone and allows the user to read mail, receipts, fliers, and many other documents

• **2. LITERATURE REVIEW**

A feasibility study is a high-level capsule version of the entire System analysis and Design Process. The study begins by classifying the problem definition. Feasibility is to determine if it's worth doing. Once an acceptance problem definition has been generated, the analyst develops a logical model of the system. A search for alternatives is analyzed carefully. There are 3 parts in feasibility study.

• **TECHNICAL FEASIBILITY**

Evaluating the technical feasibility is the trickiest part of a feasibility study. This is because, at this point in time, not too many detailed design of the system, making it difficult to access issues like performance, costs on (on account of the kind of technology to be deployed) etc. A number of issues have to be considered while doing a technical analysis. Understand the different technologies involved in the proposed system before commencing the project we have to be very clear about what are the technologies that are to be required for the development of the new system. Find out whether the organization currently possesses the required technologies. Is the required technology available with the organization?.

• **OPERATIONAL FEASIBILITY**

Proposed project is beneficial only if it can be turned into information systems that will meet the organizations operating requirements. Simply stated, this test of feasibility asks if the system will work when it is

developed and installed. Are there major barriers to Implementation? Here are questions that will help test the operational feasibility of a project:

- Is there sufficient support for the project from management from users?
If the current system is well liked and used to the extent that persons will not be able to see reasons for change, there may be resistance.
- Are the current business methods acceptable to the user? If they are not, Users may welcome a change that will bring about a more operational and useful systems.
- Have the user been involved in the planning and development of the project?
- Early involvement reduces the chances of resistance to the system and in general and increases the likelihood of successful project.

Since the proposed system was to help reduce the hardships encountered. In the existing manual system, the new system was considered to be operational feasible.

- **ECONOMIC FEASIBILITY**

Economic feasibility attempts to weigh the costs of developing and implementing a new system, against the benefits that would accrue from having the new system in place. This feasibility study gives the top management the economic justification for the new system. A simple economic analysis which gives the actual comparison of costs and benefits are much more meaningful in this case. In addition, this proves to be a useful point of reference to compare actual costs as the project progresses. There could be various types of intangible benefits on account of automation. These could include increased customer satisfaction, improvement in product quality better decision making timeliness of information, expediting activities, improved accuracy of operations, better documentation and record keeping, faster retrieval of information, better employee morale.

- **TRAINING**

Training is a very important process of working with a neural network. As seen from neural networks, there are two forms of training that can be employed with a neural network. They are namely:-

- Un-Supervised Training
- Supervised Training

Supervised training provides the neural network with training sets and the anticipated output. Unsupervised training supplies the neural network with training sets, but there is no anticipated output provided.

2.4.1 UNSUPERVISED TRAINING

Unsupervised training is a very common training technique for Kohonen neural networks. We will discuss how to construct a Kohonen neural network and the general process for training without supervision.

What is meant by training without supervision is that the neural network is provided with training sets, which are collections of defined input values. But the unsupervised neural network is not provided with anticipated outputs.

Unsupervised training is usually used in a classification neural network. A classification neural network takes input patterns, which are presented to the input neurons. These input patterns are then processed, and one single neuron on the output layer fires. This firing neuron can be thought of as the classification of which group the neural input pattern belonged to. Handwriting recognition is a good application of a classification neural network.

The input patterns presented to the Kohonen neural network are the dot image of the character that was hand written. We may then have 26 output neurons, which correspond to the 26 letters of the English alphabet. The Kohonen neural network should classify the input pattern into one of the 26 input patterns.

During the training process the Kohonen neural network in handwritten recognition is presented with 26 input patterns. The network is configured to also have 26 output patterns. As the Kohonen neural network is trained the weights should be adjusted so that the input patterns are classified into the 26 output neurons. This technique results in a relatively effective method for character recognition.

Another common application for unsupervised training is data mining. In this case you have a large amount of data, but you do not often know exactly what you are looking for. You want the

neural network to classify this data into several groups. You do not want to dictate, ahead of time, to the neural network which input pattern should be classified to which group. As the neural network trains the input patterns will fall into similar groups. This will allow you to see which input patterns were in common groups.

- **2.4.2 SUPERVISED TRAINING**

The supervised training method is similar to the unsupervised training method in that training sets are provided. Just as with unsupervised training these training sets specify input signals to the neural network.

The primary difference between supervised and unsupervised training is that in supervised training the expected outputs are provided. This allows the supervised training algorithm to adjust the weight matrix based on the difference between the anticipated output of the neural network, and the actual output.

There are several popular training algorithms that make use of supervised training. One of the most common is the back-propagation algorithm. It is also possible to use an algorithm such as simulated annealing or a genetic algorithm to implement supervised training

- **INTRODUCING KOHONEN NEURAL NETWORK**

The Kohonen neural network differs considerably from the feed-forward back propagation neural network. The Kohonen neural network differs both in how it is trained and how it recalls a pattern. The Kohonen neural network does not use any sort of activation function. Further, the Kohonen neural network does not use any sort of a bias weight.

Output from the Kohonen neural network does not consist of the output of several neurons. When a pattern is presented to a Kohonen network one of the output neurons is selected as a "winner". This "winning" neuron is the output from the Kohonen network. Often these "winning" neurons represent groups in the data that is presented to the Kohonen network. For example, in an OCR program that uses 26 output neurons, the 26 output neurons map the input patterns into the 26 letters of the Latin alphabet.

The most significant difference between the Kohonen neural network and the feed forward back propagation neural network is that the Kohonen network is trained in an unsupervised mode. This means that the Kohonen network is presented with data, but the correct output that corresponds to that data is not specified. Using the Kohonen network this data can be classified into groups. We will begin our review of the Kohonen network by examining the training process.

It is also important to understand the limitations of the Kohonen neural network. Neural networks with only two layers can only be applied to linearly separable problems. This is the case with the Kohonen neural network. Kohonen neural networks are used because they are a relatively simple network to construct that can be trained very rapidly.

A "feed forward" neural network is similar to the types of neural networks that we have already examined. Just like many other neural network types the feed forward neural network begins with an input layer. This input layer must be connected to a hidden layer. This hidden layer can then be

connected to another hidden layer or directly to the output layer. There can be any number of hidden layers so long as at least one hidden layer is provided. In common use most neural networks will have only one hidden layer. It is very rare for a neural network to have more than two hidden layers. We will now examine, in detail, and the structure of a "feed forward neural network".

- **The Structure of a Feed Forward Neural Network**

A "feed forward" neural network differs from the neural networks previously examined.

Figure 2.1 shows a typical feed forward neural network with a single hidden layer.

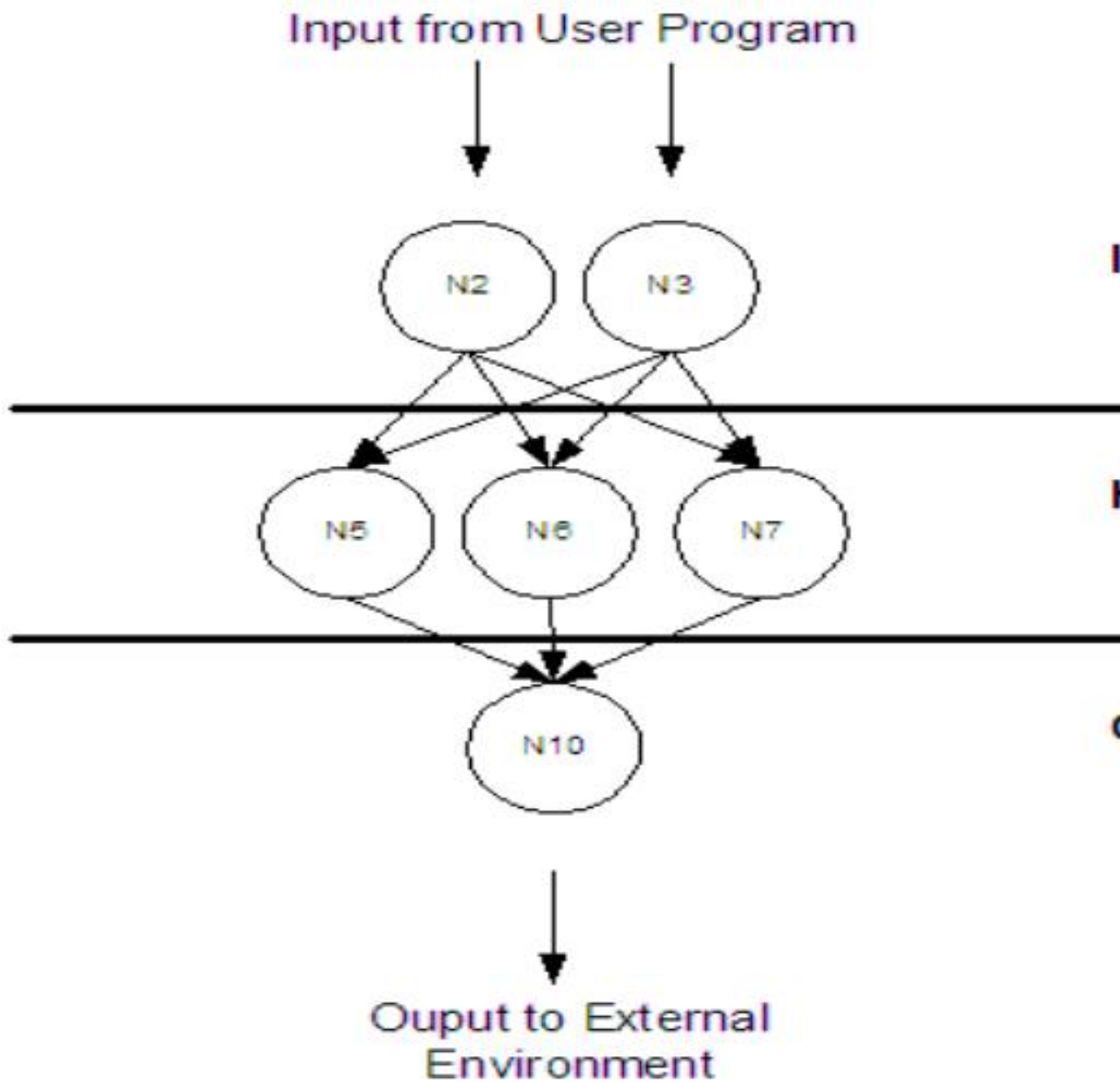


Figure 2 Feed Forward Neural Network

- **The Input Layer**

The input layer to the neural network is the conduct through which the external environment presents a pattern to the neural network. Once a pattern is presented to the input layer of the neural network the output layer will produce another pattern. In essence this is all the neural network does.

The input layer should represent the condition for which we are training the neural network for. Every input neuron should represent some independent variable that has an influence over the output of the neural network.

It is important to remember that the inputs to the neural network are floating point numbers. These values are expressed as the primitive Java data type "double". This is not to say that you

can only process numeric data with the neural network. If you wish to process a form of data that is non-numeric you must develop a process that normalizes this data to a numeric representation.

The Output Layer

The output layer of the neural network is what actually presents a pattern to the external environment. Whatever pattern is presented by the output layer can be directly traced back to the input layer. The number of output neurons should be directly related to the type of work that the neural network is to perform.

To consider the number of neurons to use in your output layer you must consider the intended use of the neural network. If the neural network is to be used to classify items into groups, then it is often preferable to have one output neuron for each group that the item is to be assigned into. If the neural network is to perform noise reduction on a signal then it is likely that the number of input neurons will match the number of output neurons. In this sort of neural network you would one day he would want the patterns to leave the neural network in the same format as they entered.

For a specific example of how to choose the numbers of input and output neurons consider a program that is used for optical character recognition, or OCR. To determine the number of neurons used for the OCR example we will first consider the input layer. The number of input neurons that we will use is the number of pixels that might represent any given character. Characters processed by this program are normalized to universal size that

is represented by a 5x7 grid. A 5x7 grid contains a total of 35 pixels. The optical character recognition program therefore has 35 input neurons.

The number of output neurons used by the OCR program will vary depending on how many characters the program has been trained for. The default training file that is provided with the optical character recognition program is trained to recognize 26 characters. As a result using this file the neural network would have 26 output neurons. Presenting a pattern to the input neurons will fire the appropriate output neuron that corresponds to the letter that the input pattern corresponds to.

2.6. VISION BASED ASSISTIVE SYSTEM FOR LABEL DETECTION WITH VOICEOUTPUT

A camera based assistive text reading framework to help blind persons read text labels and product packaging from hand-held object in their daily resides is proposed. To isolate the object from cluttered backgrounds or other surroundings objects in the camera view, we propose an efficient and effective motion based method to define a region of interest (ROI) in the video by asking the user to shake the object. In the extracted ROI, text localization and recognition are conducted to acquire text information. To automatically localize the text regions from the object ROI, we propose a novel text localization algorithm by learning gradient features of stroke orientations and distributions of edge pixels in an Adaboost model. Text characters in the localized text regions are then binarized and recognized by off-the-shelf optical character recognition software. The recognized text codes are output to blind users in speech

• INTRODUCTION

Of the 314 million visually impaired people worldwide, 45 million are blind. Recent developments in computer vision, digital cameras and portable computers make it feasible to assist these individuals by developing camera based products that combine computer vision technology with other existing commercial products such optical character recognition (OCR) systems.

Reading is obviously essential in today's society. Printed text is everywhere in the form of reports, receipts, bank statements, restaurant menus, classroom handouts, product packages, instructions on medicine bottles, etc.

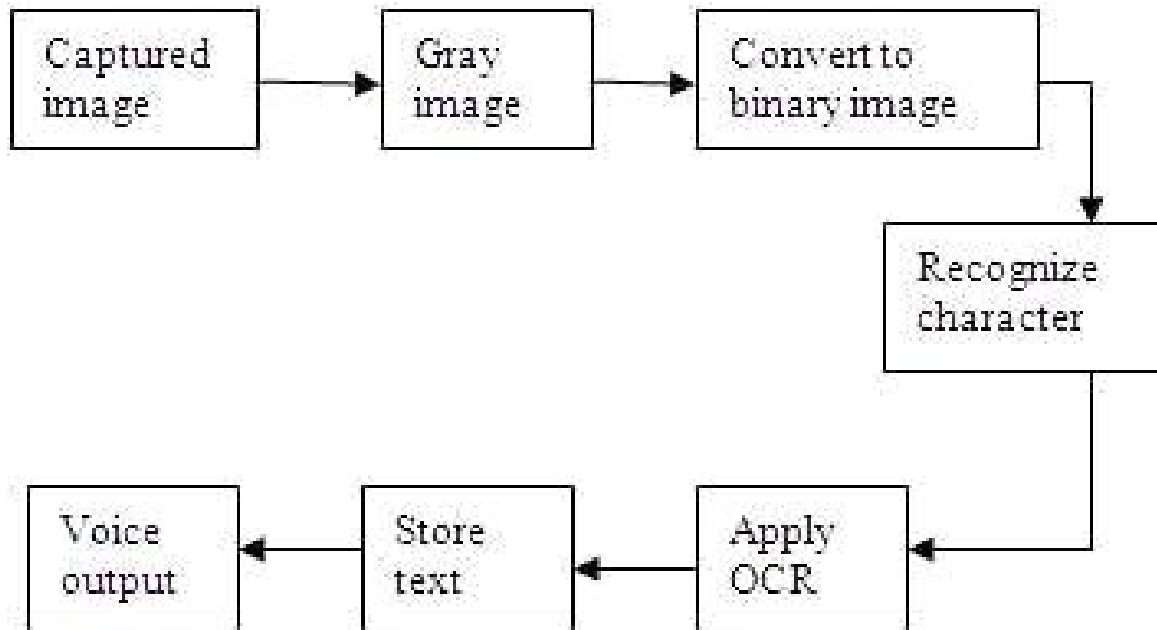
The ability of people who are blind or have significant visual impairments to read printed labels and product packages will enhance independent living and foster economic and social self-

sufficiency. Today, there are already a few systems that have some promise for portable use, but they cannot handle product labelling

Selectively extract the image of the object held by the blind user from the cluttered background or other neutral objects in the camera view; and 2) text localization to obtain image regions containing text, and text recognition to transform image-based text information into readable codes. We use a mini laptop as the processing device in our current prototype system. The audio output component is to inform the blind user of recognized text codes.

- **IMAGE CAPTURING AND PRE-PROCESSING**

The video is captured by using web-cam and the frames from the video is segregated and undergone to the pre-processing. First, get the objects continuously from the camera and adapted to process. Once the object of interest is extracted from the camera image and it converted into gray image. Use haar cascade classifier for recognizing the character from the object. The work with a cascade classifier includes two major stages: training and detection. For training need a set of samples. There are two types of samples: positive and negative.



To extract the hand-held object of interest from other objects in the camera view, ask users to shake the hand-held objects containing the text they wish to identify and then employ a motion- based method to localize objects from cluttered background.

- **AUTOMATIC TEXT EXTRACTION**

In order to handle complex backgrounds, two novel feature maps to extracts text features based on stroke orientations and edge distributions, respectively. Here, stroke is defined as a uniform region with bounded width and significant extent. These feature maps are combined to build an Adaboost based text classifier.

- **TEXT REGION LOCALIZATION**

Text localization is then performed on the camera based image. The Cascade-Adaboost classifier confirms the existence of text information in an image patch but it cannot the whole images, so heuristic layout analysis is performed to extract candidate image patches prepared for text classification. Text information in the image usually appears in the form of horizontal text strings containing no less than three character members.

- **TEXT RECOGNITION AND AUDIO OUTPUT**

Text recognition is performed by off-the-shelf OCR prior to output of informative words from the localized text regions. A text region labels the minimum rectangular area for the accommodation of characters inside it, so the border of the text region contacts the edge boundary of the text characters. However, this experiment show that OCR generates better performance text regions are first assigned proper margin areas and binaries to segments text characters from background

The recognized text codes are recorded in script files. Then, employ the Microsoft Speech Software Development Kit to load these files and display the audio output of text information. Blind users can adjust speech rate, volume and tone according to their preferences. Are designed to easily interface with dedicated computer systems by using the same USB technology that is found on most computers. Static random-access memory (SRAM) is a type of a semiconductor memory that uses bi-stable latching circuitry to store each bit.

ARM11 features are, Supports 4-64k cache sizes, Powerful ARMV6 instruction set architecture, SIMD (Single Instruction Multiple Data) media processing extensions deliver up to 2x performance for video processing, and High-performance 64-bit memory system speeds data access for media processing and networking applications. LAN9512/LAN9512i contains an integrated USB 2.0 hub, two integrated downstream USB 2.0 PHYs, an integrated upstream USB

2.0 PHY, a 10/100 Ethernet PHY, a 10/100 Ethernet Controller, a TAP Controller and EEPROM Controller. Flash memory is an electronic non-volatile compute storage medium that can be an electrically erased and reprogrammed. Earphones either have wires for connection to a signal source such as an audio amplifier, radio, CD player, portable media player or have a wireless receiver, which is used to pick up signal without using a cable

The proposed system ensures to read printed text on hand-held objects for assisting blind persons. In order to solve the common aiming problem for blind users, a motion-based method to detect the object of interest is projected, while the blind user simply shakes the object for a couple of seconds. This method can effectively distinguish the object of interest from background or other objects in the camera view. An Adaboost learning model is employed to localize text in camera-based images. Off the shelf OCR is used to perform word recognition on the localized text regions and transform into audio output for blind users.

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- **INTRODUCTION**

Of the 314 million visually impaired people worldwide, 45 million are blind. Recent developments in computer vision, digital cameras and portable computers make it feasible to assist these individuals by developing cam-era based products that combine computer vision tech-neology with other existing commercial products such optical character recognition (OCR)

systems. Reading is obviously essential in today's society. Printed text is everywhere in the form of reports, receipts, bank statements, restaurant menus, classroom handouts, product packages, instructions on medicine bottles, etc.

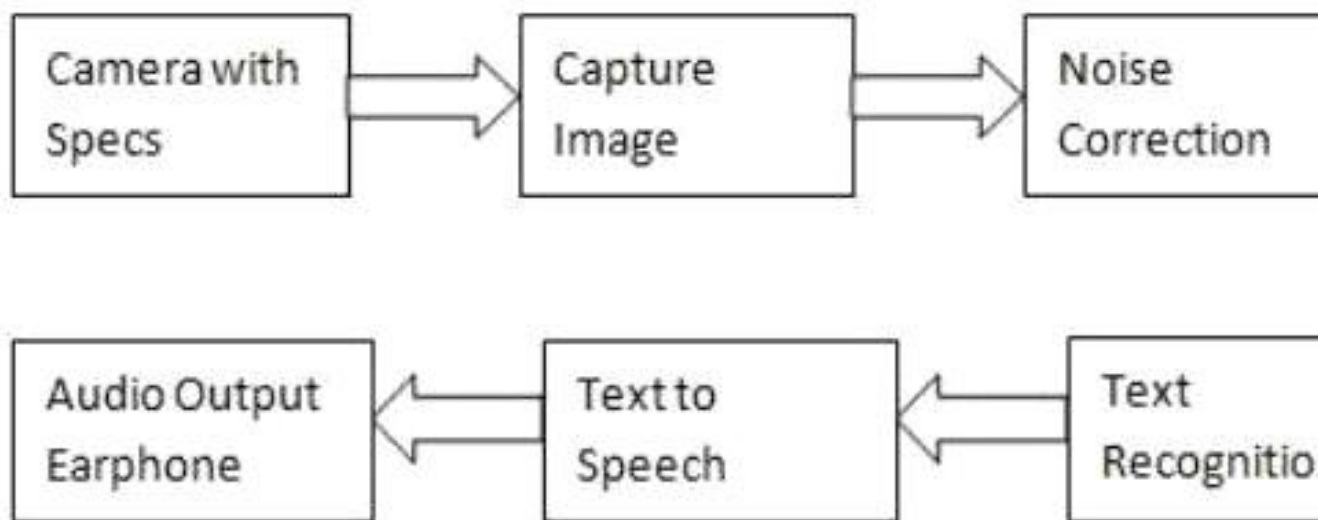
The ability of people who are blind or have significant visual impairments to read printed labels and product packages will enhance independent living and foster economic and social self- sufficiency. Today, there are already a few systems that have some promise for portable use, but they cannot handle product labeling. For example, portable bar code readers designed to help blind people identify different products in an extensive product database can enable users who are blind to access information about these products through speech and Braille.

- **PROJECT DESCRIPTION**

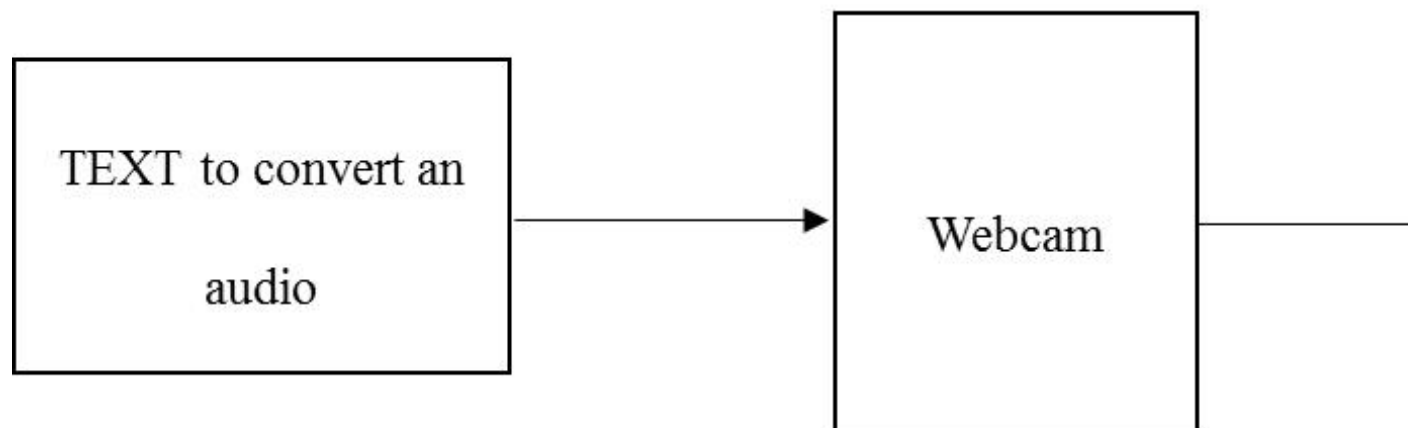
But a big limitation is that it is very hard for blind users to find the position of the bar code and to correctly point the bar code reader at the bar code. Some reading assistive systems such as pen scanner might be employed in these and similar situations. Although a number of reading assistants have been designed specifically for the visually impaired, to our knowledge, no existing reading assistant can read text from the kinds of challenging patterns and backgrounds found on many everyday commercial products.

To assist blind persons to read text from these kinds of hand-held objects, we have conceived of a camera based assistive text reading framework to track the object of interest within the camera view and extract print text information from the object. Our proposed algorithm can effectively handle complex background and multiple patterns, and extract text information from both hand-held objects and nearby signage.

FLOW DIAGRAM:



BLOCK DIAGRAM:



We have described a prototype system to read printed text on hand-held objects for assisting blind persons. In order to solve the common aiming problem for blind users, we have proposed a motion-based method to detect the object of interest, while the blind user simply shakes the object for a couple of seconds. The automatic ROI detection and text localization algorithms were independently evaluated as unit tests to ensure effectiveness and robustness of the whole system. We subsequently evaluated this prototype system of assistive text reading using images of hand-held objects captured by ten blind users in person. Two calibrations were applied to prepare for the system test. First, we instructed blind users to place hand-held object within the camera view. Since it is difficult for blind users to aim their held objects, we employed a camera with a reasonably wide angle.

In future systems, we will add finger point detection and tracking to adaptively instruct blind users to aim the object. Second, in an applicable blind-assistive system, a text localization algorithm might prefer higher recall by sacrificing some precision

When our application starts running it first check all the devices and resources which it needs are available or not. After that it checks the

connection with the devices and gives control to the user. The GUI for the user has the following options. An optional label is used for displaying the image taken from the camera. A status box is for representing the detected data from the image. The capture button is to detect the data from the image. The detect button is to detect the human from the video streaming in front of the camera. The audio jack port is the output port here. The Raspberry board comes with integrated peripherals like USB, ADC and Serial etc. On this board we are installing Linux operating system with necessary drivers for all peripheral devices.

- **WORKING PRINCIPLE**

When capture button is clicked this system captures the product image placed in front of the web camera which is connected to ARM microcontroller through USB .After selecting the process button the captured label image undergoes Optical Character Recognition(OCR) Technology. OCR technology allows the conversion of scanned images of printed text or symbols (such as a page from a book) into text or information that can be understood or edited using a computer program.

The most familiar example is the ability to scan a paper document into a computer where it can then be edited in popular word processors such as Microsoft Word. However, there are many other uses for OCR technology, including as a component of larger systems which require recognition capability, such as the number plate recognition systems, or as tools involved in creating resources for SALT development from print based texts. In our system for OCR technology we are using TESSERACT library. Using Flite library the data will be converted to audio.

Camera acts as main vision in detecting the label image of the product or board then image is processed internally and separates label from image by using open CV library and finally identifies the product and identified product name is pronounced through voice.

Now it identifies received label image is converted to text by using tesseract library. Once the identified label name is converted to text and converted text is displayed on display unit connected to controller. Now converted text should be converted to voice to hear label name as voice through ear phones connected to audio jack port using flite library.

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Optical character recognition is the translation of optically scanned bitmaps of printed or written text into digitally editable data files. OCRs developed for many world languages are already under efficient use.

- **Computer Vision**

Human intelligence is described as the capability to make decisions based on information which is incomplete and noisy. This is the ability which makes human being the most superior amongst all living creatures in the world.

There are five senses that provide information to humans for making everyday decisions and out of these the senses of hearing and vision are the sharpest of all. The auditory sense helps us recognize sounds and classify them. It is this sense which tells us that the person on the phone is a friend because his voice is *recognizable*. We can differentiate between an endless variety of sounds, voices, utterances and put them in exactly the slots they belong to, animal sounds, musical notes, wind swishing, the footsteps of a family member, all are within recognition range of a person with a normal sense of hearing.

The other one and the one more profound is the human vision which allows us to identify a known person in a crowd of unknowns merely by casting a cursory glance at him. It allows us to

pick an object that belongs to us from a number of those looking exactly as ours, and by being able to recognize a miss-spelt word in a sentence and unconsciously correct it. The fact is that the human mind is capable of identifying an image on features spontaneously determined and not predefined or predetermined.

With the development of technology these human processes are imitated to create intelligent machines, so much for the immense growth of robotics and

intelligent decision making systems and yet the work done so far is not comparable to any natural involuntary human action or process. The hindrance however is that it is not practically possible to imitate all the functions of the human mind and make computer vision as efficient and accurate as the human eye but even though such a possibility may be remote, efforts are consistently being made to bring them as close to it as possible.

Artificial Intelligence is a broad field of computer science taking into account a number of other disciplines that form the bulk of its study. One of the most popular definitions of Artificial Intelligence (AI) was given by Elaine Rich and Kevin Knight as, “Artificial Intelligence (AI) is the study of how to make computers do things which, at the moment, people do better” [20]. One important branch of Artificial intelligence is Computer vision, as mentioned in Figure 1.1 that shows few sub-branches of Computer Vision, the area of research which aims to imitate human vision and forms the basis of all image acquisition, its processing, document understanding and recognition. Computer vision relies on a solid understanding of the physical process of image formation to obtain simple inference from individual pixel values like shape of the object and to recognize objects using geometric information or probabilistic techniques

In its own turn document understanding is a vast and difficult area for the focus of research today lies in being able to make content based searches which hope to allow machines to look beyond the key words, headings or merely topics to find a piece of information. A far more streamlined field of Document Recognition and understanding is Optical Character Recognition which attempts to identify a single character from an optically read text image as a part of a word that can be then used to process further information on. The area gains rising significance as more

and more information each day needs to be stored, processed and retrieved rather than being keyed in from an already present printed or handwritten source.

Figure 1.1: Sub-fields of Artificial Intelligence

- **Character Recognition**

Character recognition is a sub-field of pattern recognition in which images of characters from a text image are recognized and as a result of recognition respective character codes are returned, these when rendered give the text in the image.

The problem of character recognition is the problem of automatic recognition of raster images as being letters, digits or some other symbol and it is like any other problem in computer vision

Character recognition is further classified into two types according to the manner in which input is provided to the recognition engine. Considering figure 1.2 which shows the classification hierarchy of character recognition

the two types of character recognition are:

- On-line character recognition
- Off-line character Recognition

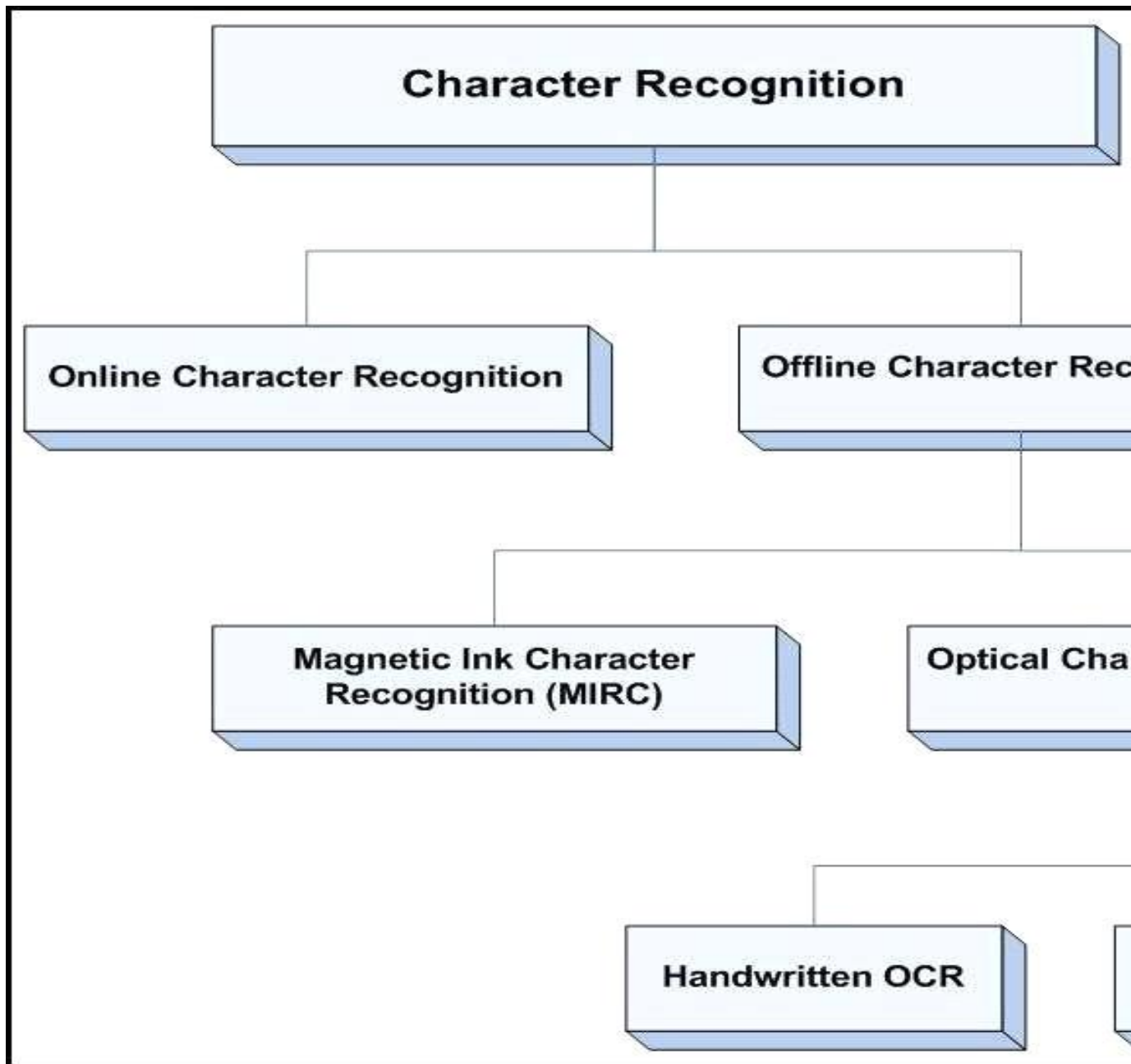


Figure 1.2: Classification of Character Recognition

• 1.2.1 Online Character Recognition

Online character recognition systems deal with character recognition in real time. The process involves a dynamic procedure using special sensor based equipment that can capture input from a transducer while text is being written on a pressure sensitive, electrostatic or electromagnetic digitizing tablet. The input text is automatically converted with the help of a

recognition algorithm to a series of electronic signals which can be stored for further processing in the form of letter codes. The recognition system functions on the basis of the x and y coordinates generated in a temporal sequence by the pen tip movements as they create recognizable patterns on a special digitizer as the text is written.

- **Offline Character Recognition**

There is a major difference in the input system of off-line and on-line character recognition which influences the design, architecture and methodologies employed to develop recognition systems for the two. In online recognition the input data is available in the form of a temporal sequence or real time text generated on a sensory device thus providing time sequence contextual information. On the contrary in an off line system the actual recognition begins after the data has been written down as it does not require real time contextual information.

Offline character recognition is further classified in two types according to the input provided to the system for recognition of characters. These are,

- Magnetic ink Character Recognition (MICR)
- Optical Character Recognition (OCR)
- **Magnetic ink Character Recognition (MICR)**

MICR is a unique technology that relies on recognizing text which has been printed in special fonts with magnetic ink usually containing iron oxide. As the machine prepares to read the code the printed characters become magnetized on the paper with the North Pole on the right of each MICR character creating recognizable waveforms and patterns that are captured and used for further processing. The reading device is comparable to a tape recorder head that recognizes the wave patterns of sound recorded on the magnetic tape. The system has been in efficient use for a long time in

banks around the world to process checks as results give high accuracy rates with relatively low chances of error.

There are special fonts for MICR, the most common fonts being E-13B and CMC-7.

- **Optical Character Recognition (OCR)**

Optical Character Recognition or OCR is the text recognition system that allows hard copies of written or printed text to be rendered into editable, soft copy versions. It is the translation of optically scanned bitmaps of printed or written text into digitally editable data files. An OCR facilitates the conversion of geometric source object into a digitally representable character in ASCII or Unicode scheme of digital character representation [37].

Many a times we want to have an editable copy of the text which we have in the form of a hard copy like a fax or pages from a book or a magazine. The system employs the use of an optical input device usually a digital camera or a scanner which pass the captured images to a recognition system that after passing it through a number of processes convert it to a soft copy like an MS Word document.

When we scan a sheet of paper we reformat it from hard copy to a soft copy, which we save as an image. The image can be handled as a whole but its text cannot be manipulated separately. In order to be able to do so, we need to ask the computer to recognize the text as such and to let us manipulate it as if it was a text in a word document. The OCR application does that; it recognizes the characters and makes the text editable and searchable, which is what we need. The technology has also enabled such materials to be stored using much less storage space than the hard copy materials. OCR

technology has made a huge impact on the way information is stored, shared and communicated.

OCRs are of two types,

- OCRs for recognizing printed characters
- OCRs for recognizing hand-written text.

OCRs meant for printed text recognition are generally more accurate and reliable because the characters belong to standard font files and it is relatively easier to match images with the ones present in the existing library. As far as hand writing recognition is concerned the vast variety of human writing styles and customs make the recognition task more challenging. Today we have OCRs for printed text in Latin script as an everyday tool in offices while an OCR for hand writing is still in the research and development stage to have more result accuracy.

Optical Character Recognition (OCR) is one of the most common and useful applications of machine vision, which is a sub-class of artificial intelligence, and has long been a topic of research, recently gaining even more popularity with the development of prototype digital libraries which imply the electronic rendering of paper or film based documents through an imaging process.

- **History of OCR**

The history of OCR dates back to the early 1950s with the invention of *Gismo* a machine that could translate printed messages into machine codes for computer processing. The product had been a combined effort of David Shepard, a cryptanalyst at (Armed Forces Security Agency) AFSA and Harvey Cook. The successful achievement was then followed by the construction of the world's first OCR system, also by David Shepard under his Intelligent Machines Research Corporation. Shepard's customers included The Readers' Digest, Standard Oil Company of California for making credit card imprints, Ohio Bell Telephone Company for a bill stub reader and The U.S. Air force for reading and transmitting teletype messages.

Another success came in the area of postal number recognition, which although crude in its inception stage became more refined with advancement in technology. By 1965 Jacob Rainbow an American inventor had patented an OCR for sorting mails which was then used by the U.S. Postal Service. The OCR has since become an interesting field of research posing numerous complexities and offering unique possibilities in the areas of Artificial Intelligence and

Computer Vision. As advancements were made and new challenges were undertaken it became more and more clear that the scope of such an undertaking, though attractive would be daunting and adventurous.

- **OCR Processes**

The OCR process begins with the scanning and subsequent digital reproduction of the text in the image. It involves the following discrete sub-processes, as shown in figure 1.3.

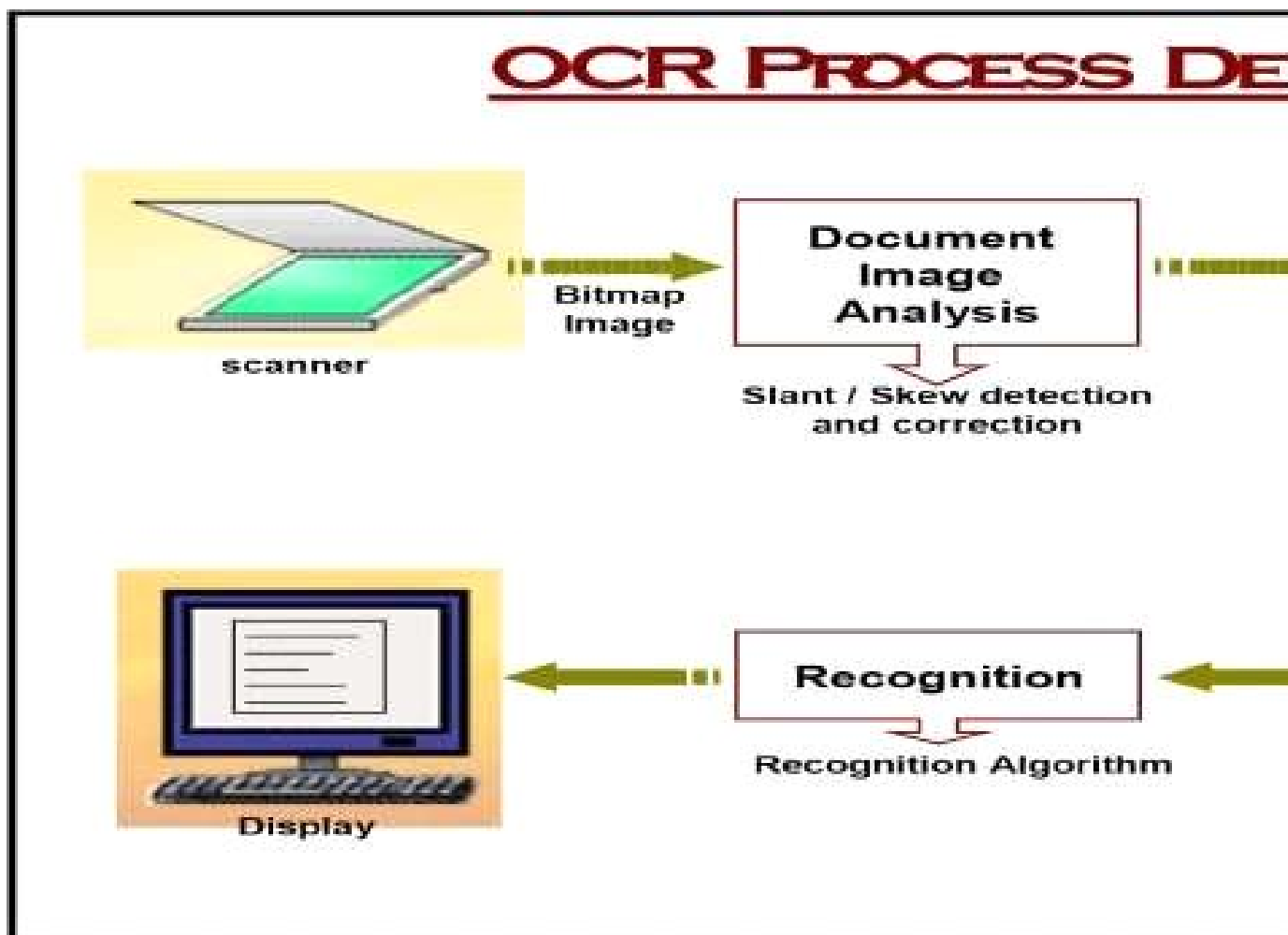


Figure 1.3: OCR Processes

- Scanning

A flat-bed scanner is usually used at 300dpi which converts the printed material on the page being scanned into a bitmap image.

- **Document Image Analysis**

The bitmap image of the text is analyzed for the presence of skew or slant and consequently these are removed. Quite a lot of printed literature has combinations of text and tables, graphs and other forms of illustrations. It is therefore important that the text area is identified separately from the other images and could be localized and extracted.

- **Pre-processing**

In this phase several processes are applied to the text image like noise and blur removal, binarization, thinning, skeletonization, edge detection and some morphological processes, so as to get an OCR ready image of the text region which is free from noise and blur.

- **Segmentation**

If the whole image consists of text only, the image is first segmented into separate lines of text. These lines are then segmented into words and finally words into individual letters. Once the individual letters are identified, localized and segmented out in a text image it becomes a matter of choice of recognition algorithm to get the text in the image into a text processor.

- **Recognition**

This is the most vital phase in which recognition algorithm is applied to the images present in the text image segmented at the

character level. As a result of recognition character code corresponding to its image is returned by the system which is then passed to a word processor to be displayed on the screen where it can be edited, modified and saved in a new file format.

Tesseract - an open-source OCR engine that has gained popularity among OCR developers. Even though it can be painful to implement and modify sometimes, there weren't too many free and powerful OCR alternatives on the market for the longest time. Tesseract began as a Ph.D. research project in HP Labs, Bristol. It gained popularity and was developed by HP between 1984 and 1994. In 2005 HP released Tesseract as an open-source software.

OCROpus - OCROpus is an open-source OCR system allowing easy evaluation and reuse of the OCR components by both researchers and companies. A collection of document analysis programs, not a turn-key OCR system. To apply it to your documents, you may need to do some image preprocessing, and possibly also train new models. In addition to the recognition scripts themselves, there are several scripts for ground truth editing and correction, measuring error rates, determining confusion matrices that are easy to use and edit.

Ocular - Ocular works best on documents printed using a hand press, including those written in multiple languages. It operates using the command line. It is a state-of-the-art historical OCR system. Its primary features are:

Unsupervised learning of unknown fonts: requires only document images

and a corpus of text. Ability to handle noisy documents: inconsistent inking,

spacing, vertical alignment

Support for multilingual documents, including those that have considerable word-level code- switching.

Unsupervised learning of orthographic variation patterns including archaic spellings and printer shorthand.

Simultaneous, joint transcription into both diplomatic (literal) and normalized forms.

SwiftOCR - I will also mention the OCR engine written in Swift since there is huge development being made into advancing the use of the Swift as the development programming language used for deep learning. Check out blog to find out more why. SwiftOCR is a fast and simple OCR library that uses neural networks for image recognition. SwiftOCR claims that their engine outperforms well known Tesseract library.

In this blog post, we will put focus on Tesseract OCR and find out more about how it works and how it is used.

Tesseract OCR

Tesseract is an open source text recognition (OCR) Engine, available under the Apache 2.0 license. It can be used directly, or (for programmers) using an API to extract printed text from images. It supports a wide variety of languages. Tesseract doesn't have a built-in GUI, but there are several available from the 3rdParty page. Tesseract is compatible

with many programming languages and frameworks through wrappers that can be found [here](#). It can be used with the existing layout analysis to recognize text within a large document, or it can be used in conjunction with an external text detector to recognize text from an image of a single text line.

OCR Process Flow to build API with Tesseract from a blog post

Tesseract 4.00 includes a new neural network subsystem configured as a text line recognizer. It has its origins in OCRopus' Python-based LSTM implementation but has been redesigned for Tesseract in C++. The neural network system in Tesseract pre-dates TensorFlow but is compatible with it, as there is a network description language called Variable GraphSpecification Language (VGSL), that is also available for TensorFlow.

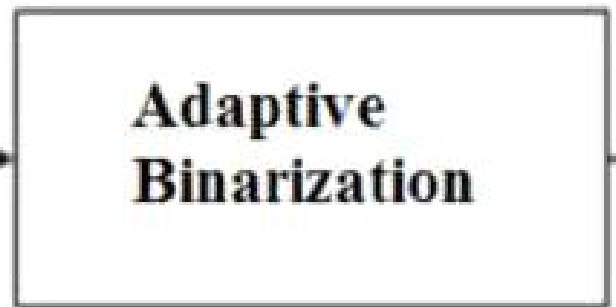
To recognize an image containing a single character, we typically use a Convolutional Neural Network (CNN). Text of arbitrary length is a sequence of characters, and such problems are solved using RNNs and LSTM is a popular form of RNN. Read this [post](#) to learn more about LSTM.

Technology - How it works

LSTMs are great at learning sequences but slow down a lot when the number of states is too large. There are empirical results that suggest it is better to ask an LSTM to learn a long sequence than a short

sequence of many classes. Tesseract developed from OCRopus model in Python which was a fork of a LSMT in C++, called CLSTM. CLSTM is an implementation of the LSTM recurrent neural network model in C++, using the Eigen library for numerical computations.

Original Image



Editable Document



Tesseract 3 OCR process from paper

Legacy Tesseract 3.x was dependant on the multi-stage process where we can differentiate steps:

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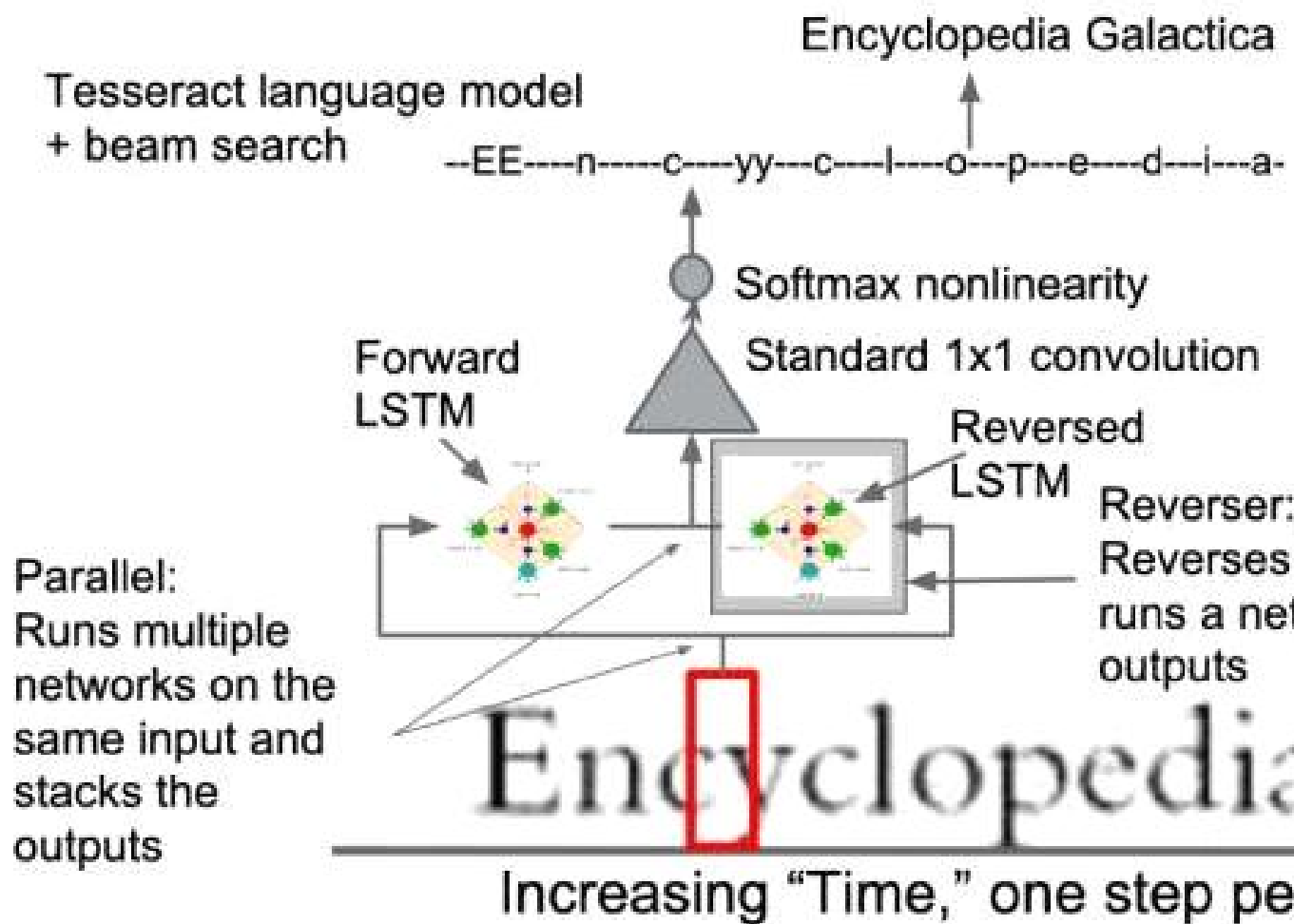
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Character classification

Word finding was done by organizing text lines into blobs, and the lines and regions are analyzed for fixed pitch or proportional text. Text lines are broken into words differently according to the kind of character spacing. Recognition then proceeds as a two-pass process. In the first pass, an attempt is made to recognize each word in turn. Each word that is satisfactory is passed to an adaptive classifier as training data. The adaptive classifier then gets a chance to more accurately recognize text lower down the page.

How Tesseract uses LSTMs...



Google

Modernization of the Tesseract tool was an effort on code cleaning and adding a new LSTM model. The input image is processed in boxes (rectangle) line by line feeding into the LSTM model and giving output. In the image below we can visualize how it works.

How Tesseract uses LSTM model presentation

After adding a new training tool and training the model with a lot of data and fonts, Tesseract achieves better performance. Still, not good enough to work on handwritten text and weird fonts. It is possible to fine-tune or retrain top layers for experimentation.

Installing Tesseract

Installing tesseract on Windows is easy with the precompiled binaries found [here](#). Do not forget to edit “path” environment variable and add tesseract path. For Linux or Mac installation it is installed with few commands.

After the installation verify that everything is working by typing command in the terminal or cmd:

```
$ tesseract --version
```

And you will see the output similar to:

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You can install the python wrapper for tesseract after this using pip.

```
$ pip install pytesseract
```

Tesseract library is shipped with a handy command-line tool called tesseract. We can use this tool to perform OCR on images and the output is stored in a text file. If we want to integrate Tesseract in our C++ or Python code, we will use Tesseract's API.

Running Tesseract with CLI

Call the Tesseract engine on the image with `image_path` and convert image to text, written line by line in the command prompt by typing the following:

```
$ tesseract image_path stdout
```

To write the output text in a file:

```
$ tesseract image_path text_result.txt
```

To specify the language model name, write language shortcut after -l flag,
by default it takes English language:

```
$ tesseract image_path text_result.txt -l eng
```

By default, Tesseract expects a page of text when it segments an image. If you're just seeking to OCR a small region, try a different segmentation mode, using the --psm argument. There are 14 modes available which can be found [here](#). By default, Tesseract fully automates the

page segmentation but does not perform orientation and script detection. To specify the parameter, type the following:

```
$ tesseract image_path text_result.txt -l eng --psm 6
```

There is also one more important argument, OCR engine mode (oem).

Tesseract 4 has two OCR engines — Legacy Tesseract engine and LSTM engine. There are four modes of operation chosen using the --oem option.

- Legacy engine only.

- Neural nets LSTM engine only.
- Legacy + LSTM engines.
- Default, based on what is available.

Result of the

Tesseract OCR

engine OCR

with

Pytesseract

and OpenCV

Pytesseract is a wrapper for Tesseract-OCR Engine. It is also useful as a stand-alone invocation script to tesseract, as it can read all image types supported by the Pillow and Leptonica imaging libraries, including jpeg, png, gif, bmp, tiff, and others. More info about Python approach read [here](#). The code for this tutorial can be found in this repository.

```
import cv2
```

```
import pytesseract
```

```
img = cv2.imread('image.jpg')
```

```
# Adding
```

```
custom
```

```
options
```

```
custom_config
```

```
= r'--oem 3 --
```

```
psm 6'
```

```
pytesseract.image_to_string(img,
```

```
config=custom_config)
```

Preprocessing for Tesseract

To avoid all the ways your tesseract output accuracy can drop, you need to make sure the image is appropriately pre-processed.

This includes rescaling, binarization, noise removal, deskewing, etc.

To preprocess image for OCR, use any of the following python functions or follow the OpenCV documentation.

CHAPTER 5

RESULT AND DISCUSSION:

The existing project consists of Raspberry-Pi, PC and a speaker. Python language is used for coding the Raspberry-pi. There are number of ways through which the input text can be converted into speech like string matching, frequency matching etc. Initially, the GPIO pins should be initialised in order to use them as input or output. This can be coded in python by importing GPIO module. At first the coding is done for matching the English alphabets with the user defined alphabets and playing the corresponding audio file. Audio files can be database or voice recordings.

Python coding provides one more logic called frequency matching. In this method the frequencies on the basis of repetition of alphabets for each word should be written and then

as per the coding logic all the words having matched frequencies should be called and corresponding audio for that word should be played.

Another method for converting the text into speech can be through the ASCII values of English letters. By using this method the coding length can be decreased. There are many Text to Speech converters are there but their performance depends on the fact that the output voice is how much close to the human natural voice. For example, consider a name pretty, it can be a name of a person as well as it can be defined as beautiful. Thus it depends on how the words are pronounced. Many text to speech engines do not give the proper pronunciation for such words thus combining some voice recordings can give more accurate result. The TTS system converts an English text into a speech signal with prosodic attributes that improve its naturalness. There are many systems which include prosodic processing and generation of synthesized control Parameters. The proposed system provides good quality of synthesized speech. The text processing component provides reliable grammatical classification and phonetic transcription

Prototype implementation of the proposed system is done. Fig. 5 shows the image of the Text to speech (TTS) conversion. The input string or word is given by the user to Raspberry-pi which further uses python coding and some programming logic, calls the corresponding audio file of that input text. Thus, Text to Speech conversion is done successfully for the set of words by using some algorithm. Fig. 6 shows the hardware setup which includes Raspberry-pi connected to the computer. The work can be extended for using the video characteristics of Raspberry-pi to make the proposed system more effective. The further application can also be extended to controlling the electronic devices like LED through speech signal.

The proposed Text to speech (TTS) system was designed in order to produce an equivalent acoustic signal which goes in synchronization with the text which is provided as an input to the Raspberry-Pi system. The programming strategy involved the GPIO lines, the database connectivity and the audio amplifiers. This experimental validation can be extended to conjoined

sounds and words of higher complexity also. The scope of the Raspberry-Pi in speech synthesis and feature extraction is also quite boundless.

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In this paper, we have described a prototype system to read printed text on hand-held objects for assisting blind persons. In order to solve the common aiming problem for blind users, we have proposed a motion-based method to detect the object of interest, while the blind user simply shakes the object for a couple of seconds. This method can effectively distinguish the object of interest from background or other objects in the camera view. To extract text regions from complex backgrounds, we have proposed a novel text localization algorithm based on models of

stroke orientation and edge distributions. The corresponding feature maps estimate the global structural feature of text at every pixel. Block patterns project the proposed feature maps of an image patch into a feature vector. Adjacent character grouping is performed to calculate candidates of text patches prepared for text classification. An Adaboost learning model is employed to localize text in camera-based images. Off-the-shelf OCR is used to perform word recognition on the localized text regions and transform into audio output for blind users. Our future work will extend our localization algorithm to process text strings with characters fewer than three and to design more robust block patterns for text feature extraction. We will also extend our algorithm to handle no horizontal text strings. Furthermore, we will address the significant human interface issues associated with reading text by blind users. It has been developed by integrating features of all the hardware components and software used. In this paper, the camera acts as input for the paper. As the Raspberry Pi board is powered the camera starts streaming. The streaming data will be displayed on the screen using GUI application. When the object for label reading is placed in front of the camera then the capture button is clicked to provide

image to the board. Using Tesseract library the image will be converted into data and the data detected from the image will be shown on the status bar. The obtained data will be pronounced through the ear phones using Flite library. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. In this by using highly advanced ARM11 board this paper has been implemented.

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