La Fila Converter: A file Converter Using Optical Character Recognition Implementing K Nearest Neighbors Algorithm

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Abstract: **This study was entitled La Fila Converter: A file converting system using Optical Character Recognition (OCR) implementing K-Nearest Neighbours Algorithm. The purpose of this study is to implement an existing algorithm under Optical Character Recognition that uses patterns to perform converting of a file. The fact that humans have a higher demand in file converting applications is the reason why this study was conducted. Computers don't have eyes to read just like human do, they use pattern recognition to read characters. Using K-Nearest Neighbours Algorithm will help the system to be more accurate and consistent in recognizing text characters. Incremental Software Methodology was utilized for the development of the study. Functional and Conformance Test are used as testing instruments. The evaluation criteria were based on ISO 9126-1 software quality standard. The result of the system evaluation showed that the developed system is highly acceptable with a Mean of 3.47 and 0.55 of SD.**

Keyword: **Converter, Optical Character Recognition (OCR), K-Nearest Neighbors Algorithm, Functional Testing, Conformance Testing.**

1. INTRODUCTION

The computer has made a very enormous impact on the society. Most people rely on computers to accomplished different tasks quickly and easily. It is considered as one of the most powerful weapons today because in your computer, you can do anything. To make a computer do anything, excellent computer programs are needed. Writing computer programs need different algorithms to be more accurate and consistent. Algorithm is a step by step process of telling the computer exactly what you want it to do. Following each step mechanically, allows the machine to accomplish the end goal.

Conversion is an exchanged of a convertible type of asset into another type of asset. This process existed even before the technology came in. Before measurements, currency and any other objects computed manually using mathematical operations were the only thing that could be converted. But now with the influence of technology, people have developed different software applications that transformed the style of converting, from manual to automated process wherein more objects could be converted.

The researchers proposed this project to help those people who are have difficulty in converting their documents. Using La Fila Converter with Optical Character Recognition (OCR) with the implementation of K-Nearest Neighbors Algorithm; this application allows you to convert your electronic document to another format. Instead of typing and copying the content of the document, you could convert your file to your designated format in just a minimal amount of time.

Project Context:

Conversion is one of the most complicated tasks today. In order for you to convert something you must use mathematical equations or create it manually before having another type of asset. With the aid of technology, different software applications have been made to make this job easier and require less effort. One example of this is the file converting system, it is a software application that converts electronic documents or files to another file format. It comes in many ways, video to audio, audio to text and vice-versa, etc. Today capturing notes is one of the most effective ways: of storing information. This system would be helpful for those having a hard time in creating notes in different formats having the same contents. It can save and send to email address the converted file while allowing the user to keep their original files. This study focuses on conversion of image to Word, Text, MP3, and can also simulate HTML code

Project Description:

Nowadays, conversion of files is highly needed especially by students and different industries. Using devices ranging from mobile phones to DSL cameras to take pictures of lectures has become a growing trend. This method of note-taking is increasing in prevalence as students explore new ways of keeping up with lectures and staying on top of their classes. That where OCR comes in. Optical Character Recognition is the process of turning a picture of text into text itself—in other words, producing something like a TXT or DOC file from a scanned image of a printed or handwritten page. And that is the purpose of this study, to allow the users to convert their images to another file formats to Word, PDF, Text, and MP3, and the function also includes simulation of html code. Just like us, computers can also read too, but the difference is computers don't have eyes and a brain to read characters just like us. In order for the computer to read characters, it uses pattern recognizing and feature detection. The researchers implement the K-Nearest Neighbors' Algorithm which has been used in statistical estimation for pattern recognition and text classification.

Objectives of the Study:

The general objective of this study was to design and develop a file converter system for personal computers that would utilize an existing algorithm on Optical Character Recognition (OCR).

Specifically, the project aimed to:

1. Design a file converter that has the following features:

a. It has a very simple Interface Design   for the user to be used easily.

b. Allows the user to choose and upload the file from their computer and provide them different file formats for the converting of files.

c. Convert image to Word, Text, and to Speech or run as HTML.

d. Allows the user to save their converted file and keep their original file.

e. The system can convert files within minimum amount of time and maximum amount of characters.

f. The system can translate the content of the file to other languages.

g. The Podcast can speak other languages that are provided by the system.

2. Create the project using C# as front end. It will run on any computers under Windows 10 Operating System or   later and .net 4.5 or higher framework.

3. Apply Incremental Software Methodology for the   development of the study.

4. Test and improve the developed system using functional and conformance test.

5. Evaluate the acceptability of the system based on the ISO 9126 standard based on the following criteria:

a. Functionality

b. Reliability

c. Usability

d. Efficiency

e. Maintainability

f. Portability

2. SCOPE AND LIMITATIONS OF THE STUDY

The researchers aimed to develop a file converter with OCR technology. The system used the K-Nearest Neighbors algorithm for character classification. The system could help the users to convert their electronic documents within a minimum amount of time with a maximum of characters to be converted. The developed system could only run on laptops and computers under Windows 10 Operating System or later versions and .net 4.5 or higher framework. This system can only convert words. It can't convert text written in cursive, special characters, a text with a small front size and blurred images. Not all languages can be converted, but English has a higher success rate. The file can also be converted to speech for listening purposes and can be saved. The system can also translate the contents of the file to other languages. In order for the system to perform the user must have an internet connection. The system can only translate up to two hundred twenty (220) characters. It can't translate images with Japanese characters to mp3 but it has a higher success rate on converting images with Japanese characters to speech. It can also read html files and run it. The time of conversion depends on the length of characters on image. The system can also convert image with hand written text but not all characters can be read. The users can train their handwritten stroke for handwritten text on image. The images will not be converted if it's in reverse position. The image to speech function will not work if the computer has no Microsoft default speech platform. The system has a tutorial web page that can help users to use the system. The system can send the converted or the translated image to the users email address.

Significance of the Study:

The research project "La Fila Converter: A file converter using Optical Character Recognition (OCR) implementing K-Nearest Neighbors Algorithm" would benefit the following:

Students. A lot of students are have a hard time in reading especially in the subject of literature. This application will be helpful for those students who prefer listening than reading. By using this project they can convert their reading materials into speech, wherein instead of reading material, after converting it they can now browse it by listening to its contents.

Computer Users. It will also be helpful to anyone who needs a document converter. Using this project instead of re-typing or copying the contents of the document just to make another file type, it can help you to do the job easier. To convert your file, you just need to upload the file that you needed to convert and choose the designated file type.

Computer Science Students. This project may help them to study the codes and algorithms that were used in this project. This study might give them some ideas in doing their projects.

Future Researchers. This study will be helpful to future researchers who are interested in doing or developing a file converter. This may serve as their source for getting ideas on file converting and its requirements.

3. REVIEW ON RELATED LITERATURE AND STUDIES

In this the related literature and studies were identified and their uses were discussed for the development of the project. This chapter includes the discussion of the conceptual model for this study that illustrates the basic structure of the whole system.

Review on Related Literature:

Data Conversion:

Data conversion is a technical process of changing the bits contained in the data from one format to another format for the purpose of interoperability between computers. The simplest example of data conversion is a text file converted from one character encoding to another. Some of the more complex conversions involve conversion of office file formats and conversion of audio, video and image file format which needs to consider different software applications to play or display them. [1]

As stated by [Davis, 2014] [2] there are many data conversion programs on the market that support a wide number of text, database, spreadsheet and graphics formats. If a text document, database or spreadsheet format is not supported in a packaged conversion program, the textual data within the file can be converted if the application that created it is available and it can export its contents to ASCII text.

According to [Beros, 2015] [3] there are more complex conversions as well, such as those involving image, audio and video file conversion. These types of file conversions require the consideration of the different software applications that might play the files, and there can be a much higher level of variation in such software.

The purpose of this study was to convert images to another file formats, and in order to do that understanding data conversion is the fundamental knowledge that is needed. Process in data conversion is very important in this study to have a valid output. With the used of the concept of data conversion, the proposed system was guided for the development of this study.

Optical Character Recognition:

Optical character recognition refers to the branch of computer science that involves reading text from paper and translating the images into a form that the computer can manipulate (for example, into ASCII codes). An OCR system enables you to take a book or a magazine article, feed it directly into an electronic computer file, and then edit the file using a word processor. [4]

As reported by [Eikvil,1993] [5] optical Character Recognition deals with the problem of recognizing optically processed characters. Optical recognition is performed off-line after the writing or printing has been completed, as opposed to on-line recognition where the computer recognizes the characters as they are drawn. Both hand printed and printed characters may be recognized, but the performance is directly dependent upon the quality of the input documents.

According to [Lais, 2002] [6] OCR engines add the multiple algorithms of neural network technology to analyze the stroke edge, the line of discontinuity between the text characters, and the background. Allowing for irregularities of printed ink on paper, each algorithm averages the light and dark along the side of a stroke, matches it to known characters and makes a best guess as to which character it is. The OCR software then averages or polls the results from all the algorithms to obtain a single reading.

Character Recognition is the main focus of this study. The proposed system was to convert the images in word processing programs, enable to it to converted as MP3 and be able to simulate HTML code. Files that can only be converted are those images with text characters. In order to accomplish it, the system must be able to read or recognize the file's contents. With the use of the OCR process the system can read the characters in the image by recognizing patterns designed for this system.

Integrated Development Environment (IDE):

An integrated development environment (IDE) is a programming environment that has been packaged as an application program, typically consisting of a code editor, compiler, a debugger, and a graphical user interface (GUI) builder. The IDE may be a standalone application or may be included as part of one or more existing and compatible applications. The BASIC programming language, for example, can be used within Microsoft Office applications, which makes it possible to write a WordBasic program within the Microsoft Word application. IDEs provide a user-friendly framework for many modern programming languages, such as Visual Basic, Java, and PowerBuilder. [7]

According to [Farlex, 2015] [8] IDE is a system that supports the process of writing software. It may include a syntax-director editor, graphical tools for program entry, and integrated support for compiling and running the program.

As stated by [Christiano, 2015] [9] even a simple search for IDEs will turn up quite a few choices. IDEs are available from Open Source communities, vendors, and software companies. They range from free to pricing dependent upon the number of licenses required. There isn't a standard for IDEs and each has its own capabilities, along with strengths and weaknesses. Generally, an IDE provides an easy-to-use interface, automates development steps, and allows developers to run and debug programs all from one screen. It can also provide the link from a development operating system to an application target platform, like a desktop environment, smartphone or microprocessor.

With the use of IDE in this study, it helped the system to process the software and it supported the Visual Studio for creating an application.

Visual Studio:

Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs for Microsoft Windows, as well as web sites, web applications and web services. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code. [10]

It supports different programming languages such as C, C++, VB.NET, C#, F#, ASP.NET Android and IOS which are built in. It also supports XML, HTML, JavaScript and CSS.

According to [J. Avery, 2005] [11] it can be used to write console applications, Windows applications, Windows services, Windows Mobile applications, ASP.NET applications, and ASP.NET web services, in your choice of C++, C#, VB.NET,

J#, and more. It is also includes various additional development tools, such as Visual SourceSafe; which tools are included depends greatly on the edition of Visual Studio that you are using.

The researchers developed the system using Microsoft Visual Studio Professional a developer tool for building any application type. Everything from compiling of programs to the system installer were all constructed using this application.

C-Sharp (C#):

The C Sharp is an object-oriented programming language from Microsoft that aims to combine the computing power of C++ with the programming ease of Visual Basic. C# is based on C++ and contains similar features of Java. Microsoft's aim is to facilitate the exchange of information and services over the Web, and to enable developers to build highly portable applications. [12]

In accordance to [Nakov, 2013] [13] the C#, language is distributed together with a special environment on which it is executed, called the Common Language Runtime (CLR). This environment is part of the platform .NET Framework, which includes CLR, a bundle of standard libraries providing basic functionality, compilers, debuggers and other development tools.

Based to [Bolton, 2014] [14] C# is a modern programming language and is really only rivalled by Java. It does though require the .NET framework on Windows. There remains a substantial body of code written in C++ and it seems that C# will coexist with C++ rather than replace it. C# is an ECMA (European Computer Manufacturers Association) and ISO standard and this has allowed other implementations such as the Linux project Mono to happen.

C# served as the front-end of the system. This programming language was used in constructing the whole project inside Microsoft Visual Studio.

Windows Operating System (OS):

The windows operating system was developed by the Microsoft Corporation to run on personal computers. The windows OS featured the first Graphical User Interface for IBM and soon dominated the market. [15]

According to [Rouse, 2014] [16] the multitasking operating system where multiple programs can be running at the same time, but the operating system determines which of the applications should run in what order and how much is the needed time to be allowed for each application before giving another turn.

This project was developed using Windows Operating System. This system could only run on laptops or computers under Windows 10 OS or later versions.

Metro Framework:

As stated by [J. Thiel, 2013] [17] it is based on software from the winforms-modernui project that includes custom themes, conversion into a clean, aspect-oriented design, style extender to support theming of legacy controls and fixed issues with maximizing and restoring windows.

To make the User Interface more attractive the researchers implemented the Metro Framework in the project. All forms of the application were from metro framework as well as the text boxes and buttons.

Docx:

According to [Coffey, 2015] [18] it is a .NET library that allows developers to manipulate Word 2007/2010/2013 files, in an easy and intuitive manor DocX is fast, lightweight and best of all it does not require Microsoft Word or Office to be installed.

One of the output formats of the application is the word document or .docx. Using the concept of .docx, it helped the researchers in converting images to word and saving it in a .docx format.

Google Translate:

According to [Farlex, 2015] [19] it is a free statistical multilingual machine-translator provided by the Google Inc. to translate written text to another language. It can help the reader to understand the general content of foreign languages.

The proposed system allows the user to translate the file contents to another language. The researchers used google translate to use the language translation, and in order to use it, an internet connection is needed.

Application Program Interface (API):

The abbreviation of application program interface is a set of routines, protocols, and tools for building software applications. The API determines how the software components interact with each other and used when in programming graphical user interface (GUI).[20]

According to [Li, 2014] [21] the correct way to write a program that request services in operating system (OS) for the developer. APIs is a code that allows the two software programs to communicate with each other.

Using Google translate API the amount of translated character increased.

Review On Related Studies:

K-Nearest Neighbors Algorithm:

As explained in an article posted by [S.Deokar, 2009] [22] the K Nearest Neighbors Algorithm (KNN) is a lazy learning algorithm. It defers the decision to generalize beyond the training. To calculate the distance K Nearest Neighbors algorithm uses Euclidian Distance,and Minkowski Distance, Mahalanobis Distance. Distance usually relates to all attributes and assumes all of them have the same effects on distance. This algorithm requires large memory. It is in basic form is the most simple machine learning methods. It also gives the maximum likelihood estimation of the class posterior probabilities. It can be used as a baseline method.

Algorithm is the most important requirement for this study. With the implementation of K-Nearest Neighbors it helped the system in text classification. This algorithm must be included in major functions of the system.

Euclidian Distance:

According to [P. Black, 2015] [23], the Euclidean is a straight line between two points. It can be calculated using the Pythagorean Theorem. Squared Euclidean distance (SED) is the square of the difference between the means of each variable in adjacent windows, summed across all variables used. Standardized Euclidean distance divides the measure of each variable in each sample by the largest value observed for each variable in the entire data set.

In training characters, the computer will identify the nearest point to classify the characters. In order to classify the characters, the formula of Euclidian Distance was used. With this, the researcher got the nearest equivalent of countered image in the training set.

Minkowski Distance:

Base to [J. Schuiz] [24] Minskowski distance is a generalized metric that includes others as special cases of the generalized form. [25] The Minkowski Sum/Difference is a fast and relatively simple way of detecting whether two shapes interact. In essence it works by subtracting one object from another and then checking whether that new object contains the origin.

With the development of the system, Minkowski distance can get the nearest equivalent of contoured image in the training set.

Mahalanobis Distance:

According to [Jenness Enterprises, 2015] [26] Mahalanobis distances provide a dominant method of measuring on how similar some set of conditions is to an ideal set of conditions, and can be very useful for identifying which regions in a landscape are most similar to some "ideal" landscape.[27] Mahalanobis distance has the different properties; the fact that the variances in each direction are different, the covariance between variables, and the familiar Euclidean distance for uncorrelated variables with the unit of variance.

In the analysis, the developers used this concept in the matching of contoured image and training set.

Handwritten Script Identification Using Fuzzy – K Nearest Neighbor:

Base to [R. Hegadi] the automatic script identification of handwritten document images facilitates have many applications such as sorting and indexing as large collection of images, or as a precursor of the Optical Character Recognition (OCR). The fuzzy k nearest neighbor classifier is used for the classification of the new handwritten document images and its performance is compared with crisp k nearest neighbor classifier. [28]

The proposed system also included recognition of handwritten characters. This topic was used as a basis for the function of this study that focuses on handwritten script recognition.

Handwritten Digit Recognition Using K Nearest-Neighbor, Radial-Basis Function, and Backpropagation Neural Networks:

According to [Y. Lee] the recent research suggest that carefully designed multiplayer neural networks with local "receptive fields" and shared weights may be unique in providing low error rates on handwritten digit recognition tasks.

The simple KNN classifier can also perform handwritten digit recognition, but requires a prohibitively large amount of memory and is much slower at classification. Nevertheless, the simplicity of the algorithm and fast training characteristics makes the KNN classifier an attractive candidate in hardware-assisted classification tasks [29]

This topic helped the researchers to gain an idea in recognizing numbers and special handwritten characters. The computer is given set of instructions in classifying and recognizing the text characters.

K-Nearest Neighbors in C Sharp:

Based on [Emgu CV, 2015] K Nearest Neighbors (KNN) is a method for classifying objects based on closest training examples in the feature space. K-NN is a type of instance-based learning, or lazy learning where the function is only approximated locally and all computation is deferred until classification. [30]

K-Nearest Neighbors Algorithm was the algorithm implemented in this study. This topic was very significant because it helped the researchers to have an idea on how to implement the algorithm to C# programming language and to the whole system.

Synthesis:

The topics and concepts above focused on how the researchers developed the system. The related literature and studies helped the researchers to obtain more information about the topic and to develop the system. The project developers discussed the relation of the study to the related literature and studies in order to come up with the idea which was used in the development of the project. Through the related literature the proponents understood the programming languages that were relevant in the system. Related literature listed down the proper tools needed to implement in the system. It helped the developers to elaborate what must be needed to the system in this state. While in the related studies the proponents get some ideas of the authors about the said system.

This study helped to lessen the time of writing notes and typing it again and again not just students of Lyceum of the Philippines University Cavite will be benefited but all the students and other users.
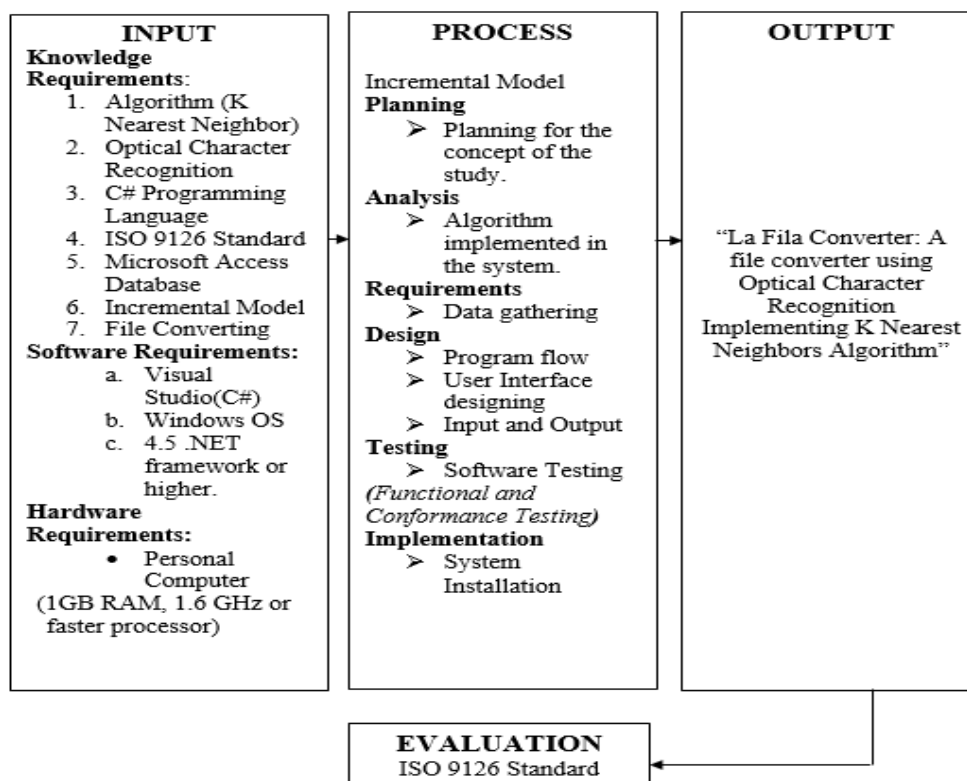
Conceptual Framework of the Study:

Figure.1: Conceptual Framework of the Study

Figure 1 shows the whole context of the study. The input knowledge requirements listed down all the concept and ideas needed to apply for the development of the project. For the software and hardware requirements it listed all the devices

with its specifications and the software applications that were required to develop the system. The process phase shows the steps in developing the project using incremental model process. Conforming together all the requirements stated by "La Fila Converter: A file converter using Optical Character Recognition Implementing K-Nearest Neighbors Algorithm" was developed as an output in this figure. After obtaining the result of the output, the system was evaluated under ISO9126.

Theoretical Background:

This study was based from file converting that used the optical character recognition (OCR) system that acknowledged an existing algorithm to perform converting of files. This chapter provided an overview and analysis about the theory, algorithms, architecture text categorization and mathematical model used in the system.

Theorems:

Optical Character Recognition (OCR) is a field of science dealing with pattern analysis, especially with identification of characters. It is a very complex task. This research focused on the last stage of character recognition in which separated characters were treated as objects to be identified. This stage consists of pre-processing, feature extraction and classification.

The pre-processing prepares a character in such a way that a representative feature vector may be extracted. In the classification stage a classifier (e.g. classical, statistical, fuzzy logic or neural network) employing certain knowledge and basing on the extracted feature vector assigns the characters to a particular class. The knowledge base of the classifier comprises formerly generated feature vectors of characters from the learning set, which membership classes are known.

In order to recognize a character correctly, the closet vector to the character's vector from among learning set vectors must be found (minimal distance classifier used mostly in the research). Although this method is relatively simple and fast, it may cause mistakes and thus often so called k-nearest neighbor classifier is used. It improves the recognition results by a few percentage points, but the general tendency stays the same. [31]

This study focuses on Character Recognition, this theory was implemented to the developed system by utilizing the steps and process in recognizing of text characters. OCR works in order for the system to recognize a character from the image. Computers use pattern recognition to read characters. The first process is converting scanned or captured documents into a form of bitmap image. Then afterwards the image is normalized into a 20x30 window size. After resizing the image, it transform into a contoured image. Once the contoured image is formed, next process is character extraction by diagonal and transition features for recognition of the character. And last process was text classification with the implementation of K-Nearest Neighbors Algorithm to classify the characters using stored data in training sets resulting to an output.

Optical Character Recognition – How it works?

Optical Character Recognition is a complex technology that converts images to a word processing programs or to another editable file formats. OCR allows you to convert screenshots, photos from mobile phones and scanned documents to editable documents like .docx, .txt or .pdf. This technology is generally used in different industries, and the most advanced OCR system can process almost all types of images, even working on old documents, or photos from mobile phones. [32]

The process of converting an image to editable documents consists of several steps. How does the OCR works? General steps in OCR process are:

- Loading image as bitmap from given source. Images that can only be uploaded are in JPEG, PNG, and TIF format.
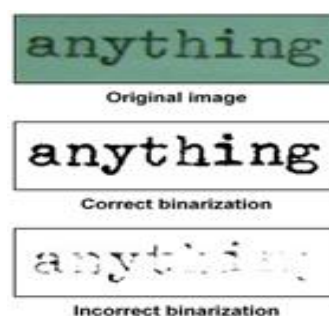

Figure 2: Image features.

- Image features detection like resolution and inversion are very important processes shown in figure 2. Font sizes and font colors or background colors must be rescaled and inverted before processing in order for them to be more readable for the computers.
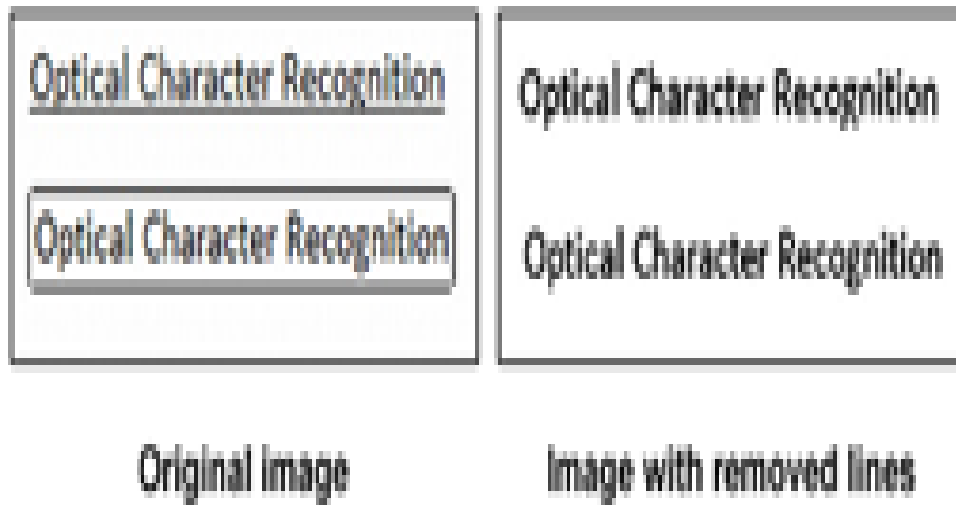

Figure 3: Image lines detection and removing

- Figure 3 shows the detection and removing of lines. To have a better recognition quality for underlined characters and to improve the page layout analysis, this step is required.

- Page layout analysis; this step is also called "zoning". At this stage The OCR system must detect positions and types of all important areas on the image.

- "Zoning" is another term for page layout analyzation. This process is for detection of the image position and important areas on the image.

- Word and text line detection is sometimes a complicated task, because of small spaces between characters and different font sizes.

- Character recognition is the main method of OCR. Characters in the images must be read and converted correctly.

- Dictionary support for better recognition quality, this can be used for spacing between words and for similar characters like "l", and "1", "j" and "i".

- Saving of the converted file. It is important to get the selected output format like to Word, Text, PDF etc and keep the original copy of the file.Every process in the OCR is very important, if there is one step that is not done, the whole process of the OCR would fail. To acquire the best results, the OCR system must have the ability to adjust the most significant parameters of every process; sometimes this is the only way to have a better recognition quality.

Fundamental Algorithm Used:

K-Nearest neighbor (KNN) algorithm is a classification strategy that is an example of a "lazy learner." The system implemented the algorithm with the use of training sets directly for the classification of the character. In pattern recognition, the k-nearest neighbor algorithm is a method to classify objects based on the nearest training sets in the feature space. Training sets are the list of all trained or registered characters stored as XML file. Having a training set D the input is classified by taking a majority vote of the k (where k is a positive integer) closest training records across all d attributes and a test object X= (X $^{'}$, Y $^{'}$) where X is the training objects, while Y is its class. The KNN algorithm used to compute the distance between the z or the test object and all the training objects. Once the nearest-neighbor list is obtained, the test object is classified based on the majority class of its nearest neighbors. To find the nearest points, the researchers used the formula of Euclidian Distance: $D = \sqrt{[(X_1-X_2)^2 + (Y_1-Y_2)^2]}$ = Nearest Point

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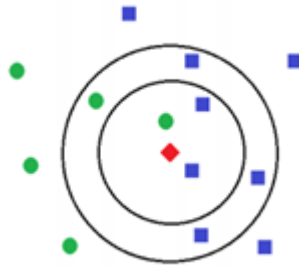
Figure.4: KNN Classification [34]

Figure 4, shows the classification of the K-Nearest Neighbors algorithm. The red diamond represented the test object that should be classified either to first class (blue) or to the second class (green). To find the nearest points to the unknown point, use the formula of Euclidian distance wherein the input D is the training set and test object $z = (x^{'}, y^{'})$. Then compute the distance between z and every object (x^1, y^1) on the stored training sets. In this figure, it shows that if k = 3 the test object is assigned to the first class because there are 2 squares and only 1 circle inside the inner circle. If k = 7 it is assigned also to the first class.

Figure.5: Samples of handwritten text characters in image

Since we all have different penmanship techniques, the researchers wrote different styles of handwritten characters for higher success rate of recognizing the handwritten text in image. Figure 5 shows one of the examples of the handwritten that was written by the researchers. In this figure, the letter "f" has different font styles, sizes and cases.
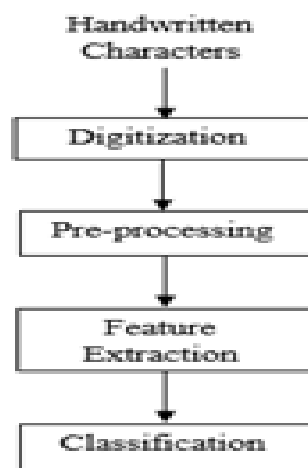

Figure.6: Process of handwriting recognition phases.

The developed system was made up of the 4 phases. Namely, digitization, pre-processing, feature extraction and classification. The process of handwriting recognition of the developed system is shown in Figure 6. Digitization is the process of converting the image to editable file formats like Word, TXT, PDF etc. This process is done by scanning the file in the form of a bitmap image. Pre-processing is a sequence of procedures, this is the initial stage of character recognition. In this phase, the image is normalized into a window size of 20x30. Once the image is resized, it produces a bitmap image of normalize image.

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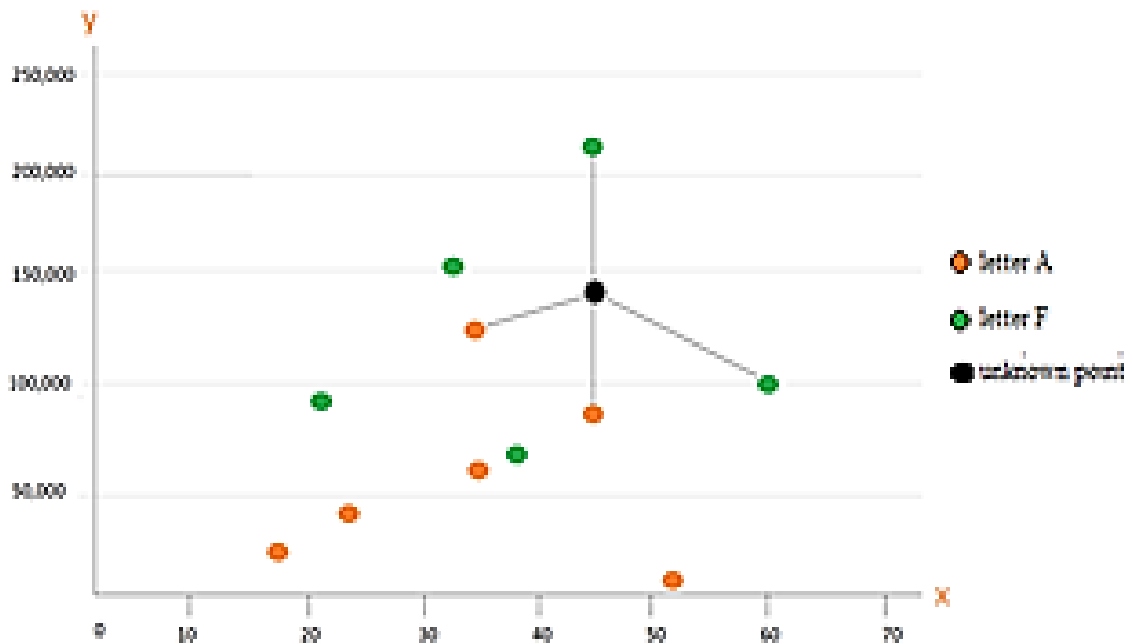
This process will transform the bitmap image to a contour image wherein the system will get the outline of the character that is shown in Figure 7 a and b.

(a)   (b)

Figure.7: (a) Digitized image of text character F (b) Contour image of text character F

Next is feature extraction. In this phase features of input characters are extracted. These features should be able to classify each character. Researchers used diagonal and transition features for recognition handwritten characters. Here, the first transformation of the input character image into contour image is shown in Figure 7 (a) and Figure 7 (b). Classification stage if for text classification, it uses the features extracted in the feature extraction stage for deciding the class membership. Researchers implemented the K-Nearest Neighbors Algorithm for classification and used Euclidian Distance formula N √ d x y. In the given formula, N is the total number of features in feature set, x is the library stored feature value and y is the candidate feature value.

K-Nearest Neighbors Text Classification:

Figure 8: Sample input to the system

Figure 8 above shows the sample input to be recognized by the system.

Figure.9: Sample Diagram of KNN Classification

In Figure 9, X and Y are two numerical variables (predictors) that define the location of the points. Points represent the characters stored in the program. Assuming that the one point is letter A and the other point is letter F these points are data stored in training sets that are used to classify the letter of the unknown point. In this sample, the unknown point must be classified whether it is letter A or letter F by finding its nearest point. This figure is the sample diagram for KNN Classification, in using the training set to classify an unknown case (X=48 and Y=142,000) using Euclidean distance. If K=1 then the nearest neighbor is the last case in the training set with letter A.

$D = \sqrt{[(48-33)2 + (142000-150000)2]} = 8000.01 = A$

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Table.1: Summary of results from KNN Classification Diagram

X	Y	Default	Distance	
25	40,000	F	102,000	
35	60,000	F	82,000	
45	80,000	F	62,000	
20	20,000	F	122,000	
35	120,000	F	22,000	2
52	18,000	F	124,000	
23	95,000	A	47,000	
40	62,000	A	80,000	
60	100,000	A	42,000	3
48	220,000	A	78,000	
33	150,000	A	8,000	1
48	142,000	?		

Table 1 is the summary of results from KNN classification diagram as represented in Values of X and Y used from figure 9. In this example, it shows how the system classifies the character that was recognized by the system. For system text classification it classified the character using the Euclidian Distance of K-Nearest Neighbors Algorithm by finding its nearest neighbors or point to the stored training sets. To find the nearest point the system will consider all the nearest points to the unknown point and with the given example there are three (3) closest neighbors to the unknown point represented as K=3, those points classified as letter A and F. Here is the solution that was implemented to the system to solve for the closest point to the unknown using the formula of Euclidian Distance $D = \sqrt{[(X_1-X_2)^2 + (Y_1-Y_2)^2]}$ = Nearest Point.

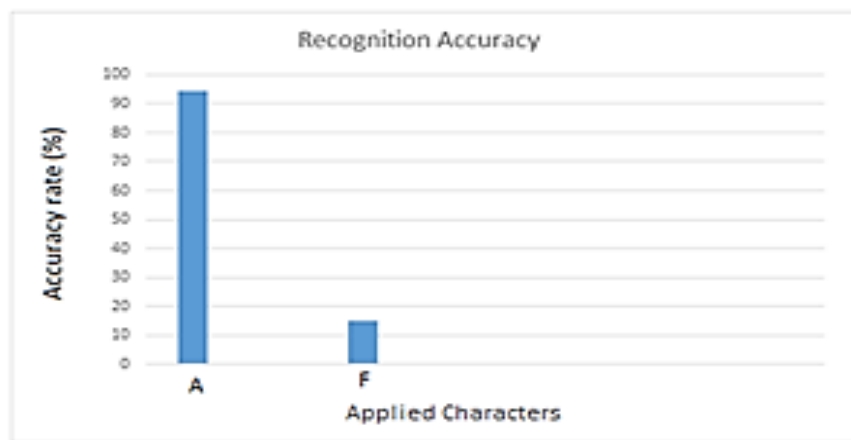$D = \sqrt{[(48-33)^2 + (142000-150000)^2]} = 8000.01 = A$

Figure.10: Recognition Accuracy

Figure 10 shows that the unknown letter has a higher accuracy rate recognized by system as letter A than letter F. Therefore the unknown letter object on the inputted image is classified as letter A.

Pseudocode of K-Nearest Neighbors Algorithm

1: data= trained data

2: img =load image;

3: contour =convert img to grayscale;

4: output;

5: for each letter in contour

6: Compute the distance of the contour to data

7: If contour ==data { $\sqrt{\sum_{i=1}^{k} (x_i - y_i)^2}$

8: output=letter;

9: }else{

10: Print"error";

11: }

End;

Figure.11: K nearest Neighbor Algorithm

Figure 11 shows K nearest neighbor algorithm recognized text from image: In line 1 variable named *data* is equal to the sets of trained data. In line 2 variable named *img* is equal to the image loaded. In line 3 variable *contour* is equal to the image that has been converted to grayscale. In line 4 variable output has been declared. In Line 5 it checked all letters from variable contour. In Line 6 It computed the distance of contour to data using Euclidian distance. Point's x_i and y_i are the length of the line segment connecting them. Σ this symbol is a summation symbol. In Line 7 It checked if *contour* is equal to data. In Line 8 the contour that equals to data had been saved to variable *output*. In Line 9 and 10 showed if the contour is not equal to data it will print error. In Line 11 it is the end of the condition.

Architecture of Text:

This section discusses the architecture of text categorization and its processes. Text categorization is consists of three (3) components. First is the data pre-processing which performs the function of converting documents into compact representation, and will be applied to training, validation and classification phase. Next, component is the classifier, wherein process of inductive learning is implemented in training dataset, and implementing the process of document classification in document categorization. Having these three components makes the text categorization applicable.
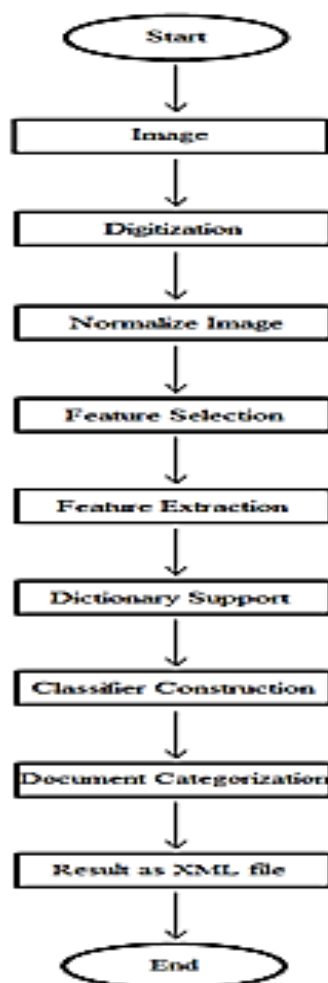

Figure.12: Program Flowchart of La Fila Text Categorization

Figure 12 shows the flow of the data in the categorization process represented by the arrow with dashed line and the data flow in the classifier construction process represented by the arrow with the solid line. Data pre-processing consist five (5) phases. First is the digitization this process is for converting of printed images or scanned documents, or photos from mobile phones and form a bitmap image. Next is resizing of image that will normalized the image into a 20x30 window size. Feature selection is removing of unnecessary spaces on the image. Then feature selection is for extraction or removal of the features of the input, like lines and transition features the dictionary support, which is used as a reference for converting the text document to a vector of features. Each feature in the vector corresponds to a word in the dictionary. After obtaining the data in pre-processing stage, the next process is for writing the results of text categorization by having an XML files to be stored as training sets.

4. DESING AND DEVELOPMENT OF THE STUDY

Project Requirement Specification:

Operational Feasibility:

Fishbone Diagram. This visualization tool identifies the potential causes of a problem that the system may encounter.
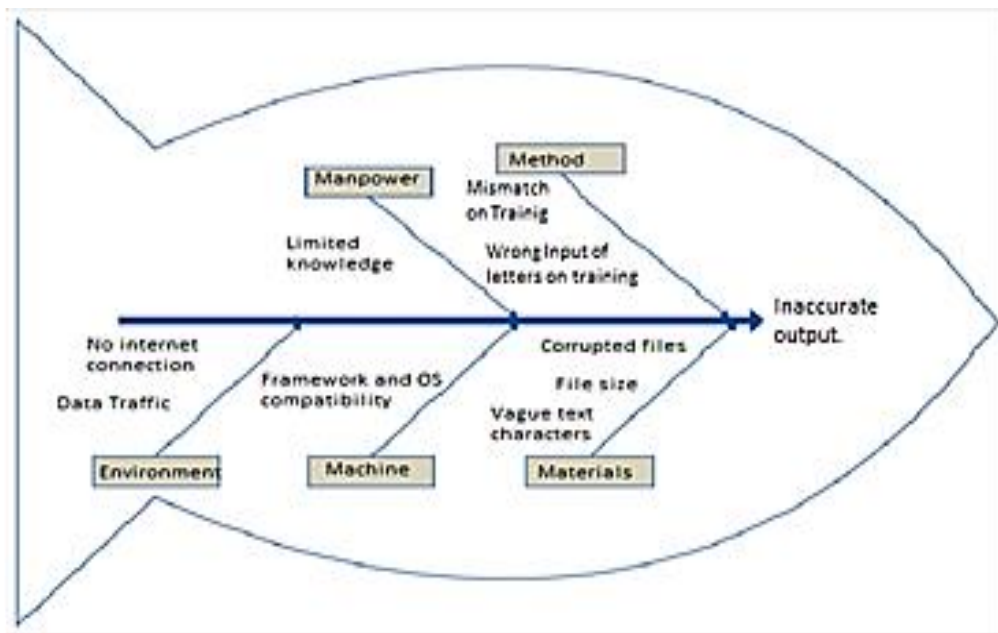

Figure.13: Fishbone Diagram

Figure 13 enumerates the possible causes of problems in converting the file in terms of manpower, method, environment, machine and materials. In this way the researchers thought of possible solutions whenever the system faces these problems.
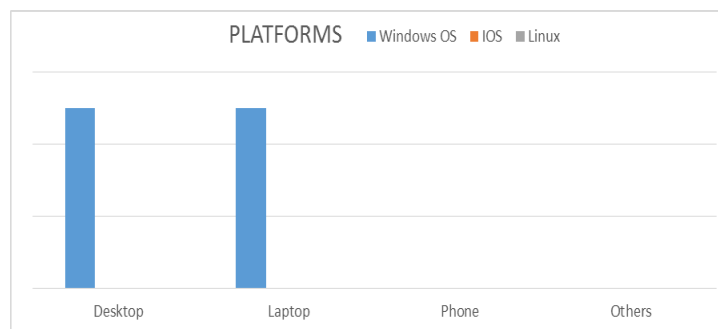
Technical Feasibility:

Figure.14: System Compatibility

Figure 14 illustrates the compatibility of the developed system in terms of devices and Operating System to be used. This sections shows that the developed system would only run on desktops and laptops under Windows Operating System having Windows 10 OS or later versions.

Software Specification:

In this section, the software used in developing the system, programming language and tools are shown. Windows 10 or later versions are required for the Operating System of the computer are required to have a 4.5 .NET or higher framework. In constructing the whole project, the researchers used the software application of Microsoft Visual Basic 2013 Professional.

The system was developed using Microsoft Visual Basic under C# programming language implementing K-Nearest Neighbors algorithm and Adobe Photoshop in designing. The system will only run on computers that are running under Windows 7 and 8 Operating System and it requires having a .net 4.5 or higher framework.

Hardware Specification:

This states all the hardware materials that are needed in the implementation of system. Computers are the only hardware requirements for this study that must have a 1GB of RAM and 1.6 GHz or faster processor.

Schedule Feasibility:

Table.2: Schedule Feasibility Gantt Chart

Activity	2015				2016		
	Jun	Jul	Aug	Sept	Jan	Feb	Mar
First Consignment (Word, PDF, Text , HTML, GUI)	■	■					
Second Consignment (MP3, Send to Email)			■				
Third Consignment (Translation, Handwritten recognition)				■			
Fourth Consignment (Installer, Webpage)					■		
Fifth Consignment (Recommendations & Revisions)					■	■	■

Table 2 presents all the activities done in developing and enhancing the system that is presented in a Gantt Chart. Contents are divided into three parts wherein each cycle has checking and evaluating for the consistency and accuracy of the system.

Economic feasibility:

Economic analysis could also be referred to as cost/benefit analysis. It is the most frequently used method for evaluating the effectiveness of a new system. In the economic analysis the procedure is to determine the benefits and savings that are expected from a candidate system and compare them with the costs. If benefits outweigh costs, then the decision is made to design and implement the system. [44]

Table.3: Summary of Cost Analysis of La Fila Converter for Year 0.

Summary		
Recurring Cost	Employee Salary	PHP 80,000.00
Non- Recurring Cost	Hardware Cost	PHP 11,500.00
	Software Cost	PHP 7,000.00
	Total	**PHP 98,500.00**

Table.4: Cost Analysis of La Fila Converter for Year 1-5

Summary		
Recurring Cost	Employee Salary	PHP 36,000.00
Non- Recurring Cost	Hardware Cost	PHP 0.00
	Software Cost	PHP 0.00
	Total	PHP 36,000.00

Table 4 shows the summary cost of La Fila converter for year 1-5. It stated here that the cost was lesser than the initial year because the only expenses for year 1-5 were coming from employees' salary. Refer to appendix D for more detailed information.

Project Design:
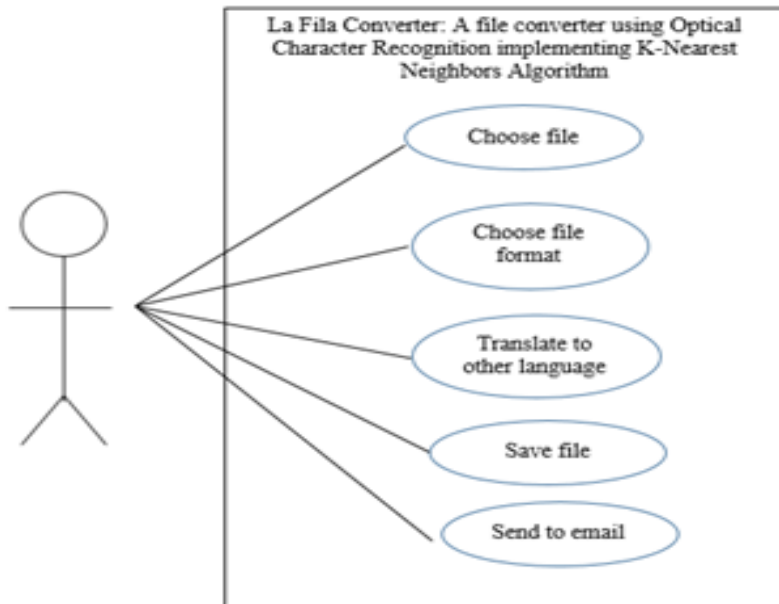
Requirement Modelling:

Figure.15: Use Case Diagram

Use case diagram as shown in Figure 15, shows the functions and methods that the user can utilize from the system. Wherein the user can choose their file and designated file format to be converted. The system gives an option to the user whether they want to translate the content of their file to another language or not. It also allows the user to save the converted file in their computers or send it to their e-mails.
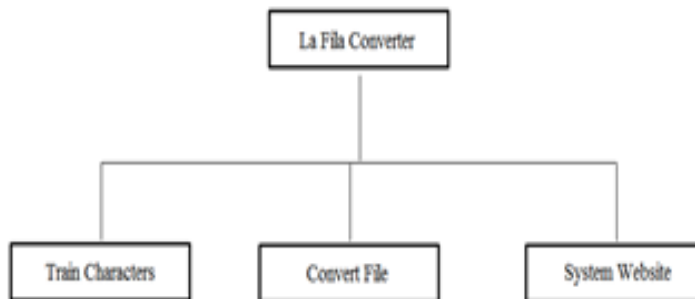

Figure.16: Functional Decomposition Diagram

Figure 16 shows all the processes that can be done by the system, training of characters that are for registering characters. Next is converted file for file conversion process that is to convert image to Word, Text, MP3 and can simulate HTML code. This function has sub functions that the system can perform and those are language translation, saving of the converted file, listening to the podcast, and sending of the converted file to user's email address. And lastly, is the system webpage that contains the system tutorial and information that also includes the system installer.
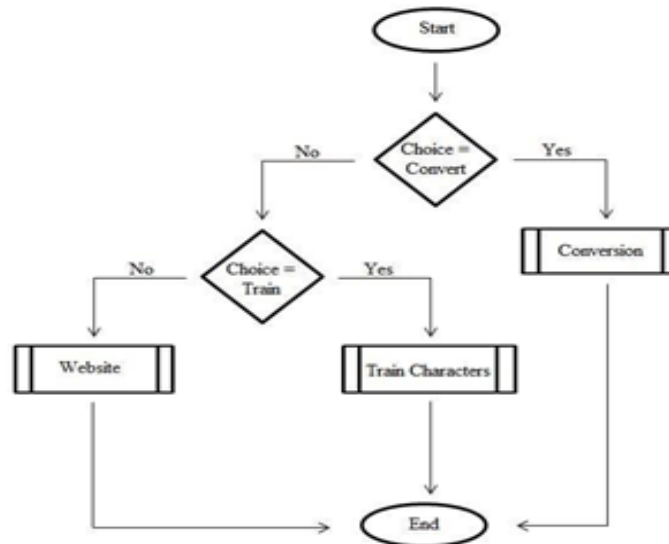

Figure.17: System Flowchart of La Fila Converter

In Figure 17, the system flow chart is shown. In this figure it is stated that there are three (3) options that the user can perform in the system. If the user wanted to choose the convert action, he will go to the conversion form which is the main function of the developed system. If the user wants to register or train the characters, he must choose the train action, and if the user wants to be guided on how to use the system, he can go to the application webpage by choosing the tutorial action.
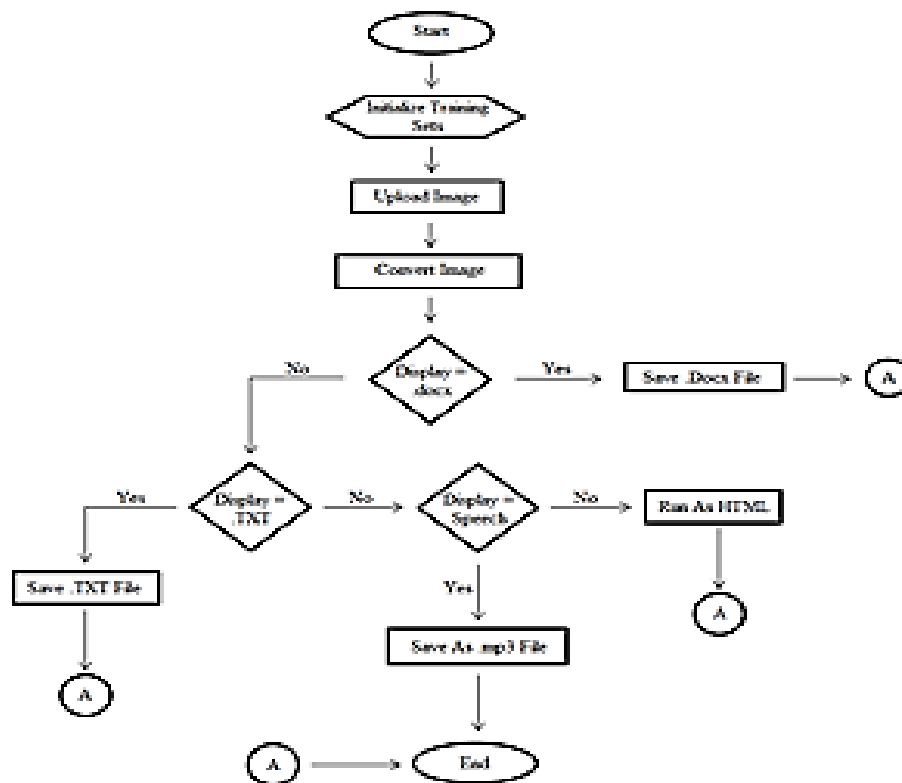

Figure.18: Program Flowchart of conversion

Figure 18 illustrates the program flow chart of the system. The program starts to run when the user inputs their file from their computer and the user needs to load the training set saved in their computers. Users have four (4) options in choosing output file format. After choosing file format the next process is converting of file. And lastly when the system is done converting the file the user has two options, if they want to save the file in their computer or send it in their email. When saving the file, the system requires the user to have their own file name and choose its file location, and on the other hand, in sending to email the user must input their email address first before sending to their email.

Figure.19: Program Flowchart of training images in La Fila Converter

Figure 19 illustrates the flow chart of training images in the system. The first process is the uploading of the image needed to train or to register to the system. Then after uploading the user will select the file location for saving the training sets. Once the user has decided where to locate the xml files, the user will start training, this will be done by typing the letter inside the red box. That red box represents the data that was recognized by the system. Whenever the user is done training, the system will prompt the user that training is complete and the system will create the xml file to the chosen location of the user.
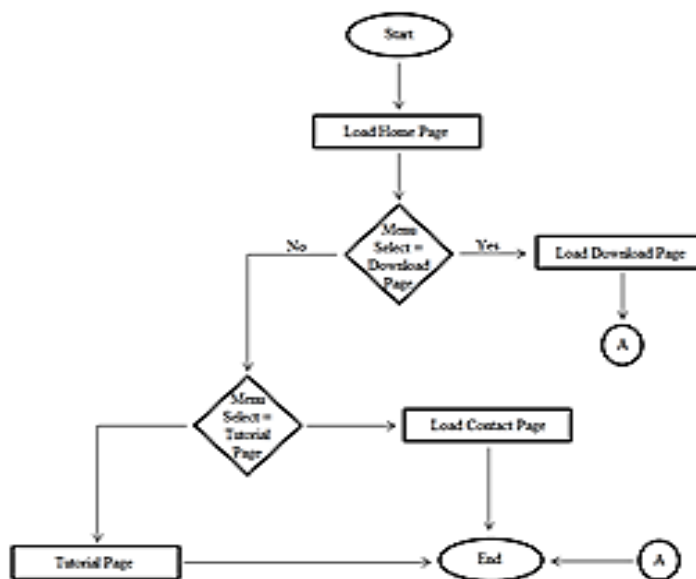

Figure.20: Program Flowchart for La Fila Website

Figure 20 shows the program flow for the website of the La Fila. The application installer can be downloaded by the user by clicking the download button to the website. The user can also select the tutorial page for them to be guided with detailed steps on using the application. The contact information of the developers of the system can also be viewed by the users. All those information can be found at the La Fila website.

Figure.21: La Fila Converter Main UI

In the figure shown above, it simply shows the Graphical User Interface of the system (GUI). The system must be user friendly so the system design must be very simple yet eye catchy for easier understanding, where all buttons are named according to its functions together with its icon. The system also provides a help page wherein users can be guided in using the system.

Project Implementation:

The system that the researchers implemented is the La Fila Converter: A file converting system using Optical Character Recognition implementing K-Nearest Neighbors Algorithm. The system was made to serve and provide a file converting system to avoid written or copying manually the file content to form another file format.

In this section, responsibilities of the person in-charge in implementation of this study were discussed. Plans to be followed by procedure schedule of the project implementation were also stated in this part of the documentation.

Project Implementation Plan:

The developers planned to distribute flyers to everyone that contained important information about La Fila. To implement this project effectively the system developers analyzed the possible consumers of this application. The following statements discussed the target purchaser of the developed system.

Individual. The developed system can be used by every computer user aged ten (10) years old and above. The developers planned to have video tutorials to be uploaded on the website to guide each individual user on how to use the application. The website url is included in the flyers to be distributed.

Organization. The developed system can also be used in different industries or organizations that might help them to lessen the time and effort in file conversion. The developers planned to set a schedule to visit each organization or companies who would purchase the application for the system implementation and they will provide a user manual of the system.

During the implementation, the presence of a system administrator is highly needed to assist, and respond to all questions and concerns of the users. This role would also handle the maintenance of the system. Users can refer to the contact information provided at the application webpage for more inquiries.

Implementation Procedure:

Everyone is the target user of the developed system. The researchers will provide a video tutorial for everyone to be uploaded to the application webpage to guide the users well from introducing to closing the application. They will also provide an area for users' comments and suggestions to the application. And as for the companies that are also the target consumer of this research the researchers will provide training plan so that they can fully operate the system.

- Introduction of the system.

- Explaining the difference between the existing system and the proposed system of the researchers.
- Guiding the user in downloading and for the installation of the system.
- The researchers will guide the user to navigate each function in the application.
- General training: the users will use the system with no assistance but with the researcher's presence.

The developers would discuss thoroughly each procedure in the user manual. This training plan is planned to do for one (1) day. Once the user has learned how to use the application, the researchers will conduct an evaluation in order to know the possible comments and suggestions of the users for the enhancement of the system.

Implementation Schedule:

In order to use the time wisely, developers must set a schedule for all the actions needed to be done. To avoid wasting of time or to finish the requirements needed they need to follow schedule. The developers began by making the tutorial videos of the application and the flyers for the system. Then the developers continued to implement the developed system to a group or organizations. Each implementation to a company was done for one (1) day.

Implementation Contingency:

Some risks may arise in the implementation of the system. Operating system might be an issue for software compatibility. The system might not work properly if the computer runs on an operating system that is not compatible with it. Losing an internet connection might also risk a problem, without internet connection translating the content to another language is absurd.

The researchers planned things to be done to be able to minimize this risk. The researchers reminded and trained the users well about every little detail of the application to lessen the misunderstanding with the system. They gave all the information for the requirements needed by the user in order to run the application properly. The researchers managed their time wisely.

Project Evaluation:

Functionality Test is a verification that the software performs the required actions or functions correctly according to the given specification. During the testing, testers validated if every action of the system was functional. This testing was based on ISO 9126 software standard.

Conformance Test is testing to see if an implementation met the requirements of a standard or specification. To aid in this, many test procedures had been developed. If the criteria or requirements for conformance are not specified there can be no conformance testing.

The standard used to test for this project was the ISO 9126 standard that categorized 6 main quality characteristics, namely:

- **Functionality**. This is the essential goal of any product or service created that states the functionality of every buttons or actions in the system must be operative.
- **Reliability**. This is the capability of the system to sustain its service provision under defined condition in a definite period of time.
- **Usability.** This characteristic refers to the ease of use for a given function.
- **Efficiency.** This is concerned with the system resources used when providing the required functionality without wasting materials, time and effort.
- **Maintainability.** The ability to detect and fix a certain fault within the software component.
- **Portability.** It refers to the software adaptability to its environment as well as its modification.

5. METHODOLOGY

This section justifies the means in which the study was obtained and helps in giving it purpose and strength as it will then be truthful and analytical. To be able to gather the necessary data, the researchers utilized the descriptive method, using quantitative approach. Specifically, this research covered the following: the research design and method, the respondents or subjects to be studied (which includes the sampling method), the data collection instrument, and the data analysis. These are presented in this whole chapter.

Research Method Used:

This study utilized the quantitative type of research because of its appropriateness to study, specifically the descriptive design and system development. It usually involves collecting and converting data into numerical form so that statistical calculations can be made and conclusions drawn. Descriptive research or also known as the statistical research, describes data and characteristic about the population being studied. The question "What is the current situation?" should be answered.` In terms of the system development, a model or system is developed with the aid of thorough analysis of current situation or trends to an improved version of it or better, a new one. The implementation of conversion existed even before. System Development was conducted in order to comply with the project description and goals.

System Development Process Used:

The researchers used Incremental Process Model in the system. In incremental model the whole requirement is divided into various builds. Each module passes through the planning, requirements, design, implementation and testing phases.
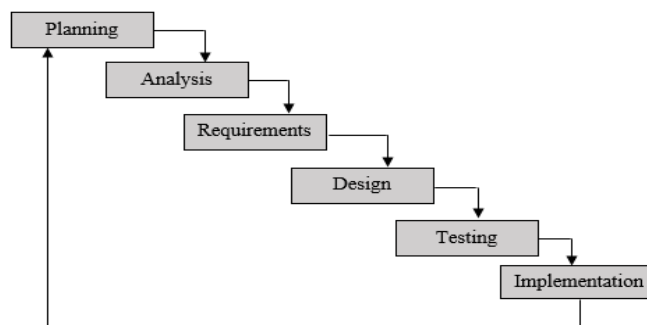

Figure.22: Incremental Model of the study [35]

Figure 22 illustrates the increment of the study. Each increment has a different consignment which is the other function of the system. The researchers had undergone with these stages for the development of the study. For the planning process, the researchers plotted all the ideas and concept for the project and the algorithm that was used. For the analysis phase, the researchers studied about the K-Nearest Neighbors Algorithm and how it was implemented for the conversion concept. Then for the requirements phase they gathered all the materials and data that were suited for the study. In the design phase, the researchers used Functional Decomposition Diagram (FDD) to break down the detailed function of the system. In the testing phase, functional testing and conformance testing were used which is under ISO 9126 Standards. In the implementation phase, the setup or the system
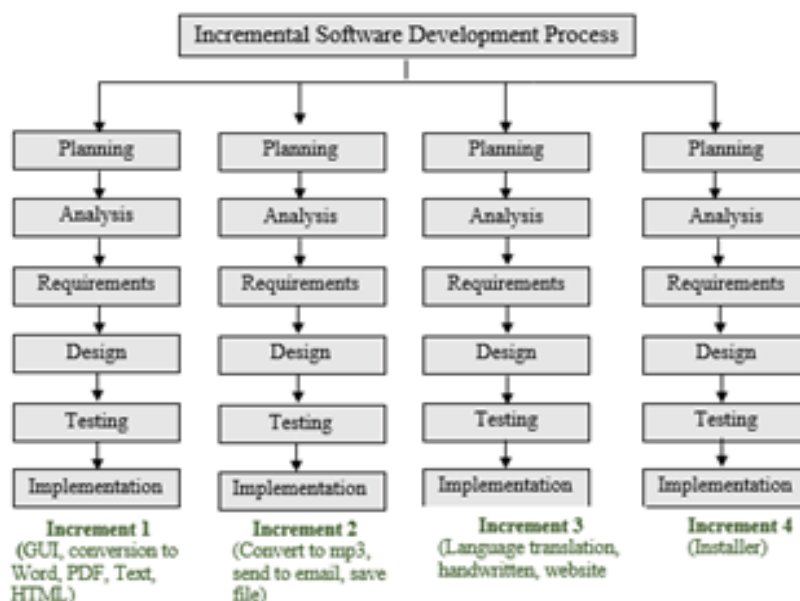

Figure.23: Implementing the software process to the study

This process was distributed in each module of the project. First consignment was composed of the Convert to Word, PDF, Text, HTML and the GUI. The second consignment was the establishment of the Convert to Speech, sending to Email and saving of file. Thirdly, the language translation and handwritten recognition were added. And the last consignment which was the fourth was the construction of the application installer and uploading of the webpage. Conforming together was completely finished.

Locale of the Study:

The researchers designed and implemented the study in Lyceum of the Philippines University Cavite Campus. In the events of evaluating the end users evaluated the program inside the campus. On the other hand, the IT proficient evaluators were from the different companies that agreed to accommodate the researchers to conduct this evaluation. The study started from June 2015 to March 2016, all within the academic year.

Respondents of the Study:

A total of forty (40) evaluators, consisting of thirty (30) End Users and ten (10) I.T. Experts which composed of IT Specialists, and .NET Developers were the respondents of the study. They evaluated the program based on the given criteria in the evaluation form.

Sample and Sampling Technique:

Multistage sampling was chosen for this study. This type of sampling technique is sampling at multiple stages. 40 persons were the target population for conducting this evaluation, and they were clustered into different states. 30 persons for the end-user respondents and the other part were for IT experts which consisted of 10 persons.

Research and Test Instruments Used:

The research project was evaluated under The Software Criteria based on ISO 9126 to ensure that this study complied with the standard requirements for a quality software project. The evaluation instrument form required the evaluators to give the information needed for the survey, such as age, gender, participant's category whether they responded as end user or IT specialist, and they also needed to indicate their position for both parties. There was a space for the evaluator's name but it was optional. On the last part of the form there was an area allotted for the respondent's comments and suggestions that helped for the enhancing of the project.

Moreover, the software evaluated within sets of characteristics. First, It was evaluated under functionality that tested the system to its suitability, accuracy, interoperability and security. Next was reliability test that fell under the maturity, fault tolerance, and recoverability of the system. Respondents tested the understandability, learnability and operability of the software. After that was the efficiency of the application for its time and resource behavior. Furthermore was based on the maintainability of the software, specifically analyzability, changeability, stability, testability, and maintainability compliance of the project must be examined. And lastly the portability, the adaptability and conformance of the system were tested. They evaluated the software by choosing the scores of 4, 3, 2 and 1 classified as Highly Acceptable, Moderately Acceptable, Slightly Acceptable and Unacceptable.

The participants for the group of 40 were chosen randomly within the Lyceum of the Philippines University Cavite Campus and outside of the school that consisted of students and school employees. A dissimilar way in choosing for the IT proficient that was selected, because the selected IT experts were those who were available for the time period of evaluation and willing to entertain the group for evaluation survey.

Statistical Treatment of Data:

The results converged in the evaluation had been evaluated by counting the scores being chosen among 4, 3, 2 and 1. The collected forms that were from 10 IT experts and 40 end users were tallied separately.

Data gathered from the evaluation were tallied and tabulated to calculate the mean and standard deviation in each criterion in order to identify the results. The formula to get the mean was where for the mean, for summation, X is the symbol for the scores and N represented the number.

Table.5: Scoring System

Numerical Rating	Equivalent
4	Highly Acceptable
3	Moderately Acceptable
2	Slightly Acceptable
1	Unacceptable

Table 5 shows the scoring system used to rate and interpret certain criteria from the ISO 9126 standard software evaluation instruments. Results accumulated from the computation of mean and standard deviations were also rated and interpreted using this scoring system.

Table.6: Likert Scale

Numerical Rating	Equivalent
3.25 – 4.00	Highly Acceptable
2.50 – 3.24	Moderately Acceptable
1.75 – 2.49	Slightly Acceptable
1.00 – 1.74	Unacceptable

Table 6 shows the Likert scale was used to determine the acceptability of the system based on the evaluator's view on the software. Each corresponding numerical rating had its equivalent interpretation of data being rated.

Results And Discussion:

These presentations of the gathered data as the outcome of the conducted evaluation survey Accumulated data shown in this chapter were interpreted using the evaluation techniques discussed in the previous chapter.

Data Presentation:

Using the ISO 9126 software evaluation instrument, the researchers were able to accumulate the data from the evaluators of the study. Results from the evaluation period had been calculated and tabulated according to each criterion.

Table.7: Functionality Evaluation Survey Result

Functionality				
Criteria	IT Experts		End Users	
	Mean	SD	Mean	SD
Suitability	3.90	0.32	3.73	0.45
Accuracy	3.62	0.52	3.60	0.50
Interoperability	3.80	0.42	3.73	0.45
Security	3.30	0.67	3.40	0.67

As the result of the conducted evaluation shown in table 7, the suitability got the highest score for the functionality criteria that simply explains that this research study has the capability to provide an appropriate set of functions for specified tasks and user objectives, that followed by the interoperability, and accuracy. In this category the sub criterion security got the least score, because the proposed application did not need to have user registration since this is a PC-based project so it is up to the owner if he will allow the other user to use the application.

Table.8: Reliability Evaluation Survey Results

Reliability				
Criteria	IT Experts		End Users	
	Mean	SD	Mean	SD
Maturity	3.40	0.52	3.40	0.50
Fault Tolerance	3.30	0.48	3.33	0.48
Recoverability	3.30	0.67	3.33	0.48

For reliability criteria, maturity of the system got the top point that described the system effectiveness and efficiency of its processes and work practices. And the other criteria got the same results. The fault tolerance and recoverability shown in table 8.

Table.9: Usability Evaluation Survey Results

Usability				
Criteria	IT Experts		End Users	
	Mean	SD	Mean	SD
Understandability	3.80	0.42	3.67	0.66
Learnability	3.80	0.42	3.67	0.48
Operability	3.40	0.52	3.73	0.45

The understandability and learnability of the system got the same results as well as the highest point in usability criteria for IT experts. On the other hand operability got the highest point for End Users.

Table.10: Efficiency Evaluation Survey Results

Efficiency				
Criteria	IT Experts		End Users	
	Mean	SD	Mean	SD
Time Behavior	3.40	0.52	3.50	0.51
Resource Behavior	3.60	0.52	3.53	0.57

Table 10 shows the evaluation result for criteria of efficiency. In this table it shows that the project was capable to complete tasks at the minimum amount of time and the software was able to adapt to the newer versions of operating system.

Table.11: Maintainability

Maintainability				
Criteria	IT Experts		End Users	
	Mean	SD	Mean	SD
Analyzability	3.40	0.52	3.47	0.51
Changeability	3.20	0.42	3.37	0.49
Stability	2.90	0.82	3.43	0.50
Testability	3.50	0.53	3.47	0.51
Maintainability Compliance	3.20	0.79	3.37	0.49

6. EVALUATION SURVEY RESULTS

For table 11, it shows that the maintainability of the software was on the average score, not too high yet not too low that the system was able to adapt to changes, actions and maintenance done by the users.

Table.12: Portability Evaluation Survey Results

Portability				
Criteria	**IT Experts**		**End Users**	
	Mean	SD	Mean	SD
Adaptability	3.30	0.67	3.53	0.51
Conformance	3.00	1.05	3.53	0.51

For portability results in software evaluation shown in table 12, it shows that the system adaptability and conformance was also in the average range of score for meeting the standard requirements.

Data Analysis, Interpretation and Implication:

In this part of the documentation, the analyzation and interpretation of the results and implications of the evaluators to the proposed study were discussed.

Table.13: Summary of Evaluation Survey Results

Criteria	Average Mean	SD	Interpretation
Functionality	3.64	0.50	Highly Acceptable
Reliability	3.34	0.52	Highly Acceptable
Usability	3.68	0.49	Highly Acceptable
Efficiency	3.50	0.53	Highly Acceptable
Maintainability	3.33	0.56	Highly Acceptable
Portability	3.34	0.69	Highly Acceptable
Grand Mean/SD	**3.47**	**0.55**	**Highly Acceptable**

Table 13 shows the summarized results of the conducted evaluation survey by the researchers to both IT Experts and End Users. Each of the criteria was interpreted using the Likert scale shown in the previous chapter.

Based on the evaluators' perspectives, the proposed software is highly acceptable. The system received a highly acceptable remark in all criteria that was based on ISO 9126 software evaluation instrument. This meant that the system can do all tasks and meet the standard requirements of quality software. As stated on table 13, the usability of the software received the highest acceptable mark for both IT Experts' and End Users that simply shows that the software is capable to be understood, learned, used and is attractive to the user when used under specified conditions. As for the functionality, it says that the software functionalities and operations can generate certain outputs without experiencing any error.

In system efficiency, it shows that the software was capable of providing appropriate performance, relative to the amount of resources used under stated conditions. In terms of reliability, it shows that the system was qualified for performing a specified number of operations. It handled faults and errors and continued working in times of failure but it should lessen the times that would happen.

In terms of portability, the system can be transferred in most computers regardless the computer specifications. And for maintainability of the software it says that the system can follow the user's preferences and situations making it changeable and testable. It can be modified to correct defects, modified to meet new requirements, modified to make future maintenance easier, or adapted to a changed environment.

7. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This presents the summary and conclusion from the conducted evaluation survey. In this section, recommendations of the study were given for future development of the project was included.

Summary of Findings:

This study implemented an existing algorithm to the developed system "La Fila Converter: A File Converter Using Optical Character Recognition Implementing K-Nearest Neighbors Algorithm". The developed system was able to convert images to Word, Text, MP3, and can also simulate HTML code from the inputted image. The developed system was constructed using Microsoft Visual Studio under C# programming language that could only run on computers and laptops under Windows 10 Operating System or later version having a 4.5 .NET framework of higher versions. The researchers followed the Incremental Software Methodology for project development. Conformance and Functionality Testing were utilized as testing instruments and lastly, the researchers evaluated the system under ISO 9126 Software Standard to identify if the proposed project met the standard requirements of quality software.

Two sets of evaluators participated in conducting the software evaluation. The first set of respondents were 30 End Users that were randomly selected within the Lyceum of the Philippines University Cavite and the other set was consisted of 10 IT Experts' from different companies.

On the test cases performed, certain errors were seen by the testing group. As response, the system errors were immediately corrected and then, again, tested which produced acceptable results.

Based on the analysis of data and interpretation of the summary results of evaluation, the following findings are listed below conceived.

How the researchers tested the study in terms of:

- Conformance Testing based on ISO 9126 Standard and gained 136 Pass and 22 fail which overall, the research study was approved.

- Functional Testing based on ISO 9216 Standard and gained 69 Yeses and 18 Nos which overall, the research study was approved.

How does the IT Experts and End User evaluate the study?

1. This software was able to perform its functions properly in terms of converting of files to another file format while performing other add-ons actions done by the user. The software allowed the users to interact with the system. In terms of functionality, the project was given a remark of Highly Acceptable with the weighted mean of "3.64".

2. The system received a Highly Acceptable remark in terms of Usability which is able to provide a friendly user Interface that can easily be understood, learned and operated even if the user is a non IT professionals.

3. The reliability of the system was rated as Highly Acceptable because the system was qualified for performing a specified number of operations and could handle fault and errors without terminating the program.

4. In terms of portability, the software can be used in different versions of Microsoft Operating System and does not require the users to have high end computer specifications to use the application. For this criterion, the project got the remarks of Highly Acceptable.

5. On the efficiency criteria the software obtained the Highly Acceptable remark, due to the performance of a task given by the user within a minimum amount of time.

6. For the maintainability criterion, the software received a Highly Acceptable because of the capability of the system to be modified to errors, met modernization, innovated to make future maintenance easier, or adapted to a changed environment.

Other Findings:

- Computers don't have eyes to read, they use pattern recognition to recognize a character.

- Dirty marks, folds, coffee stains, ink blots, and any other stray marks were all factors that reduced the likelihood of correct letter and word recognition.

- Need to use a macro (close-up) focus setting to get really sharp letters that are clear enough for accurate OCR.

- Smaller fonts can't be recognized accurately because it affects the vector outlines. Characters recognition is like zooming images. The smaller it is the more pixelated it will be.

- Even the best OCR programs aren't perfect, especially when they're working on very old documents or poor quality printed text.

- Handwritten text characters are harder to recognize than the printed text, because even your own handwriting is not in completely the same strokes.

- Internet connection must be at least 500kbps of speed to translate and decrease error of converting and sending email.

8. CONCLUSIONS

Based on the findings of the study, the following conclusions were drawn:

1. The researchers designed and implemented K Nearest Neighbor algorithm in the La Fila Converter.

2. The researchers successfully applied Incremental Software Methodology to develop the La Fila Converter.

3. The researchers successfully tested the developed study using Functional and Conformance Testing.

4. The researchers complied with the software standard based on ISO 9126.

5. The clearer the image the more accurate it will recognize.

6. The larger the font's size the higher of accuracy to be read.

7. Add security to the converted or to the translated file.

9. RECOMMENDATIONS

Based on the evaluation, findings and conclusion presented, the following recommendations are suggested:

Future Researchers. The researchers recommend that future researchers should improve the performance of this software, have a larger scope in conversion and improve the Interface of the system.

IT Experts and End Users suggest the following concepts for future development of the study.

1. Try to make it as a mobile application to be more convenient when using it.

2. Add more languages and extend characters limit in translation.

3. Try to work on the part of recognizing smaller fonts.

4. Add restrictions when uploading a file.

5. Include spell checker.

6. Recognize special characters.

7. Add security to the converted or to the translated file.

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