

**ALPHANUMERIC TEST PAPER CHECKER MACHINE THROUGH INTELLIGENT  
CHARACTER RECOGNITION (ICR) WITH ITEM ANALYSIS**

A Project Study Presented to the Faculty of  
Electronics Engineering Department  
College of Engineering  
Technological University of the Philippines

In Partial Fulfilment in the Requirements for the Degree of  
Bachelor of Science in Electronics Engineering

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## **Approval Sheet**

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- The Researchers

## **Abstract**

This paper presents the development of a test paper checker that will recognize a handwritten text using Intelligent Character Recognition (ICR) for Alphanumeric Characters. An examination can be conducted into two – digital and manual and each way had different approach in checking. In this study, the main objective is to recognize alphanumeric handwritten characters accurately using intelligent character recognition. OpenCV is used in the Python programming language and Support Vector Machine as a tool in machine learning for ICR. Answer sheet was designed with 120 items for MCQ and problem-solving questions. Item analysis and printing of results are included in the device. Experiments were conducted by giving an actual examination from the 131 participants in Technological University of the Philippines for testing the accuracy of the device. The results obtained from comparing manual and machine checking had an accuracy of 93.0769%. The group has concluded that the method used is applicable for the development of handwritten character recognition.

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# **Chapter 1**

## **THE PROBLEM AND ITS BACKGROUND**

### **1.1 Introduction**

Education is a key to the growth of any nation. It is the foundation which intellectual, physical and technological development takes place. In order to attain these developments, governments and private organizations established the growth of education through educational institutions. The only way to assess students' performance in such institutions is to take examinations. However, students feel pressured nowadays as the current educational system is a result-driven.

Examinations are the measurement of knowledge and skills possessed by students that are recorded by the evaluation. It is conducted to determine the capabilities of each individual on the respective field. Examinations are valid in the performance of its functions; reliable in terms of consistency of measurement. It can also evaluate the performance or judge the scholastic attainment of the students. In some cases, candidates are assessed on the content of a course learned over a given period of time by lecturers or by an examining body. Examinations these days are conducted in digital/computerized and manual. However, between the two, manual examinations needed much consideration because it is checked by hands manually by the checkers compared to the computerized examination that is checked by the machine.

So, the proponents aim to develop a machine that is used for reading and checking the answer sheets in alpha-numeric-character through Intelligent Character Recognition (ICR) and will give reliable results of the scores. This study includes the item analysis of the examination given that will show the difficulty of each question on the examination.

## **1.2 Background of the Study**

According to a study with a title of “*The Effect of the Teachers Teaching Style on Students’ Motivation Action Research,*” by Barberos et al. (2010), instructors, especially in universities, are entrusted with so many responsibilities that range from the very simple to most complex and very challenging jobs. Effective teaching is the primary goal of teachers in developing students to their chosen career path. The teacher must recognize individual differences among his/her students and adjust the instructions that best suit to the learners through the provided seminars and trainings by the schools and universities.

On the other hand, according to an article published by Philippine Human Rights Information Center (PhilRights) in the year 2010, schools, especially in the Philippines, have a shortage in numbers of teachers. One of the reasons in this is caused by low salary allocated for teachers compared to the other jobs and careers. To resolve this issue, teachers were forced to go different career path or chose to go abroad for a better job opportunity and better state of living. With that, professors are overwhelmed by the number of students handled.

Making examinations are included in the responsibilities of instructors. It is meant to assess the students’ learning. One of an instructor’s burdens is checking numerous test papers of students. Examinations conducted in two different categories; digitally and manually. Digitally typed of exams are taken in two ways. It is either to conduct online by web or offline conducted by the examiners. These exams vary in style given, such as an essay type, identification type, matching type and multiple-choice questions (MCQs). MCQs are commonly used because of it is being objectivity: in the past project studies being conducted, it can only check MCQs. It enables standardization and these types of

examination are graded quickly. In engineering courses, most of the examination focuses on problem solving. This requires numbers and variables in the solution to be able to get the correct answer.

### **1.3 Objectives**

#### **1.3.1 General Objective**

The purpose of this study is to develop a machine that is not only used in reading the answer sheets but also for checking the answers in alpha-numeric-character form and will give reliable results of the scores received by the examinees.

#### **1.3.2 Specific Objectives**

1. To use Open Source Computer Vision with Python Programming Language for Intelligent Character Recognition (ICR) features.
2. To develop a database management using Structured Query Language (SQL).
3. To analyse the result of the test and evaluate the difficulty of the examination using item analysis.
4. To produce a printout of the examination results using thermal printer and be able to send the results in the database of the professor/instructor.
5. To be able to install in the College of Engineering – Electronics Engineering Department to be used by the ECE Faculty.

### **1.4 Significance of the Study**

One of the burdens of the teachers is checking test papers of various students. The study of test paper checking machine enables to reduce the workload of the teacher by checking test papers consequently. The time is imperative in each teacher and by just

checking the test paper of each student, time is being wasted. Since this venture can spare greater amount on the educator's time, those circumstances can be dedicated to enhancing the classroom instruction. Using this device, instructor will save time by inputting the right answer in the device and the test paper checker does the rest. The evaluation of the handwritten answers of the student will be done by intelligent character recognition (ICR).

For result, the final score will be found in the screen of a tablet and can be transferred to the PC of the instructor. The device is capable of producing a printout of the scores of the examinee. It will also evaluate the effectiveness of each test items based on their scores by means of item analysis. It must undergo into an item analysis as it is to assess the responses of the students to individual test questions or to the examination as a whole.

### **1.5 Scope and Limitations**

The study will primarily focus on the development of a test paper checker machine capable of recognizing handwritten text and characters through intelligent character recognition for checking test papers. The answers obtain from the answer sheet will be compared to the answers set on the database. The device is subsided into different functions. First, to accurately recognize handwritten characters with the use of intelligent character recognition. Second, is to use item analysis for the interpretation of the over-all outcome of the examination. Lastly, a database for the professors for them to have their own copy of information of the examinees, the result of examination, and item analysis. The results will be displayed on the PC tablet and will produce a printout in a thermal paper using a thermal printer. The results include the name of the professor, name of the

student, subject and the score attained by the students. The result of item analysis will be seen in the database of the device.

The machine can be used for two types of questions: multiple choice and problem solving. In a multiple choice question, letter A – E are only applicable to use while in problem solving the machine is only capable of reading numeric characters and asterisk that corresponds to a decimal point. The answers must be written on the specific fields for the machine to recognize it accurately. The machine only recognizes the handwritten text that is inscribed on the formatted answer sheet. The answer sheet should be kept neat and clean for accurate recognition. The characters written on the answer sheets must be in technical lettering so the device will recognize each character accurately.

### **1.6 Statement of the Problem**

The professors are busy with academics and seminars that they had no chance of checking quickly the test papers which results to pile of unchecked test papers. Forty percent of the time of the professors is also given to extracurricular activities stated in the school calendar. That is the reason why professors sometimes seek assistance from other students. Students' number also varied to check by only one professor.

Faculty members do not perform teaching alone. Stated in Table 1 are the working loads of the faculty members according to NBC 461.

**Table 1** NBC 461 Faculty load

	Teaching Load	Research and Extension
Instructor	60%	40%
Assistant Professor	60%	40%
Associate Professor	55%	45%
Professor	50%	50%

It is required for the faculty members to do the work loads stated in the NBC 461 memorandum for them to accomplish their requirements. This consumes mostly the time of the professors that they do not have enough time to check test papers.

### **1.7 Definition of Terms**

#### **Alphanumeric**

It is a combination of numerals and letters. It is mostly used in labeling and in mathematical equations.

#### **Database management system (DBMS)**

It is a computer software application that interacts with the user, other applications, and the database itself to capture and analyse data.

#### **Deep Learning**

Deep learning is a branch of artificial intelligence. This is a machine learning method based on learning data representations. It is also a powerful technique for learning neural networks.

#### **Histogram of Oriented Gradient (HOG)**

It is used for image extraction and for the accuracy of handwritten characters. It is a characteristic of a descriptor that is commonly used in detecting objects in computer vision and image processing. HOG is used in this study for image extraction as this technique counts the instance of gradient orientation on an image.

#### **Intelligent character Recognition (ICR)**

A recognition system for handwriting that allows recognizing different styles and fonts of handwritten characters that can be learned by the computer. It is an advance technology of optical character recognition.

## **Item analysis**

This is a process to determine the item difficulty of an item in the test question. It assesses the scholastic performance. It provides statistics on the test as a whole and in individual test question. The data gathered will help to identify questions that may be poor discriminators of student's performance.

## **Point-biserial correlation**

Also known as item difficulty which refers to the ability of an item to differentiate the performance among the students and their total examination score.

## **Python Programming**

Python is a programming language used for general-purpose programming. It is a language with lots of features and capabilities used in different fields like artificial intelligence, scientific computing, web development and data analysis. Different applications can be done through the use of python programming such as cropping the scanned image, image processing, and support vector machine and for handwritten recognition.

## **Support Vector Machine (SVM)**

It is an advance classification system for pattern recognition in which the intelligent character recognition produced. It is a machine learning features from an image and it is used as a data for a certain purpose. In this study, it is used for handwritten recognition.

## **Visual Basic**

Visual Basic is a programming environment that uses BASIC programming language intended to develop for beginners as it is easy to understand. VB has a variety of tools that is used to create advanced applications. This includes an extended graphical user

interface (GUI). Diverse object-oriented programming can be done through the use of its variety of libraries.

## **Chapter 2**

### **REVIEW OF RELATED LITERATURE**

#### **2.1 Conceptual Literature**

##### **2.1.1 Alphanumeric Characters**

Alphanumeric characters refer to a set of characters that consist of both letters and numbers. Specifically, the set contains of 26 Latin letters, from A to Z, and 10 Arabic numbers, from 0 to 9. Alphanumeric is also known as alphabetic (Stanley, n.d.). The use of this characters depends on their specific use such as upper and lower case-letters and even numerical characters. Alphabets use in the present time is one of the landmark artifacts of the western culture as their common writing system is based on Latin alphabet (Mueller & Weidemann, 2011). These characters are widely used in English language as it also works well most of the time from conversing from one another.

In different type of examinations such as essays, identification and multiple choice, alphanumeric characters were commonly used for answering questions. Problem-Solving-Type of exam uses also this form of characters, but it also includes other letters such as Greek alphabets for engineering problem solving questions.

Computer machines also use alphanumeric characters since it uses machine language in the process to communicate. One example is programming. Programmer writes the codes used in terms of numbers. It is used for numeric representation of what a person see as alphabet characters (Mueller & Weidemann, 2011).

### **2.1.2 Intelligent Character Recognition Concept**

Intelligent Character Recognition or ICR reads images of hand-printed characters and converts them into machine-readable characters. Images of hand-printed characters are extracted from a bitmap of the scanned image. ICR recognition of numeric characters was much more accurate than the recognition of letters. Pre-processing, segmentation phase, and feature extraction phase are the process of Intelligent Character Recognition. The Pre-processing Phase is applied on the image so as to acquire the image suitable for the segmentation phase. It involves various steps like removal of noise from the image, resizing the image, binarization of the image or removal of slant angle from the document etc. In order to speed up the process of recognition, the images are often resized. The Segmentation Phase is considered to be the most important phase as the final output of the entire process depends upon the output of this phase. The Feature Extraction Phase is the key phase for any pattern recognition application. This step intends in extracting the important features of the objects which can be used to distinguish it from the other objects. The aim of this phase is to minimize the within class variation and maximize the between class variation so that the object can be uniquely recognized (Bohra, S., et al., 2013)

### **2.1.3 Item Analysis**

In order to assess quality of examination given to the student, item analysis is used to evaluate the student responses to each test questions. Item analysis is essential for the instructor for them to improve and eliminate the misleading items in an examination. Also, it is significant to increase the

instructor skills in constructing an examination and identifying the specific content which needs clarity.

In this way, the quality of the examination can be assessed by its internal consistency. The way item analysis works is by comparing each students' item responses per item on the examination. Item analysis has two parts; first part assesses each test questions which made up the exam and the second part shows statistics summarizing the performance of the examination as a whole. It performs to evaluate the difficulty of the overall exam. One of the major component of item analysis is the item difficulty.

Based on the book "*Introductions to Classical and Modern Test Theory*" by James Algina and Linda Crocker (1986), item difficulty is also known as item easiness. It expresses the proportion or percentage of students who answered the item correctly. The item difficulty ranges from 0% to 100%, typically written as 0.0 to 1.0. The larger the percentage getting an item right, the easier the item is understood. To compute the item difficulty, divide the number of people answering the item correctly by the total number of people answering the item. The proportion for the item is usually denoted as  $p$  and is called item difficulty.

#### **2.1.4 Scanner**

Scanner is a device that converts images, printed and handwritten text or objects into a digital image. It is widely used in different institutions such as academe, hospitals, business and any other purpose it will serve. Using a scanner reduce the cost of paper storage as well as a document cost. A scanner has different types for different purposes or applications (Creating Digital Works -

Scanning & More, n.d.). For scanning of documents, two types of scanner are used. First is the flatbed scanner, it looks like a printer with a flip-up cover that covers the glass where the paper to be scanned is placed (Harrel, 2017). Second one is the scanner that has an automatic document feeder feature. It is advisable to use when scanning multiple pages of documents. There are scanners that also has duplex automatic document feeder feature, it scans both sides of the documents in one pass.



**Figure 1** Automatic Feeder Scanner

### **2.1.5 Database Management System (DBMS)**

A database management system is a software application that enables a user to store, define, manipulate, manage and retrieve data. The data that are stored are typically organized in reality model in a way that supports process information (Database Management System, n.d.). DBMS requires data and a database. Data are facts and statistics stored that is raw and unprocessed. It becomes an information when it is processed turning it to something meaningful. Database is a collection of data gathered in forms of tables, reports, queries and other objects that can be easily updated and manipulated (Study Tonight, n.d.). A DBMS provides protection and security of the data's stored in the database. It also

allows data consistency in case of multiple users. Popular DBMS used nowadays are MySQL, SQL Server, Oracle, Sybase, IBM DB2, PostgreSQL and Amazon SimpleDB. Most of the time a database is not generally usable across different DBMSs unless it uses different DBMS that can work by using standards such as SQL and ODBC to allow a single operation work with more than one DBMS. A DBMS is classified based on the database model it supports, and the most popular one is the structured query language (SQL). There are times when a DBMS is referred as a database.

#### **2.1.6 Structured Query Language (SQL)**

Structured Query Language (SQL) is a computer language designed for relational database management system (RDBMS) that stores, manipulates and retrieves data from a database. A SQL can execute queries, insert, update and delete records. It can also create new databases, views, new tables, and set permissions to the tables. Even though SQL is standard, many database systems implement their own version such as Microsoft SQL (Halvorse, 2016). Based on the blog written by Brian Sweat Entitled Benefits of Microsoft SQL Server, Microsoft SQL is a very stable, fast, extremely popular and affordable database engine.

#### **2.1.7 Open Source Computer Vision (Open CV)**

Open CV or Open Source Computer Vision is an open source C++ library for image processing and computer vision. Open CV is one of the useful tools for image processing programmers intact. It is a series of free library and free content which is exceedingly relevant to image processing project and machine vision.

This gathering of controlling functions can be utilized by programming languages for example, C++, C this controlling function can be displayed for windows framework like Linux and windows the capacities of such collection of this function presented in the form of software Open CV (Gupta, et al., 2017).

### **2.1.8 Python Programming**

The Python scripting language is a freeware programming language. Python is a general-purpose high-level programming language. Design philosophy emphasizes code readability. As a result, Python has very clear syntax. Python is an extraordinarily convenient for end users. The basic program structures such as cycles (for, while), decision structure (if, else) can be utilized. Moreover, it is possible to avoid errors during a program run. Any unexpected error can be solved by “try: except:” programming construction in Python. In addition, notification messages can be added to result window for users about flow of the batch data processing (Dobesova, 2011).

### **2.1.9 Visual Basic**

Microsoft Visual Basic is designed for graphical user interface (GUI) programming. It is not a procedural language but Microsoft calls it an event-driven programming language. Since the sequence of events that a user chooses is practically unlimited, the programmer must code each event independently in such a way that it can interact with other events. Event-driven programming is ideally suited for object-oriented programming techniques. Visual Basic Objects: Visual Basic objects have properties, methods, and events. Properties define the identity and state of an object. Methods and events define the behaviour of an

object. Visual Basic provides three of the four major elements of the object model, namely abstraction, encapsulation, and modularity. It also provides partial support for the minor elements of typing, concurrency, and persistence. (Dukovdic, et al., 1995)

## **2.2 Related Studies**

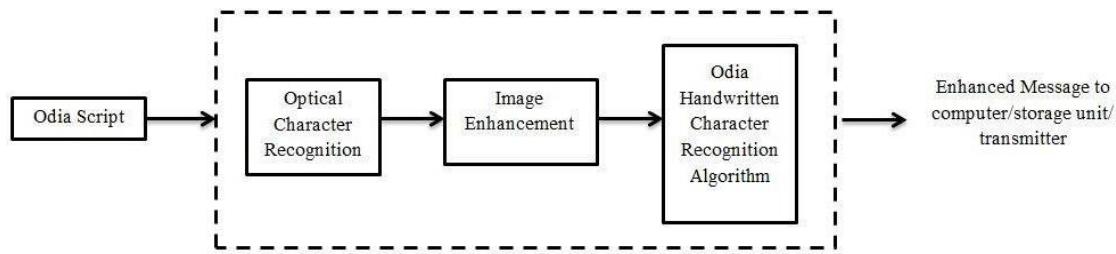
### **2.2.1 Test Paper Checker Machines**

According to the study entitled *Automatic Test Paper Checker Machine* (Cuevas, A, et al., May 2004), the test paper checker machine that was proposed and made in Technological University of the Philippines, the said machine was capable of checking 60 items examination in 120 seconds but can be used without a computer. In this study dc motors were used to speed up the process of feeding and checking of the answer sheets. The mechanical parts of the previous studies were not much improved and caused delays throughout the whole checking process. Furthermore, the studies also chose what kind of paper that should be used in order for the machine to work properly. They implement the system using Visual Basic 6.0 as the primary programming language. It was studied that it was the most effective programming language that can be used for test paper checker machines because of the complete set of tools that it can provide to simplify the rapid application development, but then it was not compatible to any Pentium based computer.

### **2.2.2 Optical Character Recognition**

Character recognition plays a vital role in modern technology as stated in the study of *An Intelligent Scanner with Handwritten Odia Character Recognition*

*Capability* published by Sukadev Meher and Debasish Basa in 2011. Over the years, humans thought of developing an algorithm that enables to read and interpret printed textual documents. This is to automatically convert into an alternate medium or format called Optical Character Recognition (OCR). This is a system developed for deriving character-based files from digitized images of printed or typewritten documents and/or handwritten manuscripts (Berchmans, D., and Kumar S.S., 2014). Based on the study of Meher and Basa, it is proposed that the given text is segmented into lines and then each line is segmented into individual words and then each word is segmented into individual characters or basic symbols.



**Figure 2** Intelligent Sensing Systems for Handwritten Character Recognition  
(Berchmans, D., Kumar S.S., 2014)

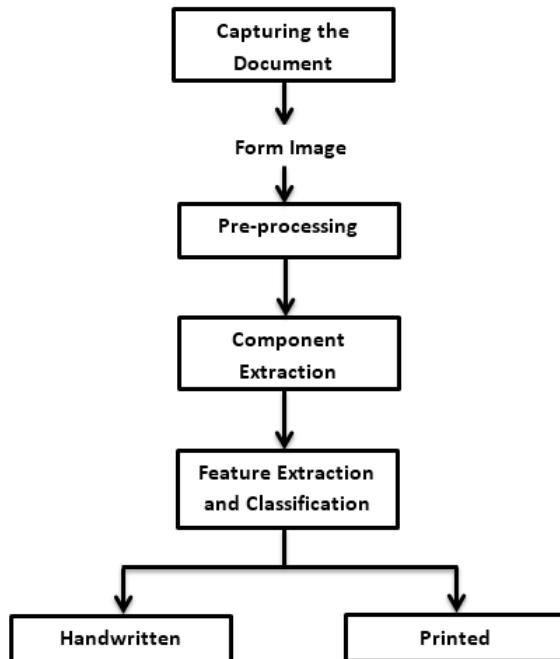
In analysing the handwriting, first script is converted into digital form by scanning the written paper with the help of an optical scanner as shown in figure 2. After that, some pre-processing tasks on the scanned image are carried out. Such tasks are de-noising, binarization, homomorphic filtering and morphological operations. Once the image is properly enhanced and restored, it is then processed by the character recognition algorithms.

The OCR software provides a fast performance assessment through similarity test engine for evaluation. The evaluation conducted and test rendered

are functional, reliable and correct alternative way for teaching basic handwriting stated in the study of *Basic Handwriting Instructor for Kids Using OCR* as an Evaluator by Alvin Kenneth S. Alvaro et al in 2010.

### 2.2.3 Image Enhancement Algorithms

In the study of *Automatic Classification of Handwritten and Printed Text in ICR Boxes* by Abhishek Jindal et al in 2014, the Intelligent Character Recognition or ICR has the ability to read handwritten characters whereas OCR has the ability to read the print characters. Document processors increase the accuracy and improve the timings by employing comprehensive automated recognition software that incorporates the best of OCR and ICR in a single solution. An obstacle to ICR systems is the mixture of printed and handwritten text in the same image. Each text type should be processed using different methods in order to enhance the recognition accuracy.



**Figure 3** Stages of System for Classifying Machine Printed and Handwritten Text

The various steps involved in classifying text in ICR cells of form image as handwritten or printed are pre-processing, segmentation at character level, feature extraction and the classification. This system for classifying machine printed and handwritten text is divided into three stages, as shown in Figure 3. It involves capturing the document, pre-processing the captured document through segmentation of zones containing ICR cells to individual components and the extraction of features of components and classification process executed by the system.

#### **2.2.4 Deep Learning**

According to the study of Wei Fu et al in 2017 in *Easy over Hard: A Case Study on Deep Learning*, the deep learning is a new method that is a representation of learning methods with multiple levels of representation. It is built on many layers of neural networks that attempt to model high level abstractions in data. This conventional machine learning algorithms is more efficient than other method at exploring high-dimensional data. The benefits of this method need to be carefully evaluated with regards to its computational cost. More, if researchers deploy some new and costly process (like deep learning), that work should be base-lined against some simpler and faster alternatives. Support Vector Machine (SVM) is one simple and faster methods that can achieve the results that are currently achievable by the concept of deep learning method.

#### **2.2.5 Support Vector Machine (SVM)**

In the study of *Handwriting Word Recognition Based on SVM Classifier* by Mustafa S. Kadhm et al in 2015, the first step in handwriting recognition

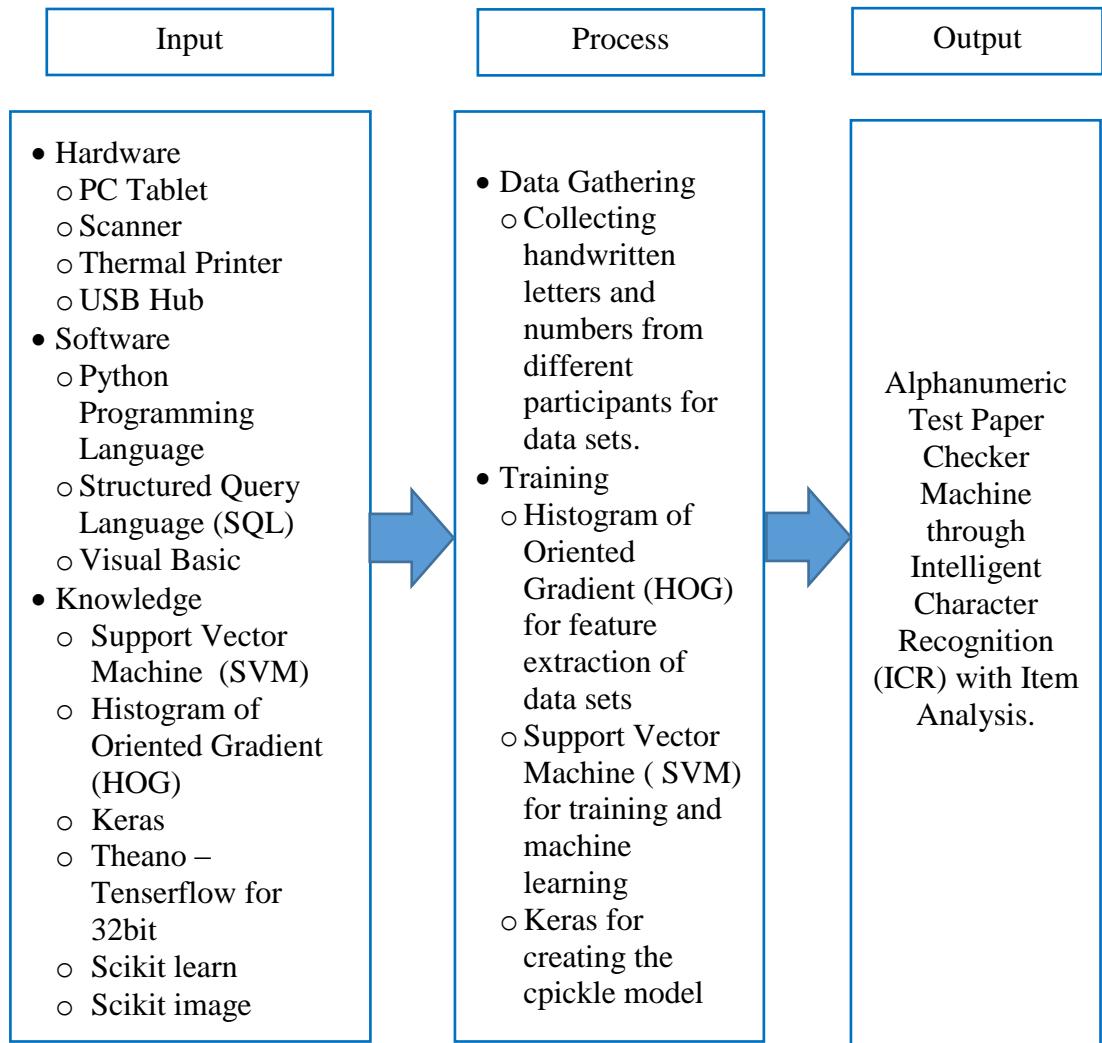
systems is the pre-processing. It helps to reduce the inconsistency of handwriting and to enhance the accuracy for segmentation and recognition methods. Features extraction is the second step to the systems of handwriting recognition and classification is the last step. The features extractor that was used in this study was the Histogram of Oriented Gradient (HOG) descriptor. It has been normalized based on the contrast to stabilize the illumination variation. This features normalization for Histogram of Oriented Gradient (HOG) descriptor used to improved accuracy. It is also successful descriptor for detection. Support Vector Machine (SVM) was used as the classifier. In this study it is stated that Support Vector Machine (SVM) is the most important and more effective classifier. The SVMs in various modern learning applications applied successfully by many researchers such as Optical Character Recognition (OCR), bioinformatics, document analysis, and image classification. SVM is a set of supervised learning methods used for classification, regression and outlier detection (Hamid, N.A. et al., 2016).

## Chapter 3

### METHODOLOGY

#### 3.1 Research Design

##### 3.1.1 IPO Diagram



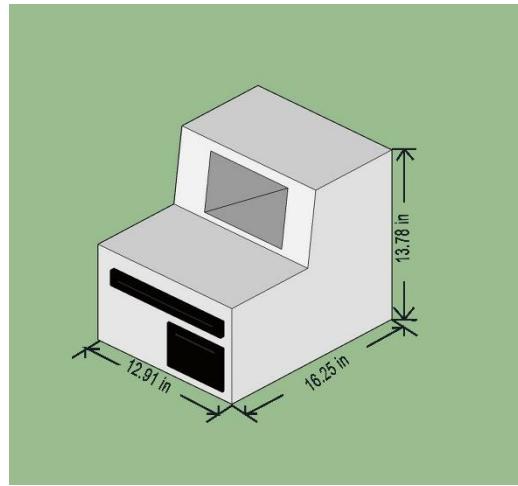
**Figure 4** IPO Diagram

Figure 4 shows the input, process, and output of the study. For the input, it shows the software and hardware of the device. In hardware, the group used PC tablet for the application of graphical user interface, scanner for the scanning of answer sheets, thermal printer for the printout of the results of the overall process,

and USB hub. Python programming language, visual basic and structured query language are used in the device for the software development. The Python programming language is for the implementation of Support Vector Machine (SVM), Histogram of Oriented Gradient (HOG) and item analyser. The Visual Basic is used for the Graphical User Interface (GUI) and Structured Query Language (SQL) is for the database of the project. The researchers studied about Support Vector Machine (SVM), Histogram of Gradient (HOG), Keras, Theano – Tensorflow for 32bit, Scikit learn, and Scikit image for the process of the system.

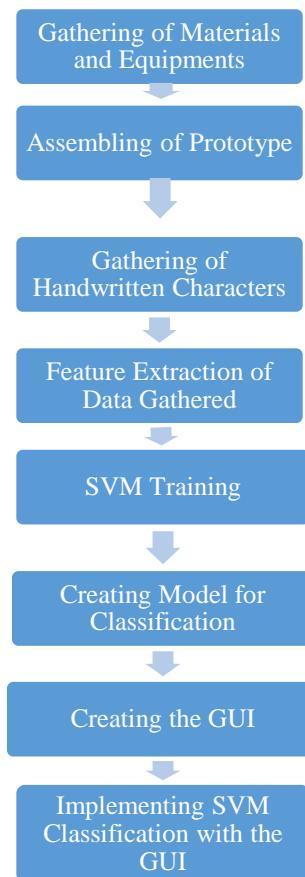
For the process, it is for the data gathering. The researchers gathered handwritten samples from different participants for the data sets. Each data set has a unique characterization in order to train the machine to be accurate. The support vector machine was used for training the data and for the machine learning of the system, the histogram of oriented gradient as an algorithm for the device. Keras is used for creating Cpickle model that stores the train data for classification of character in data set.

The output is the device known as the Alphanumeric Test Paper Checker Machine. It can recognize handwritten characters, shows the results in the PC tablet, print the results using thermal printer, and analyse test item using item analysis. The device has a dimension of 16.25 inches x 12.91 inches x 13.75 inches for its length x width x height as shown in Figure 5.



**Figure 5** Dimension of the Designed Output

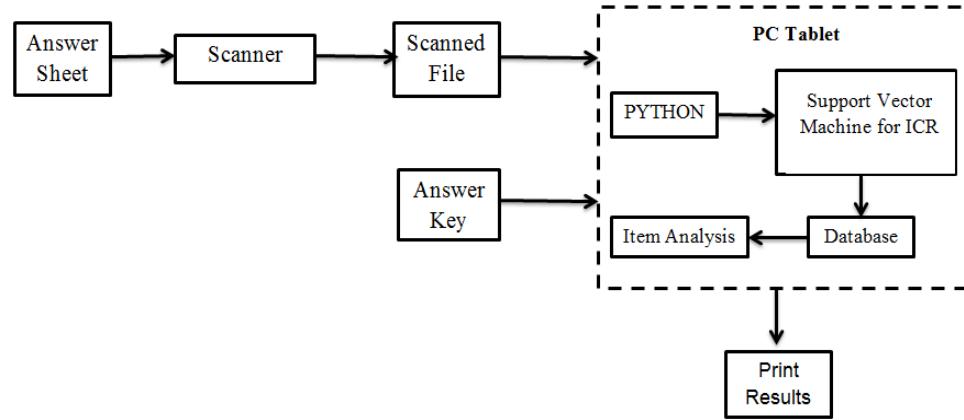
### 3.1.2 Process Flow Chart



**Figure 6** Process Flowchart

Figure 6 shows the process flowchart of the system. The materials needed were gathered such as the PC Tablet, Scanner, Thermal Printer, and the Sintra Board for Chassis. The materials were assembled. The proponents gathered handwritten characters for the test data of the machine learning. Once all the data were gathered, Histogram of Oriented Gradient and Support Vector Machine were performed through Python Programming for feature extraction and training. Then, the feature vector produced by HOG was used for SVM Training. SVM produced Cpickle file which will be the working model for the classification and prediction. The Graphic User Interface was made through Visual Basic. It was consisted of 20-item problem solving and 100-MCQs. The GUI automatically checked the scanned answer sheet and it had the information needed for the database and for the item analysis. The classification and prediction program using Python were implemented with the Visual Basic.

### 3.1.3 Block Diagram



**Figure 7** Block Diagram

For the block diagram of the device, the system design starts with the answer sheet as shown in Figure 7. The answer sheet is fed to the scanner. Once the answer sheet is scanned, an image file is produced and will be saved to a specific folder on the PC tablet. The PC tablet is where the process of cropping, recognizing and evaluation takes place. Python programming language is used for the cropping of fields where the information written on the scanned image. After bisecting the cropped image through the use of Python, the support vector machine (SVM) will classify the system for pattern recognition for the handwritten characters. The recognize character is converted into a text. This text will be used for comparing the answer key set by the examiner to the database of the system. After the results have been processed, the recorded data will go through the database where it will be stored for further references for both professors and students. The results will be evaluated with the item analysis. The item analysis will give the percentage difficulty of each question, and then the evaluated data will be stored in the database. The student's information and the test results will be displayed in the PC tablet and it will produce a printout of the results.

### **3.2 Project Development**

#### **3.2.1 Answer Sheet Design**

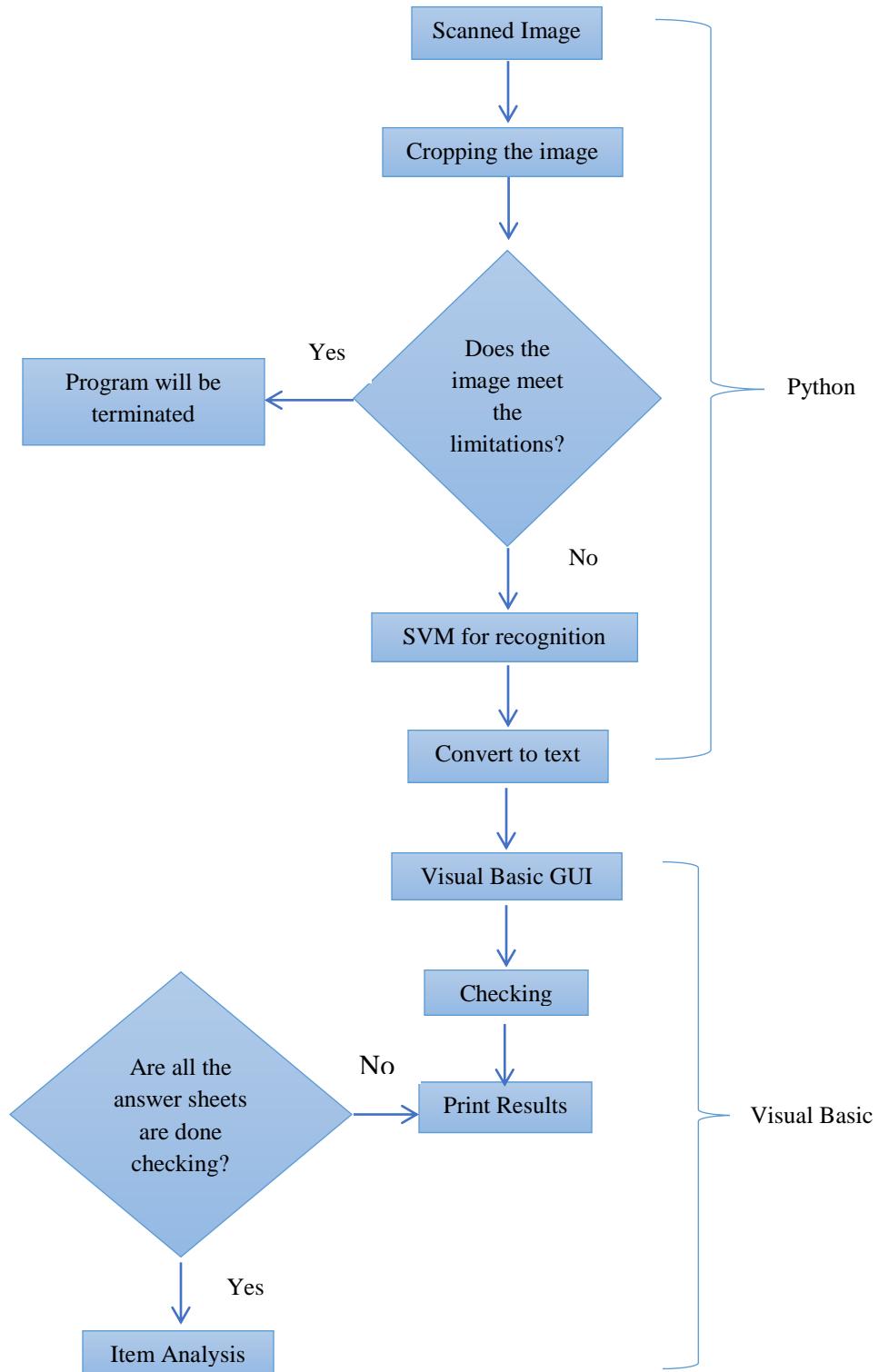
There will be a fixed design of the answer sheet as shown in Figure 8. For the information of the examinee, there is a designated field to be filled up such as the identification number, section, instructor code and subject code. Identification number and section where the personal information of the examinee while the

instructor and subject code are given by the instructor. The code given by the professor is needed so that the information will be recorded on a specific database. For the answer portion, 20 items are allotted for the identification type of exam and 100 items for multiple choices.

		<b>Technological University of the Philippines College of Engineering Electronics Engineering Department</b>					
<b>ID NO.:</b>	<b>INSTRUCTOR CODE:</b>						
<b>SECTION:</b>		<b>SUBJECT CODE:</b>					
1	01	21	41	61	81		
2	02	22	42	62	82		
3	03	23	43	63	83		
4	04	24	44	64	84		
5	05	25	45	65	85		
6	06	26	46	66	86		
7	07	27	47	67	87		
8	08	28	48	68	88		
9	09	29	49	69	89		
10	10	30	50	70	90		
11	11	31	51	71	91		
12	12	32	52	72	92		
13	13	33	53	73	93		
14	14	34	54	74	94		
15	15	35	55	75	95		
16	16	36	56	76	96		
17	17	37	57	77	97		
18	18	38	58	78	98		
19	19	39	59	79	99		
20	20	40	60	80	100		

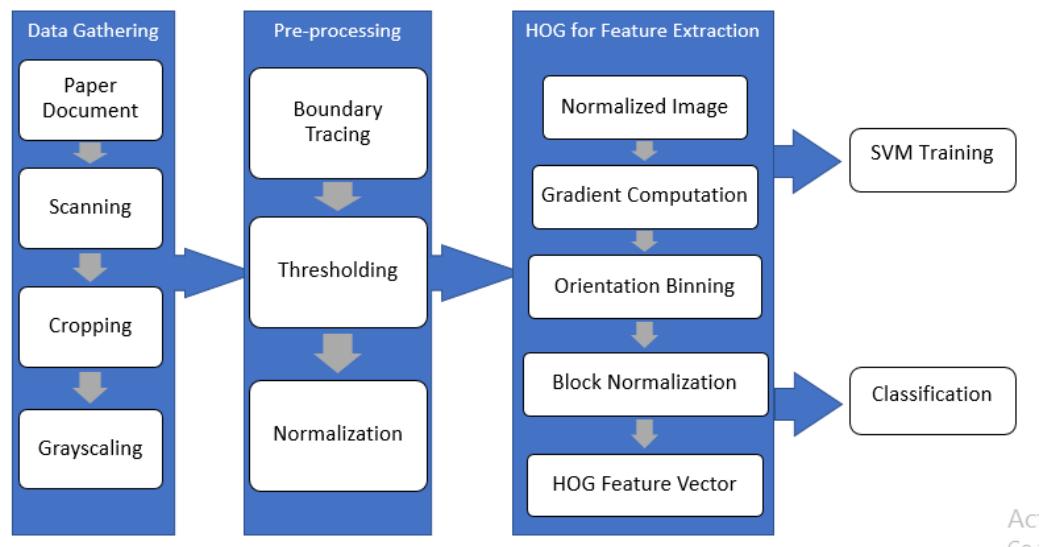
**Figure 8 Answer Sheet Design**

### 3.2.2 Software Development



**Figure 9** Program Flowchart

Figure 9 shows the program flow chart of the system. The scanned image is cropped and extracted by Histogram of Oriented Gradient (HOG) algorithm. The Support Vector Machine (SVM) is used as machine learning for recognition. Python is used as the programming language of the HOG and SVM. The process of checking, database management and printing the result is done using Visual Basic.



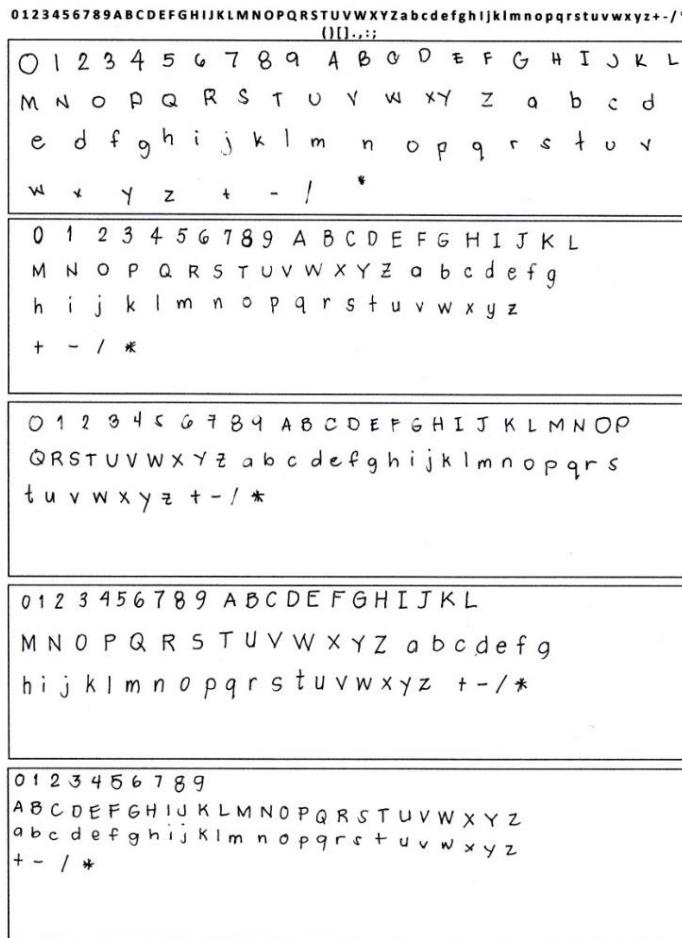
**Figure 10** Program Flow Chart for Training Datasets

Figure 10 shows the program flowchart for training the datasets. The scanned image is cropped and it is manually sorted by the researchers. The sorted character is used as the datasets of the system. Datasets are resized by fixed pixel and converted it to matrix. Histogram of Oriented Gradient (HOG) algorithm is used for training and produces a CPICKLE file for Machine learning.

### 3.2.2.1 Gathering of Training Data

The proponents have gathered samples from the students of the College of Engineering in Technological University of the Philippines – Manila. Around 500-1000 different handwritings of the students are

gathered in order to have accurate samples for training data. The proponents used two ways in gathering different handwritings. First way is shown in the scanned sample in Figure 11. Students are asked to write the numerical digits, upper, and lower case of the alphabets as well as the commonly use symbols for the answers. In one paper, a total of 5 kinds of handwriting samples and this sample will be cropped per set of samples.



**Figure 11** Sample Handwritings

The designed answer sheet is used for the next gathering of samples. Random people are asked to write 100 letter A, B, C, D on the

papers given to them. This way is used to crop the characters easily. A sample used for data gathering is shown in Figure 12.

1	01	C	21	C	41	C	61	C	81	C
2	02	C	22	C	42	C	62	C	82	C
3	03	C	23	C	43	C	63	C	83	G
4	04	C	24	C	44	C	64	C	84	C
5	05	C	25	C	45	C	65	C	85	G
6	06	C	26	C	46	C	66	C	86	C
7	07	C	27	C	47	C	67	C	87	C
8	08	C	28	C	48	C	68	C	88	C
9	09	C	29	C	49	C	69	C	89	C
10	10	C	30	C	50	C	70	C	90	C
11	11	C	31	C	51	C	71	C	91	C
12	12	C	32	C	52	C	72	C	92	C
13	13	C	33	C	53	C	73	C	93	C
14	14	C	34	C	54	C	74	C	94	C
15	15	C	35	C	55	C	75	C	95	C
16	16	C	36	C	56	C	76	C	96	C
17	17	C	37	C	57	C	77	C	97	C
18	18	C	38	C	58	C	78	C	98	C
19	19	C	39	C	59	C	79	C	99	C
20	20	C	40	C	60	C	80	C	100	C

**Figure 12** Sample Handwritings using the Answer Sheet

### 3.2.2.2 Training of Data

#### 3.2.2.2.1 Training Using SVM for Machine Learning

Aside from using Tesseract, the proponents also used different handwritings and processed it through the use of Support Vector Machine (SVM). Those images are sorted per characters and save to form new data sets to improve the accuracy of the

system. SVM was used with Histogram of Gradients algorithm for feature Extraction

### 3.2.2.2 HOG as Feature Extractor

HOG was performed for feature extraction. The first stage applies an image normalization through computing the square root or the log of the input images. It is designed to lessen the effects of illumination.

The second stage computes first order image gradients. This is to preserve the information in an image while providing further resistance to illumination variations. First order image gradients were computed through getting the horizontal derivative (1) and the vertical derivative (2) of the input images. A 3 by 3 Sobel masking and a 2-D Convolution were used to get the derivative of the images.

$$G_x = \begin{bmatrix} +1 & 0 & -1 \\ +2 & 0 & -2 \\ +1 & 0 & -1 \end{bmatrix} * A \quad (1)$$

$$G_y = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix} * A \quad (2)$$

The third stage, orientation binning, aims to produce an encoding that is sensitive to local image content while remaining resistant to small changes in pose or appearance. The adopted method pools gradient orientation information locally. The image

window is divided into small spatial regions, called cells. For each cell, the researchers accumulate a local 1-D histogram of the gradient or edge orientations over all the pixels in the cell. This combined cell-level 1-D histogram forms the basic orientation histogram representation. Each orientation histogram divides the gradient angle range into a fixed number of predetermined bins. The gradient magnitudes of the pixels in the cell are used to vote into the orientation histogram.

The fourth stage computes normalization, which takes local groups of cells and contrast normalizes their overall responses before passing to the next stage. Normalization introduces better invariance to illumination, shadowing, and edge contrast. It is performed by accumulating a measure of local histogram "energy" over local groups of cells which is called blocks. The result is used to normalize each cell in the block. Typically, each individual cell is shared between several blocks, but its normalizations are block dependent and thus different. The cell, thus appears several times in the final output vector with different normalizations. This project used L2-Hys for block normalization, which is derived from L2-Norm (3) but limiting the maximum values of unnormalized descriptor vector,  $V$ , and renormalizing it. Variable  $e$  represents small-value constants.

$$f = \frac{V}{\sqrt{\|V^2\| + e^2}} \quad (3)$$

Finally, the resulting HOG feature vector is produced and can be used for both SVM training and classification

### 3.2.2.3 Cropping of Image

Through the use of the designed answer sheet the cropping of text fields was easily done even though the way the paper scanned was disproportional. Contouring of scanned image was done by Open CV and Python then the images that were cropped based on their text fields. Cv2.RETR\_EXTERNAL was used for cropping the outer box of the text fields. Sorting is through contour based on their contour area. The character needed for each text field is extracted through cropping.

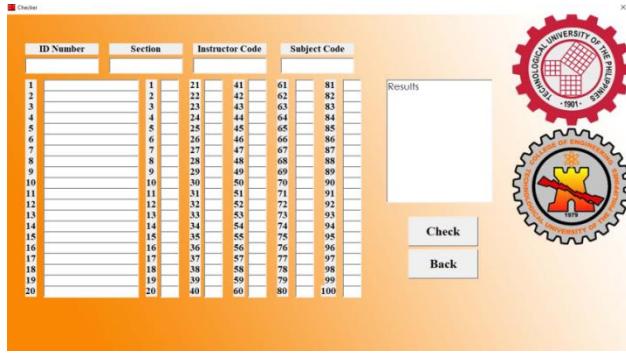
### 3.2.2.4 Database

With the use of SQL, Microsoft Access was connected to Visual Basic 6 GUI. The data stored in the database were list of students, list of instructors with their respective password for logging-in, students' record of scores, and item analysis. Item analysis includes item difficulty, frequency of error, and percentage passing.

### 3.2.2.5 Graphical User Interface (GUI)



(a)



(b)

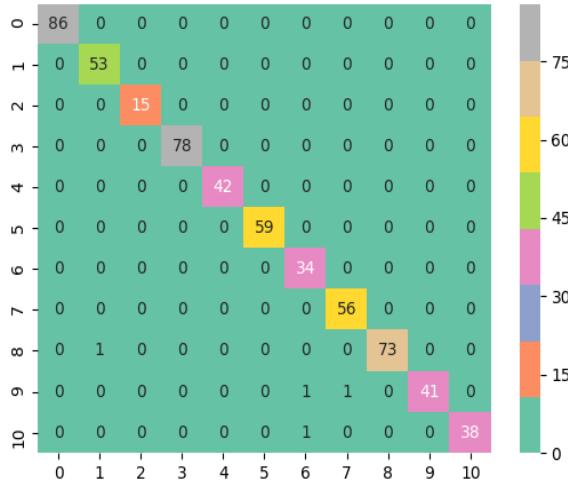
**Figure 13** Graphical User Interface (a) Log-in Prompt (b) Results

Figure 13 shows the graphical user interface (GUI) of the device. It was used in line with the format set in the answer sheet created by the proponents. GUI includes the format of answer sheet, item analysis, and checking the test paper. (a) It shows the professor's code, the subject code and the password of the professor, (b) shows the format of answer sheet where the results are being processed.

### 3.2.2.6 Support Vector Machine as Training for Machine Learning

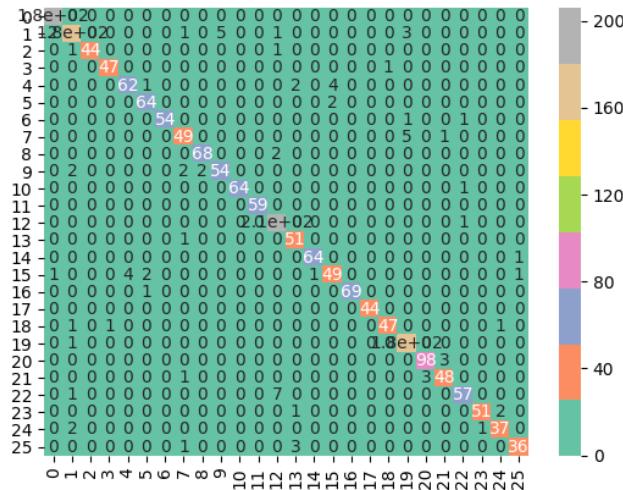
After HOG Descriptor which produced feature vector, SVM was performed. SVM used linear Support Vector Classification for training. SVM used the feature vector produced from feature extraction. Random State was set to 42 for improved accuracy. Parameters were set in the LinearSVC found in scikit-learn who will perform SVM. Number of iterations were set to 1000. The proponents set the number of test data to 20% of the dataset. Confusion matrix of the trained dataset was produced and plotted with Matplotlib project of Python. The Y-axis represents the true label and the x-axis represents the predicted label. The diagonal

boxes represent the number of correct predictions of the label. The numbers outside the diagonal boxes were the number of incorrect predictions of the label.



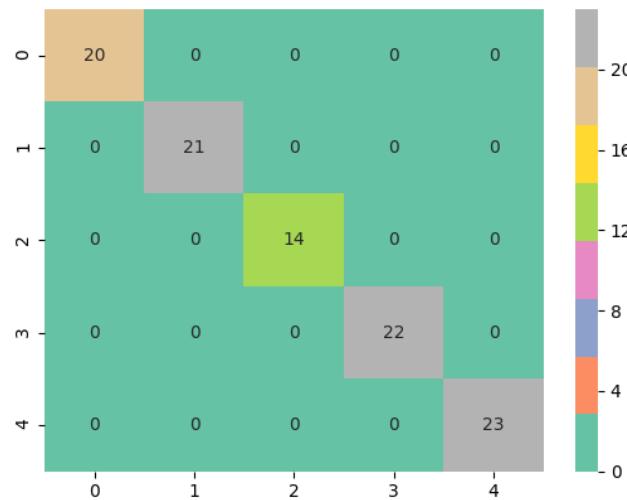
**Figure 14** Confusion Matrix for Numbers and Decimal point

In Figure 14 shows that all numbers were recognized correctly except 4 images during the training. Number 8 was recognized as number 1, Number 9 as number 6 and number 7, and the decimal point was predicted as number 6.



**Figure 15** Confusion Matrix of Alphabet Letters

The confusion matrix shows in Figure 15, there were several letters predicted incorrectly during the training. All the letters in the x and y-axis represents each alphabet such as letter A for 0 and letter z for 25. The letters with the most number of incorrect predictions were W and H. Letter A had the most number of correct predictions.



**Figure 16** Confusion Matrix of Letters A-E

When the letters used were reduced, it resulted to a higher accuracy in recognizing characters as shown in Figure 16. All the numbers in the x and y-axis represents each letter used for MCQ such as letter A for 0 and letter E for 5. The graph shows that all letters used for multiple choice, such as letters A-E were recognized correctly during the training.

### 3.2.2.7 Item Analysis

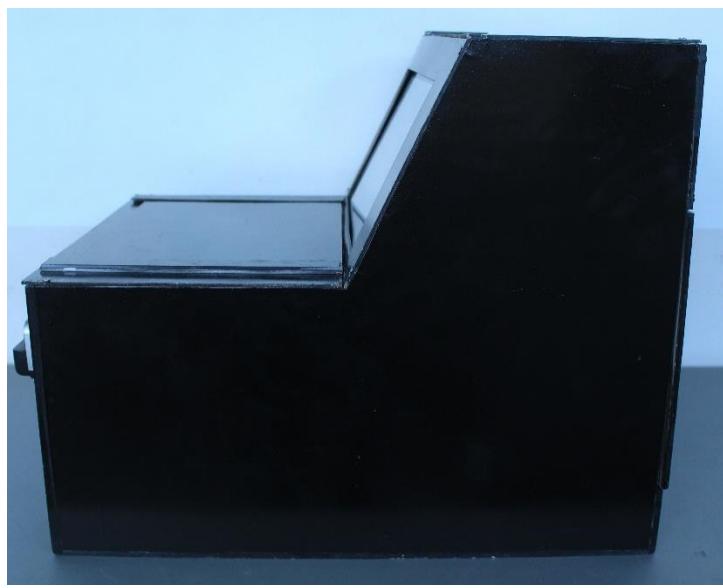
Once all the students were done taking exams and all answer sheets were checked, item analysis will be performed. With VB6 GUI, the user will search the subject he wants to perform an item analysis. Once search, the GUI will show the item numbers, frequency of error per item

number, the item difficulty, and the percentage passing. The item numbers can be arranged in descending or ascending order.

### 3.2.3 Hardware Development



(a) Front View



(b) Right Side View



(c) Left Side View



(d) Back View

**Figure 17** Checker Machine

Figure 17 shows the hardware made for the study. It was built as a simple checker machine similar to the design of an automated machine. A thermal printer, scanner and a screen are seen as the main output design of the device. Thermal printer was used to produce a printout of the results. The scanner is used

to scan the answer sheets while the screen of the PC tablet will show the answered key and other information that was set and where the results can be seen aside from the prints produced from the thermal printer. For the back view of the device, an output tray was placed to receive the ejected paper of the device. There was also an USB hub placed on the back of the device. Figure 17, also shows the right and left side view of the device.

### **3.3 Materials and Equipment**

#### **3.3.1 Materials Used for Hardware**

##### **1. PC Tablet**



**Figure 18** Asus Transformer Book T001TA-C1

A PC tablet was used for the prototype as shown in Figure 18. It was an Asus Transformer book T001TA-C1. It was where the user interface, the results and the database will show. The screen of the PC tablet was detachable to its keyboard so that it will only be seen for the hardware of the prototype.

## 2. Scanner



**Figure 19** Digital Interface-IRIScan Anywhere 3

Figure 19 shows the scanner of the prototype. The group used Digital Interface-IRIScan Anywhere 3 scanner. It was portable that can work independently even without the use of another machine.

## 3. Thermal Printer



**Figure 20** ISCTMPTR0 Thermal Printer

Figure 20 shows the thermal printer that will produce a printout of the results of the student's examination that will serve as a proof of their score immediately. It has a specification model of ISCTMPTR01 thermal printer.

#### **4. Sintra Board**



**Figure 21** Sintra Board

Figure 21 shows the Sintra Board that was used to build the casing of the prototype. Sintra board was stronger than plywood, but has the same weight as if it. It was better to use and was more presentable. The sintra board used has a thickness of 3mm to 6mm.

### **3.4 Bill of Materials**

**Table 2 Bill of Materials**

<b>Quantity</b>	<b>Material/s</b>	<b>Amount</b>
1	Asus Transformer, PC Tablet	<b>P 10500.00</b>
1	Iriscan Anywhere 3 Scanner	<b>P4500.00</b>
1	Thermal Printer	<b>P 2800.00</b>
2	USB Hub	<b>P 400.00</b>
1m	Electric Cord	<b>P 259.00</b>
3 rolls	Thermal Paper	<b>P 77.00</b>
1	Power Supply Adapter	<b>P 325.00</b>
	Casing (Labor)	<b>P 2500.00</b>
20	Screws and Nuts	<b>P 40.00</b>
1m x 1m	Sintra Board	<b>P 1000.00</b>
<b>Total Amount</b>		<b>P 22, 401.00</b>

### **3.5 Testing Procedures**

1. Answer key will be set in the device.
2. Answer sheet will be scanned through iris scanner.
3. The scanned image will undergo extraction and configuration through support vector machine with the support of histogram of gradient algorithm
4. The extracted image will convert into text and it will compare to the answer key in the database.

5. The result will be seen in the PC tablet and it will produce a printout through thermal printer.

### **3.6 Evaluating Procedure**

#### **3.6.1 Evaluation**

After the construction and thorough inspection and testing of the device by the researchers, the evaluation was made by the system developers. It allows the proponents to determine the changes needed to be modify and the accuracy of the device. Also, it allows the proponent to determine whether the device comply the evaluation criteria.

#### **3.6.2 Evaluation Criteria**

Several aspects of the complete prototype will be concern on the functionality of the device is taken into consideration. The following set of criteria was as follows:

1. Functionality
  - Accuracy of the Machine

This criteria focus on accuracy of the device. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 was below average.

- Functionality Compliance

This criteria focus on how well the software adheres the application related standards. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

- Suitability

This criteria focus on how suitable the software into the device. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

## 2. Reliability

- Recoverability

This criteria focus on the recoverability of the program to the system. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

- Reliability Compliance

This criteria focus on the reliability of device how well the system perform to the users. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

## 3. Usability

- Learnability

This criteria focus on how well the user can learn the function of the system software. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

- Operability

This criteria focus on how the device can function well. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

- Attractiveness

This criteria focus on the quality of the system software. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

#### 4. Effectiveness

- Time Behaviour

This criteria focus on how efficient the device can function. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

- Efficiency Compliance

This criterion is based on efficiency of software performance relative to amount of resources used. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

#### 5. Maintainability

- Maintainability Compliance

This criteria focus on system software maintainability. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

#### 6. Portability

- Installability

This criteria focus on the capability of the software to be installed in the device. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

- Co-existence

This criterion is based on the performance of the device to its functions efficiency compared to other machine checker. Given a range of 1 to 5 where 5 is the excellent, 4 is very satisfactory, 3 is satisfactory, 2 is average and 1 is below average.

### 3.6.3 Evaluation Sheet



#### Evaluation Form for Alphanumeric Test Paper Checker Machine through Intelligent Character Recognition (ICR) with Item Analysis

Your comments are essential for improving the effectiveness of the prototype continuing its technological activities. Please answer this questionnaire and return it with the researchers after answering.

Name:  
Occupation:

Date:

Please rate the following accordingly:

Legend:

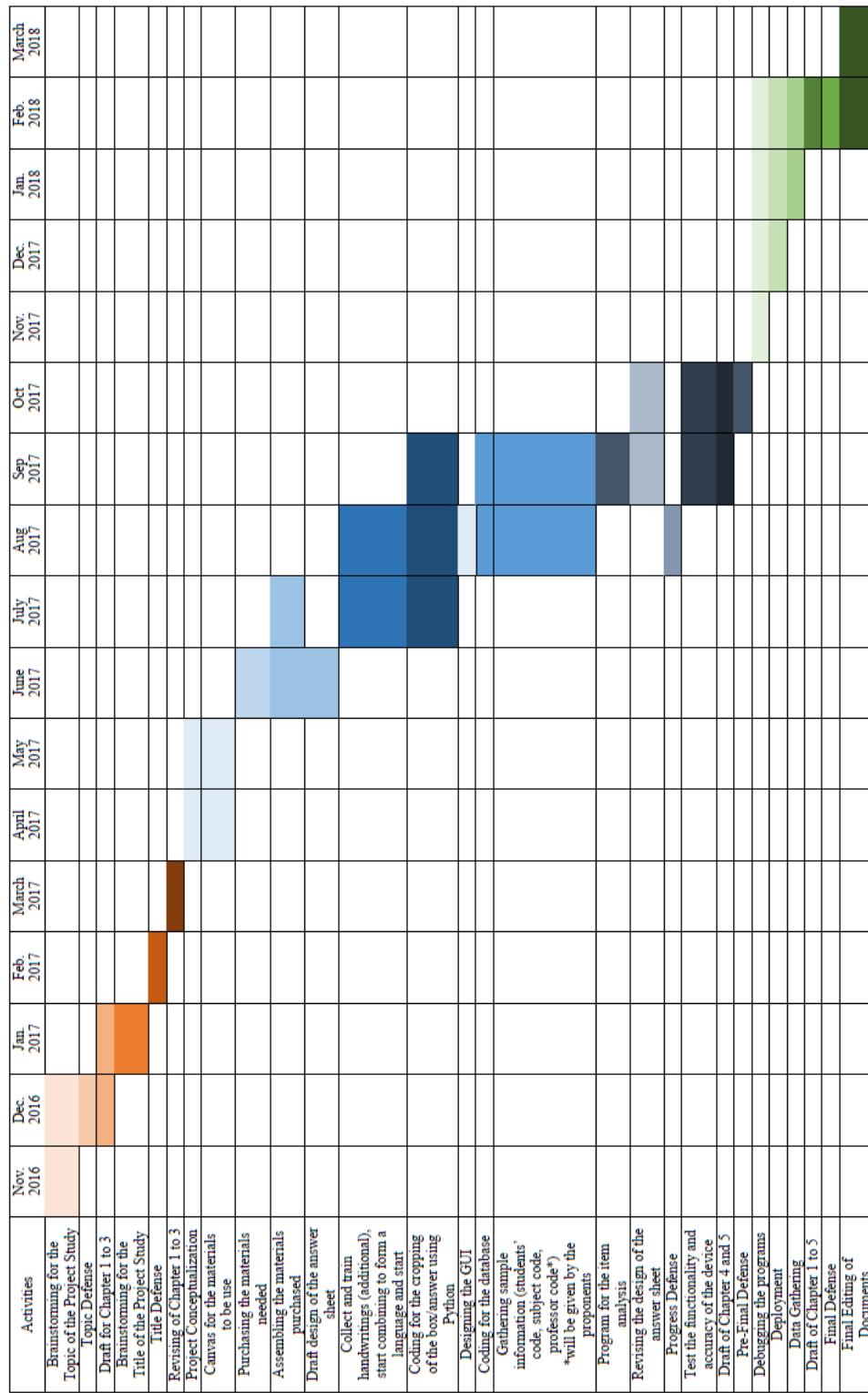
- 5 – Outstanding
- 4 – Very Satisfactory
- 3 – Satisfactory
- 2 – Average
- 1 – Below Average

	5	4	3	2	1
<b>Functionality</b>					
▪ Accuracy of the machine					
▪ Functionality Compliance					
▪ Suitability					
<b>Reliability</b>					
▪ Recoverability					
▪ Reliability Compliance					
<b>Usability</b>					
▪ Learnability					
▪ Operability					
▪ Attractiveness					
<b>Effectiveness</b>					
▪ Time Behavoir					
▪ Efficiency Compliance					
<b>Maintainability</b>					
▪ Maintainability Compliance					
<b>Portability</b>					
▪ Installability					
▪ Co-existence					

**Figure 22** Evaluation Sheet format

Figure 22 shows the image of the evaluation sheet. This was used to evaluate the device in different areas stated above. This evaluation will show what was needed to maintain and what was to be improved and developed in the device.

### 3.7 Gantt Chart



**Figure 23** Schedule of Activities

Gantt chart shows in Figure 23 served as a list of activities needed to be done by the proponents in making the project. The proponents started sharing ideas of different technologies of the recent innovations last November and December 2016. After coming up of different ideas, a topic defense was held last December 2016. Next to the topic defense is making the draft for the documentation, this includes the proposed methodology for the project, expected materials to be used. By January 2017, a list of supposed title for the study was discussed between the proponents and the adviser. Title defense was held last February 2017. Revisions for chapter 1 to 3 were made after the defense due to the proposals and suggestion of the panellist.

After different discussions and series of researches for the project study, different materials were carefully considered, purchased and put work on the device. The proponents collected different handwritings from different people that for developing data sets that was used for the program of the system. Design for the answer sheets was prepared for the efficient use of the device. Programs needed for the cropping of the answer sheets, for the database, and the recognition are prepared for the effective use of the device. Two presentations were scheduled in academic year 2017 and 2018; this were the progress defense and the pre-final defense. In progress defense, the proponent's presents the state of the study and in pre-final defense, the proponent's shows that the device is in working condition.

Constant debugging of the programs was done due to some technical problems experience along the way. The device was scheduled for deployment last December 2017 until February 2018. The results collected form the deployment was used for the data gathering. Before the final defense scheduled on February 2018, a draft of full

documentation was prepared. Final editing for the documentation was push through after getting the approval from the panelist.

This Gantt chart served as a schedule checker for proponents in making the project. After gathering the first handwriting samples, the proponents started training, step by step, making sure to follow the projected schedule in the Gantt chart. The schedules stipulated in there were projected by the proponents in the process of making the project documentation as a requirement for the Project Study class.

From the chart, the group starts gathering samples on mid-June and started conceptualizing and training data for the project. On the onset of July and August, the researchers started to make their hardware and start with their software development. And for the month of September, the researchers will combine all of their data and start the testing of the prototype.

## **Chapter 4**

### **RESULTS AND DISCUSSION**

#### **4.1 Project Technical Description**

This project aims to develop a device that can automatically check students' examination. The device is on the process of training to make a higher percentage of accuracy in handwritten text recognition. It is expected to check and analyze the students answer written on the given answer sheet; it is also capable of producing a printout of the result. This project used a PC tablet, a portable scanner, and a thermal printer. A PC tablet is used for the graphical user interface (GUI) for the system of the project equipped of a database for the professors for storing of students data and the result of their examinations.

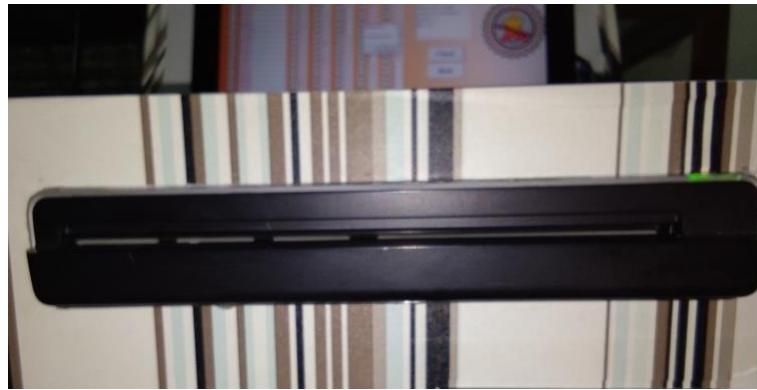
The given answer sheet with a written alphanumeric answers on it is scanned using a portable scanner and it is processed by Intelligent Character Recognition (ICR) for reading the alphanumeric characters that produces a textbox that is used for analyzing and comparing the correct answers for each item and the result is forwarded to the database created. A thermal printer produces a printout of the results of every examinee. After checking all the answer sheets, the system can perform an item analysis that will rank each item based on its difficultness. The database is created in Microsoft Access with the used of Structured Query Language (SQL) as its programming language.

## 4.2 Project Structural Organization



**Figure 24** Case of the Device

Figure 24 shows the final structure of the device. The case of the device has a dimension of 16.25 inches in width, 13.78 inches in height, and 12.91 inches in length.



**Figure 25** Scanner of the Device

The answer sheets will be fed in the scanner shown in Figure 25 to be scanned. The scanned answer sheet will be transferred to Python. Python will perform the cropping and ICR through SVM. Once the utilization is done, all of the text file will be sent to the GUI in visual basic to be checked. Then the results will display in the monitor of the PC tablet.



**Figure 26** Thermal Printer

Figure 26 shows the thermal printer where it will produce a hard copy of the results of their examination. The size of the thermal paper to be used for the printer is 57mm by 15mm.

#### **4.3 Project Limitation and Capabilities**

This study will concentrate on the handwritten recognition using Intelligent Character Recognition (ICR). The character recognition that was used in the project is usually used for printed characters but for this project the character recognition was trained to recognize handwritten characters in technical handwritten format for a higher accuracy. For better recognition, it is advisable to use a thicker point of pen and the answers must be written within the box for every items on the given answer sheet. Answer sheets that are disoriented, unclean, and does not follow the technical handwritten instructions, and with an incomplete id numbers will be considered rejects. Answer sheets must be submitted as neatly as possible.

The study will also focus on checking and analyzing every item on the examination. It has a database for the instructors to store the results of the examination of their students. After checking the examinations, it will undergo to an item analysis

that will determine the difficultness of each item. It will produce a ranking from difficult to easy. Previous study has time of 120 seconds for a 60 item exam. The test paper checker machine can produce an output for 57.1111 seconds for a 120 item examination.

In this study, future researchers are advised to use higher specification of PC tablet or laptop for higher accuracy that may be suitable for deep learning. Overall, to complete the process of the study, it will take less than three minutes to produce a result.

#### 4.4 Project Evaluation

Surveying procedure to fifteen teachers in different year level in different subject areas where conducted last December 12, 2016. Figure 27 shows the survey form answered by the respondents.

 <b>TECHNICAL UNIVERSITY OF THE PHILIPPINES</b> COLLEGE OF ENGINEERING ELECTRONICS ENGINEERING DEPARTMENT Ayala Boulevard, Ermita, Manila Telefax No. 522-3524   Website: <a href="http://www.tup.edu.ph">http://www.tup.edu.ph</a>	
<b>NEEDS ASSESSMENT SURVEY</b>	
<b>PROFILE</b>	
Pangalan: _____	Petsa: _____ / _____ / _____
Lokasyon/Address: _____	
Phone number (mobile, if available) _____	Kasarian (Gender): _____
<i>Instruction: Laygan ng isek(I) sa naayon.</i>	
Q1. Katayuang Sibil <input type="checkbox"/> Single <input type="checkbox"/> Kasal <input type="checkbox"/> iba pa: _____ Q2. Edad ng sumasagot. <input type="checkbox"/> 18-24 <input type="checkbox"/> 25-34 <input type="checkbox"/> 35-44 <input type="checkbox"/> 45-54 <input type="checkbox"/> 55 pataas Q3. Katayuan ng pagtuturo sa eskwelahan. <input type="checkbox"/> Part Time <input type="checkbox"/> Full Time <input type="checkbox"/> iba pa: _____ Q4. Iilan taon ka na negtuturo sa paaralan? <input type="checkbox"/> 5 pababa <input type="checkbox"/> 6-10 <input type="checkbox"/> 11-20 <input type="checkbox"/> 21 pataas Q5. Bilang ng subject na hinahawakan mo sa isang semester. <input type="checkbox"/> 3 pababa <input type="checkbox"/> 4-6 <input type="checkbox"/> 7 pataas Q6. Bilang ng subject na itinuturo mo sa isang araw. <input type="checkbox"/> 3 pababa <input type="checkbox"/> 4-6 <input type="checkbox"/> 7 pataas Q7. Bilang ng yunit ng isang guro sa isang semester. _____  Q8. Pinakamatasas na yunit na kinukuha mo sa isang semester. <input type="checkbox"/> 3 pababa <input type="checkbox"/> 4-6 <input type="checkbox"/> 7 pataas Q9. Pinakamatasas na bilang ng estudyante sa isang regular na klase. <input type="checkbox"/> 15-20 <input type="checkbox"/> 20-30 <input type="checkbox"/> 30-40 <input type="checkbox"/> 40 pataas Q10. Oras ng pananistiil sa loob ng eskwelahan sa isang araw. <input type="checkbox"/> 1-3 <input type="checkbox"/> 3-5 <input type="checkbox"/> 5-8 <input type="checkbox"/> 8 pataas Q11. Bilang ng pagsusulit sa isang semester. <input type="checkbox"/> 5 pababa <input type="checkbox"/> 6-8 <input type="checkbox"/> 9 pataas Q12. Uri ng pagsusulit na madulas mong gingamit. <input type="checkbox"/> multiple choice <input type="checkbox"/> identification <input type="checkbox"/> Problem Solving <input type="checkbox"/> iba pa: _____	

(a) First Page

Q13. Bilang ng oras ng pagtatama ng pagsusulit sa isang araw.  
 \_\_\_\_\_ 3 pababa \_\_\_\_\_ 4-6 \_\_\_\_\_ 7 patatas  
 Q14. Pagkatapos itama ang mga pagsusulit, naitatala ba ito ng mobilis?  
 \_\_\_\_\_ Oo \_\_\_\_\_ Hindi  
 Q15. Saan mo madalas gawin ang pagtatala sa mga pagsusulit?  
 \_\_\_\_\_ Paaralan/Unibersidad \_\_\_\_\_ Tahanan \_\_\_\_\_ Iba pa:  
 Q16. Ilang araw bago matibigay ang resulta ng pagsusulit sa mga estudyante?  
 \_\_\_\_\_ 1-3 days \_\_\_\_\_ 4-6 days \_\_\_\_\_ 7 days patatas  
 Q17. Naitatala ba kung gaano kahirap ang bawat tanong sa pagsusulit?  
 \_\_\_\_\_ Oo \_\_\_\_\_ Hindi  
 Q18. Marks sa pagpasa ng isang estudyante sa subject na iyong tinuturo.  
 \_\_\_\_\_ 50-55% \_\_\_\_\_ 66-60% \_\_\_\_\_ 60-65% \_\_\_\_\_ 70% patatas.  
 Q19. Nakagamit ka na ba ng separato o imbensyon na awtomatikong nagmamarika ng pagsusulit?  
 \_\_\_\_\_ Oo \_\_\_\_\_ Hindi  
 Q20. Maganda bang ideya ang pagkakaroon ng separato na awtomatikong nagmamarika ng pagsusulit?  
 \_\_\_\_\_ Oo \_\_\_\_\_ Hindi  
 Q21. Bilang isang guro, maskakatulong ba ng malaki kapag may begong imbensyon na awtomatikong nagmamarika ng pagsusulit?  
 \_\_\_\_\_ Oo \_\_\_\_\_ Hindi

\_\_\_\_\_  
Signature

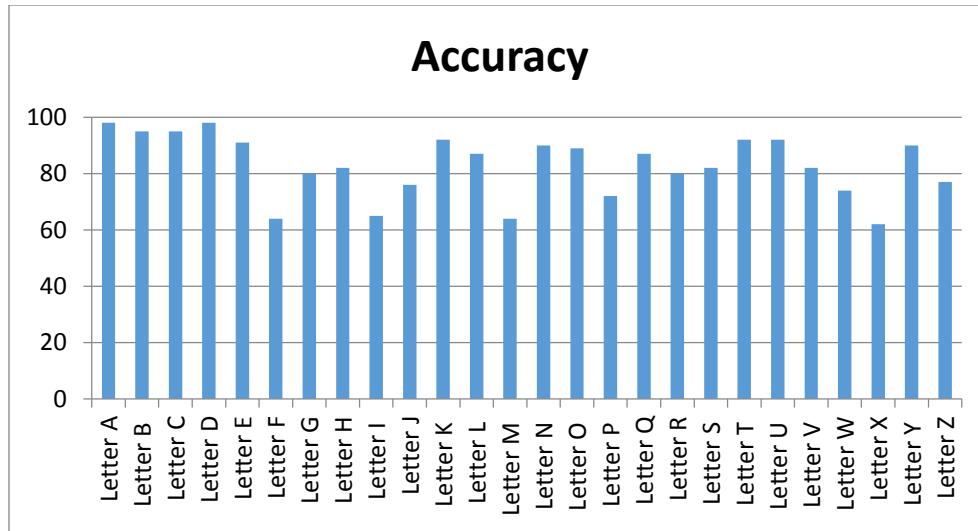
(b) Second Page

**Figure 27** Survey Sheet Format

Seventy-five percent of the respondents spent five to eight hours a day in school.

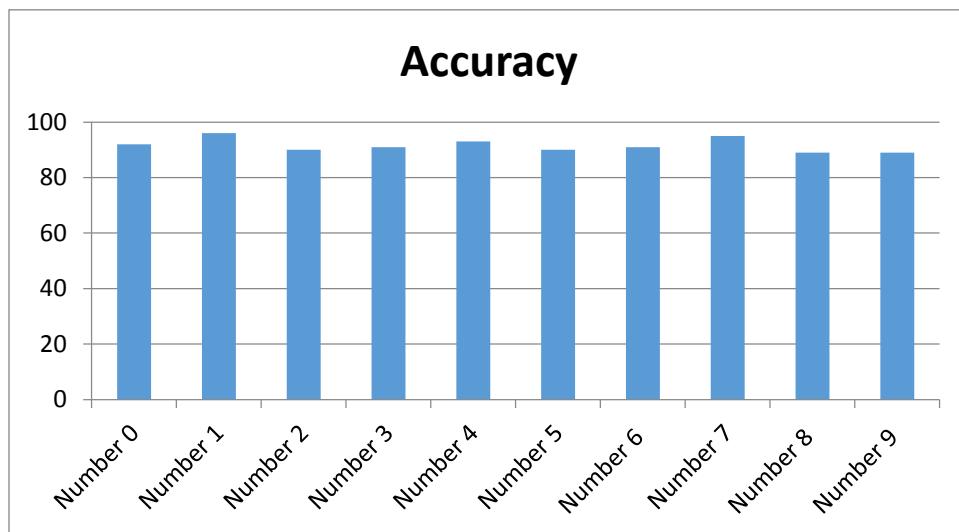
In this span of time, checking is not yet included in their frequent daily routine, with just preparing teaching materials and having a class consume most of their time. Eighty percent of the respondents desire to have an automatic machine that will help them check test papers easier and faster. Thus, the alphanumeric test paper checker machine was produced.

The testing procedure for the training of handwritten recognition is conducted. Support Vector Machine (SVM) was used as the Intelligent Character recognition (ICR) of the study. The proponents gathered sample handwritings that were used for the testing of the accuracy of the device in recognizing characters. Figure 28 shows the accuracy of recognition of alphabet characters. It can be seen that out of 100 times of testing, the character with highest accuracy of recognition were letter A and D which has a ninety-eight percentage. While the character which got the lowest accuracy of recognition is letter X.



**Figure 28** Accuracy of Alphabets

After having the results for the alphabet characters, the proponents used the data gathered for numeric characters to test their accuracy of recognition. Figure 29 shows the result of testing of 100 samples per character done using the device. The result of the character that shows higher accuracy in recognition is numeric 1, while the character that gets lower recognition is numeric 8.



**Figure 29** Accuracy of Numbers

The proponents used the formula stated below on how to compute the accuracy percentage of the alphabets and numbers.

For the accuracy of the alphabets,

$$Accuracy = \frac{\text{Summation of percentage of alphabets}}{25 (\text{Total number of alphabets from A-Z})} \quad (4)$$

For the accuracy of the numbers,

$$Accuracy = \frac{\text{Summation of percentage of numbers}}{10 (\text{Total number of numbers 0-9})} \quad (5)$$

Table 3 shows the computed accuracy percentage gathered from equation 4 and 5.

**Table 3** Percentage Accuracy for Alphabets and Numbers

Item	%
Alphabets	86.45
Numbers	91.6

After having the results for accuracy test in recognizing characters using deep learning in terms of SVM in the test paper checker machine, as for the next experiment the group ranked the most accurate letters. Table 4 shows the results of the ranked letters based on their accuracy.

**Table 4** Ranked Accuracy of the Alphabets

<b>Rank</b>	<b>Item</b>	<b>Percentage (%)</b>
<b>1</b>	Letter A	98.00
<b>2</b>	Letter D	98.00
<b>3</b>	Letter B	95.00
<b>4</b>	Letter C	95.00
<b>5</b>	Letter K	92.00
<b>6</b>	Letter T	92.00
<b>7</b>	Letter U	92.00
<b>8</b>	Letter E	91.00
<b>9</b>	Letter N	90.00
<b>10</b>	Letter Y	90.00
<b>11</b>	Letter O	89.00
<b>12</b>	Letter L	87.00
<b>13</b>	Letter Q	87.00
<b>14</b>	Letter H	82.00
<b>15</b>	Letter S	82.00
<b>16</b>	Letter V	82.00
<b>17</b>	Letter G	80.00
<b>18</b>	Letter R	80.00
<b>19</b>	Letter Z	77.00
<b>20</b>	Letter J	76.00
<b>21</b>	Letter W	74.00
<b>22</b>	Letter P	72.00
<b>23</b>	Letter I	65.00
<b>24</b>	Letter F	64.00
<b>25</b>	Letter M	64.00
<b>26</b>	Letter X	62.00

After ranking the letters based with their accuracy, consecutive letters A-E all belong to the top 10, so the group decided that the letters A-E will be used as the main answers to the multiple-choice part of the answer sheet.

$$Accuracy = \frac{\text{Number of correct recognized characters}}{\text{Total number of Testing}} \quad (6)$$

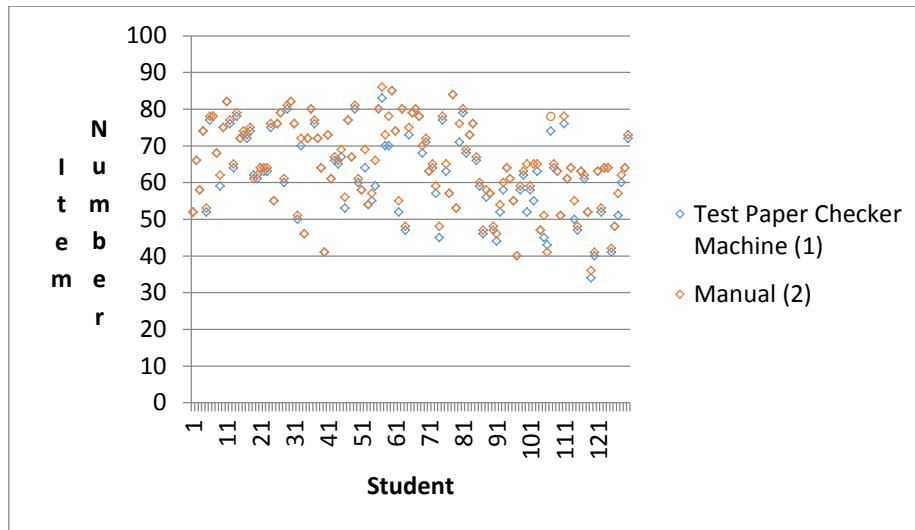
Moreover, for the identification part, the group experimented answering the identification part using the alphabets only, numbers only, and mixture of the alphabets and number for data gathering. Table 5 shows the result of the experiments using equation 6.

**Table 5** Accuracy of Identification Part

<b>Accuracy</b>	
<b>Numbers</b>	80.78%
<b>Letters</b>	40.71%

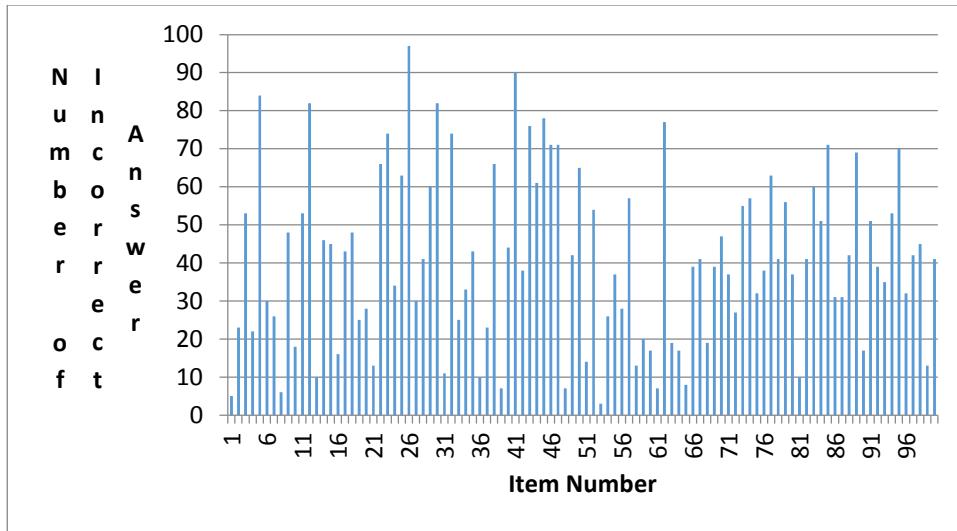
Figure 30 shows the data gathered by the proponents from the deployment of the device. The data gathered are from the multiple-choice part of the answer sheet. A total of 100 items questions are given that needed corresponding answers. To compare the score of the data gathered the proponents used two ways of checking the answer sheets. First way is the manual checking; in the table, the third column shows the results of the manual checking of the answer sheets of 130 students. Second way, is done by the used of the test paper checker machine, the results is shown in second column of the table. The difference of the results of manual checking and using the test paper checker machine is shown in Figure 30.

The project study device, Test Paper Checker Machine was scheduled for a deployment that started last December 18, 2017 up to February 3, 2018. The deployment happened at Electronics Engineering Department, Technological University of the Philippines – Manila located at Ayala Bvld, Ermita Manila, Philippines. The objective of the deployment is to let the client use the project study device and the proponents will collect the data gathered by the client. After almost two months of deployment, 130 students of the department used the project study device along with the manual checking.

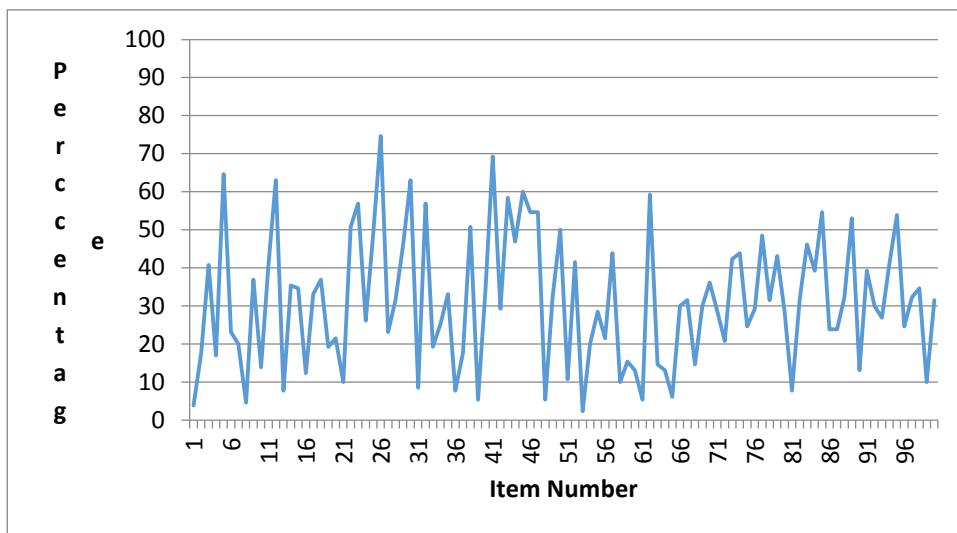


**Figure 30** Test Paper Checker Machine Checking and Manual Checking

Figure 31 shows the number of incorrect answers that students have made during their examination and Figure 32 shows the percentage of item difficulty per number.

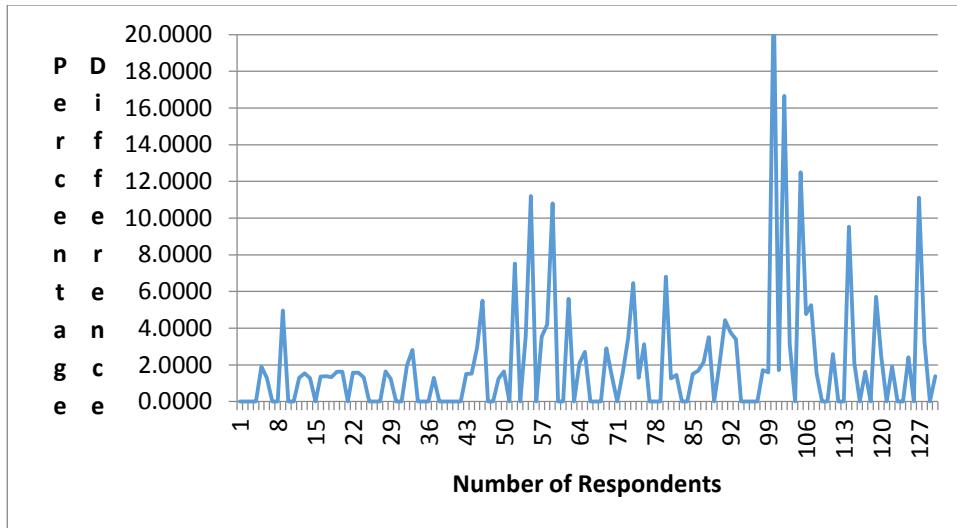


**Figure 31** Incorrect Answers Gathered From the Respondents' Examination



**Figure 32** Percentage of Difficulty per Item Number

Figure 33 shows the percentage difference of the final data gathered by the respondents.



**Figure 33** Percentage Difference of the Final Data Gathered

**Table 6** Accuracy for the Final Data Gathered

---

Recognized by the machine

---

Passed to reached the relation range	121
Failed to reached the relation range	9

---

Table 6 shows how the accuracy of the device is computed. After the device was deployed, the 121 out of 130 students are in the range in relation to the manual checking. As a result this analysis came up with 93.0769% of accuracy.

**Table 7** Analysis of Evaluation Form

	A	B	Average
<b>Functionality</b>			
* Accuracy of the machine	3	3	3
* Functionality compliance	3	3	3
* Suitability	3	4	3.5
<b>Reliability</b>			
* Recoverability	3	4	3.5
* Reliability Compliance	3	4	3.5
<b>Usability</b>			
* Learnability	4	5	4.5
* Operability	4	5	4.5
* Attractiveness	5	4	4.5
<b>Effectiveness</b>			
* Time Behavoir	4	4	4
* Efficiency Compliance	4	4	4
<b>Maintability</b>			
* Maintability			
Compliance	4	4	4
<b>Portability</b>			
* Installability	5	5	5
* Co-existence	5	5	5
Total:	4.03846		

Table 7 shows the analysis of the evaluation form gathered on the two professionals that evaluated the device. Base on the results for the criteria, the device has an average of 4.0385 which is rated as very satisfactory.

## **Chapter 5**

### **SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Summary of Findings**

Alphanumeric Test Paper Checker Machine through Intelligent Character Recognition with Item Analysis is a study which aims to find a new system of checking and analysing an examination automatically. The project focused on developing a machine that enable to check handwritten characters with the used of intelligent character recognition through deep learning to produce an accurate result.

The project utilized the software called Python Programming to create a processing system in recognizing alphanumeric characters. It used support vector machine (SVM) for machine learning that encompassed histogram of oriented gradient (HOG) as the algorithm.

In training of machine, 1000 data sets of handwritings are collected in different people. The 1000 data sets were processed to become a trained data for the machine learning. A series of tests were made to evaluate the accuracy of the system. The letters A to D has higher percentage accuracy in recognition and the lowest percentage of recognition is the letter X as shown in Figure 25. For the numbers, it resulted that the numeric 1 has the highest recognition percentage and the numeric 8 has the lowest recognition percentage as shown in Figure 26. Some alphabets have the same pattern when writing them while numbers have their unique patterns; with that, the accuracy of the numbers was higher than the accuracy of the letters.

For the assessment of the device, 130 respondents performed an actual examination. It came up that 121 answer sheets were recognized by the machine and it is

in the range in relation to manual checking and nine were rejected. The data gathered in manual checking and machine checking were averaged to compute the accuracy of the device and it came up in 93.0769% accuracy.

For the improvement of the accuracy of the handwritten recognition, more trained data of handwritten characters should be added in the system and upgrade the device through higher specifications of materials especially the laptop and scanner.

## **5.2 Conclusions**

Based on the findings and results of the study, the following are the conclusions drawn out by the proponents:

1. The Support Vector Machine (SVM) was used for machine learning and the Histogram of Oriented Gradient used as an algorithm for Intelligent Character Recognition (ICR). The Python was successfully used for the Open Source Computer Vision, SVM, and Histogram of Oriented Gradient. Visual Basic was used as the programming language for correcting and analyzing the examination.
2. The database is created to Microsoft Access with the used of Structured Query Language (SQL) as programming language
3. The item analysis was successfully installed in the program in Visual Basic and it can evaluate the difficulty of each item in examination.
4. The Thermal printer was successfully installed in the device and after the process in correcting and analyzing the examination it will produce a printout of the result.
5. It was successfully used by the ECE students in checking their examination

### **5.3 Recommendations**

The project was successfully implemented and done; however, the proponents would like to make the following recommendations for further improvement of the project:

1. It is recommended to have further research for recognition of other special characters.
2. Research and familiarize more in Deep Learning functions.
3. Other Deep Learning techniques can be used as Machine Learning for accuracy and speed in recognition.
4. Research other classifier and feature extractor for training handwritten alphanumeric characters.

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# **APPENDICES**

## **APPENDIX A**

### **Data Sheets**



## ASUS Transformer Book T100TA-C2-EDU

P/N: 90NB0451-M03190  
UPC: 886227753390



### Transform Your Mobile Lifestyle

- Detachable 10.1" HD IPS Tablet + Notebook:** Experience the newest edition of transformer notebook family.
- Windows 8.1 Pro:** Be ahead of the game with the newest version of Windows 8.1 Pro
- Enduring 11-hour Battery:** Maximize your portability with our longest lasting transformer battery built directly into the display side of the device

### ASUS Unrivaled Quality and Reliability

- 1-Year Accidental Damage Protection –Electrical Surges, Fire Damage, Drops, and Liquid Spills.**
- 30-Day Zero Bright Dot Guarantee:** Zero bright dots or dead pixels, or we'll replace it!
- \*\*UNLIMITED\*\* FREE ASUS WebStorage for One (1) Year:** From us to you, join the era of cloud computing and access all of your documents, photos, and music from any device, anywhere you can connect to the internet on ASUS' secured trusted network

### System Specifications

Operating Systems	• Windows 8.1 Professional (National Academic)
Processor	• Intel Quad Core Bay Trail-T 2317-R3
Processor Speed	• 1.83GHz (Turbo 1.96 GHz)
Memory	• 2 GB System Memory (DDRIII) • Max supported = 2 GB
Video Graphics	• Intel GMA HD
HDD Drives	• 64 GB SSD
Digital Drives	• N/A
Display	• 10.1" HD (1366x768), Glossy
Webcam	• 1.2MP HD Camera
Network Card	• N/A
Wireless Options	• 802.11ABGN
Bioscripts	• 4.0
Card Readers	• Micro SD (SDXC)
Audio	• SonicMaster Audio
Keyboard	• Keyboard Dock
Pointing Device	• Built-in Wide 16:9 Touchpad, Fingers for touch
Interface	<p>Device</p> <ul style="list-style-type: none"> <li>• 1x Audio Combo Jack : 1 * Head phone / 1 * Mic-in</li> <li>• 1x Micro HDMI</li> <li>• 1x Micro USB 2.0 port</li> <li>• 1x Card Reader Port</li> </ul> <p>Dock</p> <ul style="list-style-type: none"> <li>• 1x USB 3.0 port</li> </ul>

Finish / Color	• Gray
Carton Dimensions (in.)	• 18.8" x 12" x 9.8"
Carton Weight (lb.)	• 2.2 lbs (9.07-kg)
Dimensions (in.)	• 10.4" x 6.2" x 0.8"
Weight (lb.)	• 2.4 lbs
Battery	• 8.1Whrs, 8060mWh, 152P, 3-cell Li-ion polymer battery pack up to 11 hours



#### Compatible Accessories



### Software

#### ASUS Utility Software



#### Antivirus and Tool Software



Visit [www.service.asus.com](http://www.service.asus.com) for more information

\* Rest assured with ASUS 360 coverage protection for your device. Striving for the best quality in the industry, our international warranty allows you to service your device in any country (where coverage is available) despite original country of purchase. All devices are monitored under the highest QA standards and insure display panels are shipped with zero bright dots, which is why we offer exchanges within the first 30 days of purchase or any devices, two-way shipping on us. Contact our personnel any time of the day year round if you have questions through our 24-hour support channels!

**ASUS 360° Complete Notebook Care Package**

	1 Year International Warranty		30-Day Zero Bright Dot Guarantee
	2-Way Free Standard Shipping		24 Hour Phone Support

## IRIScan Anywhere 3

Get mobile! Scan anything, anywhere...

Cordless, battery-powered and compact, the IRIScan™ Anywhere 3 enables on-the-go users to easily capture information from all kinds of documents when away from their computer. Ideal for today's mobile lifestyle, it turns document management into a child's play.

The sheet of paper is simply zipped through the cordless and lightweight A4 scanner, and the scanned image is then either saved in the built-in memory, on an SD™ Card or on a standard USB key. Once back at home or in the office simply insert the SD™ card into your computer, and the scanned documents are automatically processed by IRIS' flagship OCR software Readiris™ and exported to the Cloud (Evernote®, Google Drive™, Dropbox, OneDrive®, iCloud®, etc.).

### Key features

#### Mobile scanner

- Cordless, battery-powered and very lightweight. No computer needed to scan!
- Scan up to 100 A4/letter size documents on battery mode.
- Scanner speed: up to 6 pages per minute.
- Directly save JPEG file to SD™ card, USB key or Internal memory (512MB).
- Free SD™ card on demand (voucher).
- Scan your business cards and use Cardiris™ Pro to manage your contacts.
- iPad® compatible (with SD™ card adaptor for iPad®, not included in the box).

#### State of the art OCR software Readiris™ Pro (Windows® and Mac®)

- Convert any paper document, PDF, or image file into editable Office documents.
- Worldwide OCR solution - 137 recognized languages (incl. Asian languages and Arabic).
- Create fully indexed and hyper-compressed PDF files up to 5 times smaller than the original image thanks to iHQC™, ideal for archiving and sharing via email.
- Upload your documents to the Cloud in a single click! (Evernote®, Google Drive™, Dropbox, OneDrive®, Box.net®, etc.).

### Quick reference guide

Product name	IRIScan™ Anywhere 3
SKU	457485
EAN code	7650104574858
Custom code	847190
Box size (H x L x D)	13,8 x 30,8 x 5,8 cm (5.43 x 12.12 x 2.28 in)
Box weight	1000g (2.20 lbs)
Scanner size (H x L x D)	4,4 x 27 x 5,4 cm (1.73 x 10.62 x 2.12 in)
Scanner weight	390g (0.86 lbs)
Box languages	Arabic, Dutch, English, French, German, Italian, Portuguese, Russian, Spanish
Box content	- IRIScan™ Anywhere 3 scanner - USB cable - Calibration sheet - Cleaning swab - Software suite available online at <a href="http://www.irislink.com/start">www.irislink.com/start</a>



### Scanner specifications

Document feeding	Sheet feed type (single)
Resolution	Low resolution : 300 dpi (default) High resolution : 600 dpi
Document size (max)	Up to A4/letter size
Interfaces	SD, xD, MS, MS Pro, MMC (for optional memory) USB slave (type-B Mini) (for computer connection) USB host (type-A) for USB key (for optional memory)
Output file format	JPEG
Flash memory	512MB (expandable with SD™ card or USB key)
Battery	Lithium-ion polymer rechargeable battery through USB cable Scanning capacity when fully charged : up to 100 A4 documents based on test conditions
Charging method	USB cable

### Minimum computer requirements

#### Scanner

- At least one USB port available.
- Installable on any operating system that supports mass storage protocols (Windows®, Mac OS®, Linux®, Unix®, etc.).
- No driver installation needed!

#### Software suite for Windows®

- Intel® Pentium® based PC or equivalent recommended.
- Microsoft® Windows® 10, 8, 7.
- 512MB RAM recommended.
- 300MB of available hard disk space.

#### Software suite for Mac OS®

- Mac® computer with PowerPC™ G3 or Intel® processor.
- Mac OS® X version 10.4 or above (compatible with Mac OS® X Lion).
- 200MB of available hard disk space.

# **APPENDIX B**

## **User Guide**

**User Guide.** The following are the steps and reminders on how to use the device.

### ***Reminders***

1. The answer sheet that will be used in examination will be provided by the examiner.
2. The answer key must be set on the database before inserting answer sheet on the device.
3. The list of names and section of the examinees must be set on the database.
4. The instructor and subject code must be set on the database.
5. The answer sheet must be scanned individually.
6. To start the application of the device the examiner must log-in to proceed on the checking process.

### ***Setting-up the Hardware***

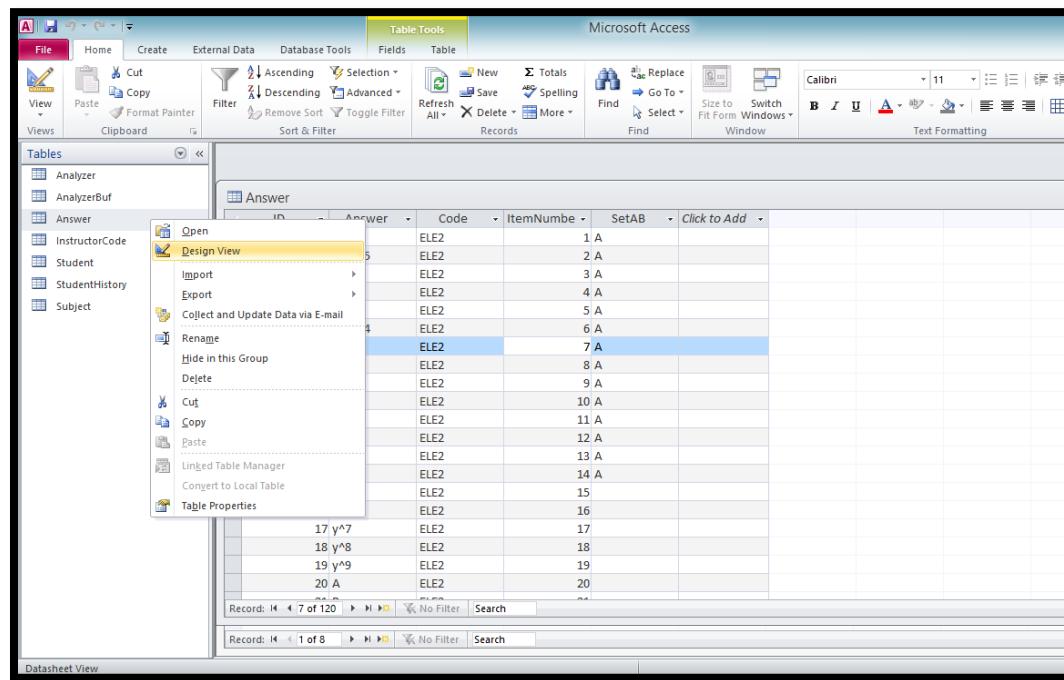
1. Plug in the device. Turn ON the scanner and pc tablet.
2. Insert the answer sheet to the scanner.
3. Select the application that will be used for checking
4. Select the set of examination.
5. Click the Proceed to ICR tab.
6. The process of the system starts, this may take time a few seconds.
7. The result will be displayed in PC tablet.
8. The result will be printed on the thermal printer.

## **Importing the database from Microsoft excel to Microsoft access**

The database that is on the Microsoft excel for the answer key and the list of name and section of the student must have the following steps to import it to Microsoft access:

### **For the answer key:**

Right click the table of **answer** in Microsoft access and select **design view**.

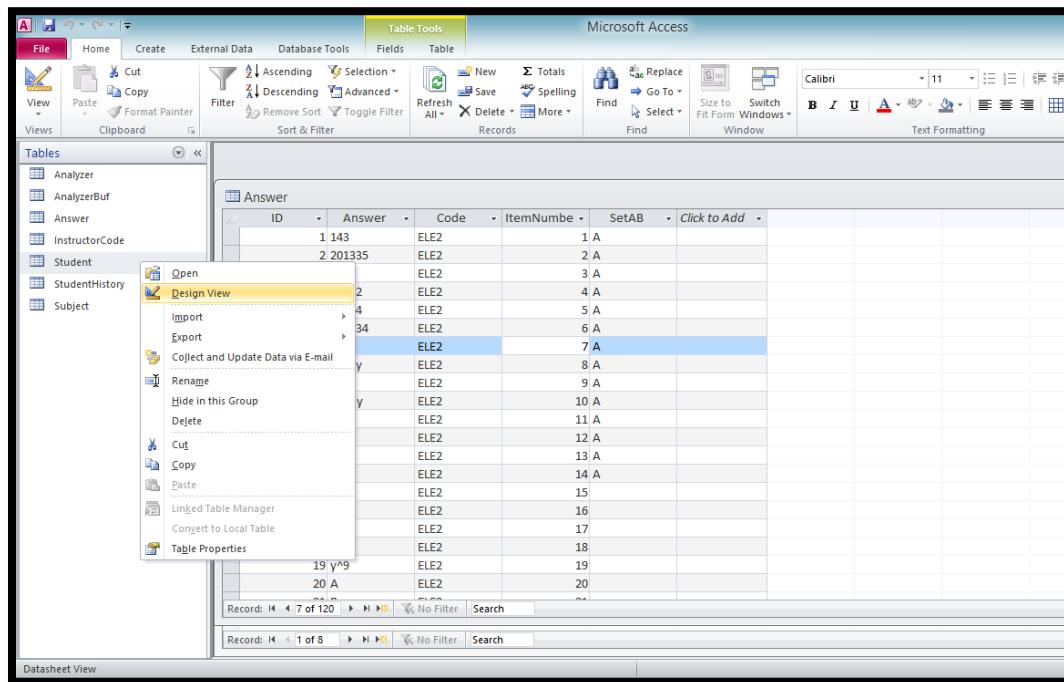


Check if it has the following format.

Answer		
	Field Name	Data Type
	ID	AutoNumber
	Answer	Text
	Code	Text
	ItemNumber	Number

## For the student database:

Right click the table of **student** in Microsoft access and select **design view**.



Check if it has the following format.

Student	
Field Name	Data Type
ID	Text
Name	Text
Sec	Text

## **APPENDIX C**

### **Test Results**

C.1 Final data gathered from the deployment of the device.

<b>Student</b>	<b>Test Paper Checker Machine (1)</b>	<b>Manual (2)</b>
<b>1</b>	52	52
<b>2</b>	66	66
<b>3</b>	58	58
<b>4</b>	74	74
<b>5</b>	52	53
<b>6</b>	77	78
<b>7</b>	78	78
<b>8</b>	68	68
<b>9</b>	59	62
<b>10</b>	75	75
<b>11</b>	82	82
<b>12</b>	76	77
<b>13</b>	64	65
<b>14</b>	78	79
<b>15</b>	72	72
<b>16</b>	73	74
<b>17</b>	72	73
<b>18</b>	74	75
<b>19</b>	62	61
<b>20</b>	61	62
<b>21</b>	64	64
<b>22</b>	63	64
<b>23</b>	63	64
<b>24</b>	75	76
<b>25</b>	55	55
<b>26</b>	76	76
<b>27</b>	79	79
<b>28</b>	60	61
<b>29</b>	80	81
<b>30</b>	82	82
<b>31</b>	76	76

<b>32</b>	50	51
<b>33</b>	70	72
<b>34</b>	46	46
<b>35</b>	72	72
<b>36</b>	80	80
<b>37</b>	76	77
<b>38</b>	72	72
<b>39</b>	64	64
<b>40</b>	41	41
<b>41</b>	73	73
<b>42</b>	61	61
<b>43</b>	66	67
<b>44</b>	65	66
<b>45</b>	67	69
<b>46</b>	53	56
<b>47</b>	77	77
<b>48</b>	67	67
<b>49</b>	80	81
<b>50</b>	60	61
<b>51</b>	58	58
<b>52</b>	64	69
<b>53</b>	54	54
<b>54</b>	55	57
<b>55</b>	59	66
<b>56</b>	80	80
<b>57</b>	83	86
<b>58</b>	70	73
<b>59</b>	70	78
<b>60</b>	85	85
<b>61</b>	74	74
<b>62</b>	52	55
<b>63</b>	80	80
<b>64</b>	47	48
<b>65</b>	73	75
<b>66</b>	79	79
<b>67</b>	80	80

<b>68</b>	78	78
<b>69</b>	68	70
<b>70</b>	71	72
<b>71</b>	63	63
<b>72</b>	64	65
<b>73</b>	57	59
<b>74</b>	45	48
<b>75</b>	77	78
<b>76</b>	63	65
<b>77</b>	57	57
<b>78</b>	84	84
<b>79</b>	53	53
<b>80</b>	71	76
<b>81</b>	79	80
<b>82</b>	68	69
<b>83</b>	73	73
<b>84</b>	76	76
<b>85</b>	66	67
<b>86</b>	59	60
<b>87</b>	46	47
<b>88</b>	56	58
<b>89</b>	57	57
<b>90</b>	47	48
<b>91</b>	44	46
<b>92</b>	52	54
<b>93</b>	58	60
<b>94</b>	64	64
<b>95</b>	61	61
<b>96</b>	55	55
<b>97</b>	40	40
<b>98</b>	58	59
<b>99</b>	62	63
<b>100</b>	52	65
<b>101</b>	58	59
<b>102</b>	55	65
<b>103</b>	63	65

<b>104</b>	47	47
<b>105</b>	45	51
<b>106</b>	43	41
<b>107</b>	74	78
<b>108</b>	64	65
<b>109</b>	63	63
<b>110</b>	51	51
<b>111</b>	76	78
<b>112</b>	61	61
<b>113</b>	64	64
<b>114</b>	50	55
<b>115</b>	47	48
<b>116</b>	63	63
<b>117</b>	61	62
<b>118</b>	52	52
<b>119</b>	34	36
<b>120</b>	40	41
<b>121</b>	63	63
<b>122</b>	52	53
<b>123</b>	64	64
<b>124</b>	64	64
<b>125</b>	41	42
<b>126</b>	48	48
<b>127</b>	51	57
<b>128</b>	60	62
<b>129</b>	64	64
<b>130</b>	72	73

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C.2 Item difficulty percentage gathered

<b>Item Number</b>	<b>Number of Students</b>	<b>Number of Incorrect Answer</b>	<b>Difficulties (%)</b>
<b>1</b>	130	5	3.8462
<b>2</b>	130	23	17.6923
<b>3</b>	130	53	40.7692
<b>4</b>	130	22	16.9231
<b>5</b>	130	84	64.6154
<b>6</b>	130	30	23.0769
<b>7</b>	130	26	20
<b>8</b>	130	6	4.6154
<b>9</b>	130	48	36.9231
<b>10</b>	130	18	13.8462
<b>11</b>	130	53	40.7692
<b>12</b>	130	82	63.0769
<b>13</b>	130	10	7.6923
<b>14</b>	130	46	35.3846
<b>15</b>	130	45	34.6154
<b>16</b>	130	16	12.3077
<b>17</b>	130	43	33.0769
<b>18</b>	130	48	36.9231
<b>19</b>	130	25	19.2308
<b>20</b>	130	28	21.5385
<b>21</b>	130	13	10
<b>22</b>	130	66	50.7692
<b>23</b>	130	74	56.9231
<b>24</b>	130	34	26.1538
<b>25</b>	130	63	48.4615
<b>26</b>	130	97	74.6154
<b>27</b>	130	30	23.0769
<b>28</b>	130	41	31.5385
<b>29</b>	130	60	46.1538
<b>30</b>	130	82	63.0769

<b>31</b>	130	11	8.4615
<b>32</b>	130	74	56.9231
<b>33</b>	130	25	19.2308
<b>34</b>	130	33	25.3846
<b>35</b>	130	43	33.0769
<b>36</b>	130	10	7.6923
<b>37</b>	130	23	17.6923
<b>38</b>	130	66	50.7692
<b>39</b>	130	7	5.3846
<b>40</b>	130	44	33.8462
<b>41</b>	130	90	69.2308
<b>42</b>	130	38	29.2308
<b>43</b>	130	76	58.4615
<b>44</b>	130	61	46.9231
<b>45</b>	130	78	60
<b>46</b>	130	71	54.6154
<b>47</b>	130	71	54.6154
<b>48</b>	130	7	5.3846
<b>49</b>	130	42	32.3077
<b>50</b>	130	65	50
<b>51</b>	130	14	10.7692
<b>52</b>	130	54	41.5385
<b>53</b>	130	3	2.3077
<b>54</b>	130	26	20
<b>55</b>	130	37	28.4615
<b>56</b>	130	28	21.5385
<b>57</b>	130	57	43.8462
<b>58</b>	130	13	10
<b>59</b>	130	20	15.3846
<b>60</b>	130	17	13.0769
<b>61</b>	130	7	5.3846
<b>62</b>	130	77	59.2308
<b>63</b>	130	19	14.6154

<b>64</b>	130	17	13.0769
<b>65</b>	130	8	6.1538
<b>66</b>	130	39	30
<b>67</b>	130	41	31.5385
<b>68</b>	130	19	14.6154
<b>69</b>	130	39	30
<b>70</b>	130	47	36.1538
<b>71</b>	130	37	28.4615
<b>72</b>	130	27	20.7692
<b>73</b>	130	55	42.3077
<b>74</b>	130	57	43.8462
<b>75</b>	130	32	24.6154
<b>76</b>	130	38	29.2308
<b>77</b>	130	63	48.4615
<b>78</b>	130	41	31.5385
<b>79</b>	130	56	43.0769
<b>80</b>	130	37	28.4615
<b>81</b>	130	10	7.6923
<b>82</b>	130	41	31.5385
<b>83</b>	130	60	46.1538
<b>84</b>	130	51	39.2308
<b>85</b>	130	71	54.6154
<b>86</b>	130	31	23.8462
<b>87</b>	130	31	23.8462
<b>88</b>	130	42	32.3077
<b>89</b>	130	69	53.0769
<b>90</b>	130	17	13.0769
<b>91</b>	130	51	39.2308
<b>92</b>	130	39	30
<b>93</b>	130	35	26.9231
<b>94</b>	130	53	40.7692
<b>95</b>	130	70	53.8462
<b>96</b>	130	32	24.6154

<b>97</b>	130	42	32.3077
<b>98</b>	130	45	34.6154
<b>99</b>	130	13	10
<b>100</b>	130	41	31.5385

### C.3 Percentage difference of the final data gathered

<b>Student</b>	<b>Test Paper Checker Machine (1)</b>	<b>Manual Checking (2)</b>	<b>Percentage Difference (%)</b>
<b>1</b>	52	52	0
<b>2</b>	66	66	0
<b>3</b>	58	58	0
<b>4</b>	74	74	0
<b>5</b>	52	53	1.9048
<b>6</b>	77	78	1.2903
<b>7</b>	78	78	0
<b>8</b>	68	68	0
<b>9</b>	59	62	4.9587
<b>10</b>	75	75	0
<b>11</b>	82	82	0
<b>12</b>	76	77	1.3072
<b>13</b>	64	65	1.5504
<b>14</b>	78	79	1.2739
<b>15</b>	72	72	0
<b>16</b>	73	74	1.3605
<b>17</b>	72	73	1.3793
<b>18</b>	74	75	1.3423
<b>19</b>	62	61	1.6260
<b>20</b>	61	62	1.6260
<b>21</b>	64	64	0
<b>22</b>	63	64	1.5748
<b>23</b>	63	64	1.5748
<b>24</b>	75	76	1.3245
<b>25</b>	55	55	0

<b>26</b>	76	76	0
<b>27</b>	79	79	0
<b>28</b>	60	61	1.6529
<b>29</b>	80	81	1.2422
<b>30</b>	82	82	0
<b>31</b>	76	76	0
<b>32</b>	50	51	1.9802
<b>33</b>	70	72	2.8169
<b>34</b>	46	46	0
<b>35</b>	72	72	0
<b>36</b>	80	80	0
<b>37</b>	76	77	1.3072
<b>38</b>	72	72	0
<b>39</b>	64	64	0
<b>40</b>	41	41	0
<b>41</b>	73	73	0
<b>42</b>	61	61	0
<b>43</b>	66	67	1.5038
<b>44</b>	65	66	1.5267
<b>45</b>	67	69	2.9412
<b>46</b>	53	56	5.5046
<b>47</b>	77	77	0
<b>48</b>	67	67	0
<b>49</b>	80	81	1.2422
<b>50</b>	60	61	1.6529
<b>51</b>	58	58	0
<b>52</b>	64	69	7.5188
<b>53</b>	54	54	0
<b>54</b>	55	57	3.5714
<b>55</b>	59	66	11.2000
<b>56</b>	80	80	0
<b>57</b>	83	86	3.5503
<b>58</b>	70	73	4.1958
<b>59</b>	70	78	10.8108

<b>60</b>	85	85	0
<b>61</b>	74	74	0
<b>62</b>	52	55	5.6075
<b>63</b>	80	80	0
<b>64</b>	47	48	2.1053
<b>65</b>	73	75	2.7027
<b>66</b>	79	79	0
<b>67</b>	80	80	0
<b>68</b>	78	78	0
<b>69</b>	68	70	2.8986
<b>70</b>	71	72	1.3986
<b>71</b>	63	63	0
<b>72</b>	64	65	1.5504
<b>73</b>	57	59	3.4483
<b>74</b>	45	48	6.4516
<b>75</b>	77	78	1.2903
<b>76</b>	63	65	3.1250
<b>77</b>	57	57	0
<b>78</b>	84	84	0
<b>79</b>	53	53	0
<b>80</b>	71	76	6.8027
<b>81</b>	79	80	1.2579
<b>82</b>	68	69	1.4599
<b>83</b>	73	73	0
<b>84</b>	76	76	0
<b>85</b>	66	67	1.5038
<b>86</b>	59	60	1.6807
<b>87</b>	46	47	2.1505
<b>88</b>	56	58	3.5088
<b>89</b>	57	57	0
<b>90</b>	47	48	2.1053
<b>91</b>	44	46	4.4444
<b>92</b>	52	54	3.7736
<b>93</b>	58	60	3.3898

<b>94</b>	64	64	0
<b>95</b>	61	61	0
<b>96</b>	55	55	0
<b>97</b>	40	40	0
<b>98</b>	58	59	1.7094
<b>99</b>	62	63	1.6000
<b>100</b>	52	65	22.2222
<b>101</b>	58	59	1.7094
<b>102</b>	55	65	16.6667
<b>103</b>	63	65	3.1250
<b>104</b>	47	47	0
<b>105</b>	45	51	12.5000
<b>106</b>	43	41	4.7619
<b>107</b>	74	78	5.2632
<b>108</b>	64	65	1.5504
<b>109</b>	63	63	0
<b>110</b>	51	51	0
<b>111</b>	76	78	2.5974
<b>112</b>	61	61	0
<b>113</b>	64	64	0
<b>114</b>	50	55	9.5238
<b>115</b>	47	48	2.1053
<b>116</b>	63	63	0
<b>117</b>	61	62	1.6260
<b>118</b>	52	52	0
<b>119</b>	34	36	5.7143
<b>120</b>	40	41	2.4691
<b>121</b>	63	63	0
<b>122</b>	52	53	1.9048
<b>123</b>	64	64	0
<b>124</b>	64	64	0
<b>125</b>	41	42	2.4096
<b>126</b>	48	48	0
<b>127</b>	51	57	11.1111

<b>128</b>	60	62	3.2787
<b>129</b>	64	64	0
<b>130</b>	72	73	1.3793

C.4 Accuracy for the final data gathered

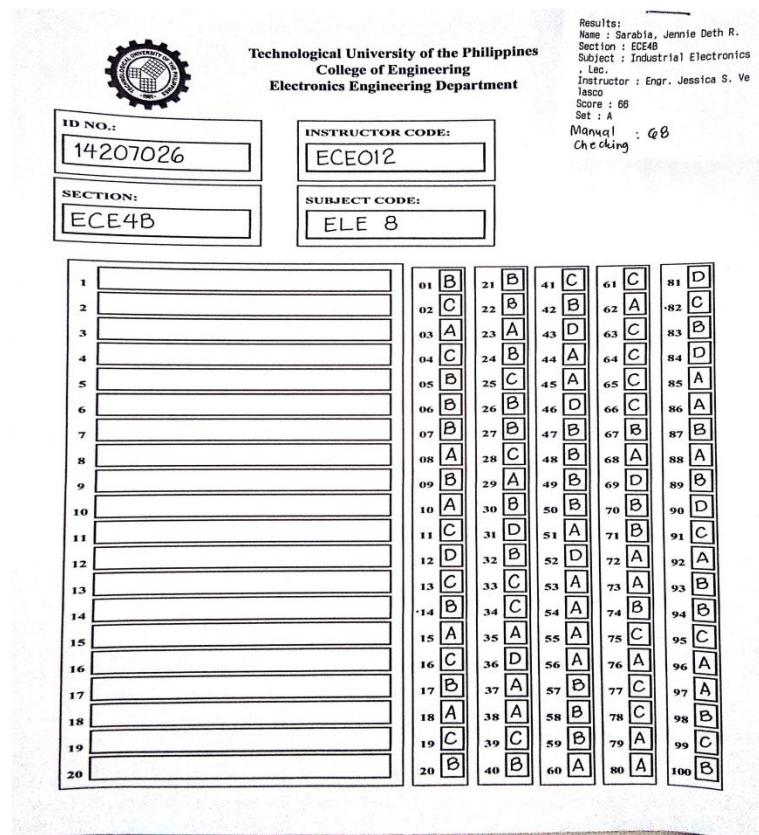
<b>Student</b>	<b>Test Paper Checker Machine (1)</b>	<b>Manual (2)</b>	<b>+5%</b>	<b>-5%</b>	<b>Partial Result</b>
<b>1</b>	52	52	57	47	1
<b>2</b>	66	66	71	61	1
<b>3</b>	58	58	63	53	1
<b>4</b>	74	74	79	69	1
<b>5</b>	52	53	57	48	1
<b>6</b>	77	78	82	73	1
<b>7</b>	78	78	83	73	1
<b>8</b>	68	68	73	63	1
<b>9</b>	59	62	66	57	1
<b>10</b>	75	75	80	70	1
<b>11</b>	82	82	87	77	1
<b>12</b>	76	77	81	72	1
<b>13</b>	64	65	69	60	1
<b>14</b>	78	79	83	74	1
<b>15</b>	72	72	77	67	1
<b>16</b>	73	74	78	69	1
<b>17</b>	72	73	77	68	1
<b>18</b>	74	75	79	70	1
<b>19</b>	62	61	66	55	1
<b>20</b>	61	62	66	57	1
<b>21</b>	64	64	69	59	1
<b>22</b>	63	64	68	59	1
<b>23</b>	63	64	68	59	1
<b>24</b>	75	76	80	71	1
<b>25</b>	55	55	60	50	1
<b>26</b>	76	76	81	71	1
<b>27</b>	79	79	84	74	1

<b>28</b>	60	61	65	56	1
<b>29</b>	80	81	85	76	1
<b>30</b>	82	82	87	77	1
<b>31</b>	76	76	81	71	1
<b>32</b>	50	51	55	46	1
<b>33</b>	70	72	76	67	1
<b>34</b>	46	46	51	41	1
<b>35</b>	72	72	77	67	1
<b>36</b>	80	80	85	75	1
<b>37</b>	76	77	81	72	1
<b>38</b>	72	72	77	67	1
<b>39</b>	64	64	69	59	1
<b>40</b>	41	41	46	36	1
<b>41</b>	73	73	78	68	1
<b>42</b>	61	61	66	56	1
<b>43</b>	66	67	71	62	1
<b>44</b>	65	66	70	61	1
<b>45</b>	67	69	73	64	1
<b>46</b>	53	56	60	51	1
<b>47</b>	77	77	82	72	1
<b>48</b>	67	67	72	62	1
<b>49</b>	80	81	85	76	1
<b>50</b>	60	61	65	56	1
<b>51</b>	58	58	63	53	1
<b>52</b>	64	69	73	64	0
<b>53</b>	54	54	59	49	1
<b>54</b>	55	57	61	52	1
<b>55</b>	59	66	70	61	0
<b>56</b>	80	80	85	75	1
<b>57</b>	83	86	90	81	1
<b>58</b>	70	73	77	68	1
<b>59</b>	70	78	82	73	0
<b>60</b>	85	85	90	80	1
<b>61</b>	74	74	79	69	1
<b>62</b>	52	55	59	50	1
<b>63</b>	80	80	85	75	1

<b>64</b>	47	48	52	43	1
<b>65</b>	73	75	79	70	1
<b>66</b>	79	79	84	74	1
<b>67</b>	80	80	85	75	1
<b>68</b>	78	78	83	73	1
<b>69</b>	68	70	74	65	1
<b>70</b>	71	72	76	67	1
<b>71</b>	63	63	68	58	1
<b>72</b>	64	65	69	60	1
<b>73</b>	57	59	63	54	1
<b>74</b>	45	48	52	43	1
<b>75</b>	77	78	82	73	1
<b>76</b>	63	65	69	60	1
<b>77</b>	57	57	62	52	1
<b>78</b>	84	84	89	79	1
<b>79</b>	53	53	58	48	1
<b>80</b>	71	76	80	71	0
<b>81</b>	79	80	84	75	1
<b>82</b>	68	69	73	64	1
<b>83</b>	73	73	78	68	1
<b>84</b>	76	76	81	71	1
<b>85</b>	66	67	71	62	1
<b>86</b>	59	60	64	55	1
<b>87</b>	46	47	51	42	1
<b>88</b>	56	58	62	53	1
<b>89</b>	57	57	62	52	1
<b>90</b>	47	48	52	43	1
<b>91</b>	44	46	50	41	1
<b>92</b>	52	54	58	49	1
<b>93</b>	58	60	64	55	1
<b>94</b>	64	64	69	59	1
<b>95</b>	61	61	66	56	1
<b>96</b>	55	55	60	50	1
<b>97</b>	40	40	45	35	1
<b>98</b>	58	59	63	54	1
<b>99</b>	62	63	67	58	1

<b>100</b>	52	65	69	61	0
<b>101</b>	58	59	63	54	1
<b>102</b>	55	65	69	60	0
<b>103</b>	63	65	69	60	1
<b>104</b>	47	47	52	42	1
<b>105</b>	45	51	55	46	0
<b>106</b>	43	41	46	35	1
<b>107</b>	74	78	82	73	1
<b>108</b>	64	65	69	60	1
<b>109</b>	63	63	68	58	1
<b>110</b>	51	51	56	46	1
<b>111</b>	76	78	82	73	1
<b>112</b>	61	61	66	56	1
<b>113</b>	64	64	69	59	1
<b>114</b>	50	55	59	50	0
<b>115</b>	47	48	52	43	1
<b>116</b>	63	63	68	58	1
<b>117</b>	61	62	66	57	1
<b>118</b>	52	52	57	47	1
<b>119</b>	34	36	40	31	1
<b>120</b>	40	41	45	36	1
<b>121</b>	63	63	68	58	1
<b>122</b>	52	53	57	48	1
<b>123</b>	64	64	69	59	1
<b>124</b>	64	64	69	59	1
<b>125</b>	41	42	46	37	1
<b>126</b>	48	48	53	43	1
<b>127</b>	51	57	61	52	0
<b>128</b>	60	62	66	57	1
<b>129</b>	64	64	69	59	1
<b>130</b>	72	73	77	68	1

C.5 Scanned answer sheets and screenshots of the actual result in GUI



Analyze

ID Number	Section	Instructor Code	Subject Code
14207026	ECE4B	ECE012	ELE8
1	B	21	B
2	C	22	B
3	A	23	A
4	C	24	B
5	B	25	C
6	B	26	B
7	B	27	B
8	A	28	C
9	B	29	A
10	A	30	B
11	C	31	D
12	D	32	B
13	C	33	C
14	D	34	C
15	A	35	A
16	C	36	D
17	B	37	A
18	A	38	A
19	C	39	C
20	B	40	B

**Results:**  
Name : Sarabia,  
Jennie Deth R.  
Section : ECE4B  
Subject : Industrial  
Electronics, Lec.  
Instructor : Engr.  
Jessica S. Velasco  
Score : 67  
Set : A

Check

Back



**Technological University of the Philippines**  
**College of Engineering**  
**Electronics Engineering Department**

RESULTS:  
 Name : Barnido, Lorin C. Jr  
 Section : ECE4A  
 Subject : Industrial Electronics  
 Lec.  
 Instructor : Engr. Jessica S. Velasco  
 Score : 52  
 Set : A  
 M0153

NO.:  
14207081  
SECTION:  
ECE4A

INSTRUCTOR CODE:  
ECE012  
SUBJECT CODE:  
ELE8

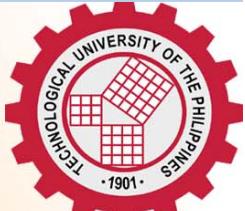
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20	

01	B	21	C	41	D	61	C	81	A
02	C	22	B	42	B	62	D	82	A
03	A	23	A	43	D	63	C	83	C
04	C	24	B	44	A	64	C	84	A
05	B	25	D	45	B	65	C	85	B
06	C	26	B	46	A	66	A	86	A
07	B	27	A	47	B	67	C	87	B
08	A	28	C	48	B	68	A	88	C
09	B	29	A	49	B	69	A	89	B
10	B	30	A	50	A	70	B	90	D
11	A	31	D	51	B	71	B	91	A
12	A	32	A	52	B	72	C	92	C
13	A	33	C	53	A	73	B	93	A
14	B	34	D	54	B	74	A	94	C
15	B	35	A	55	D	75	C	95	C
16	D	36	D	56	A	76	C	96	A
17	A	37	A	57	B	77	A	97	B
18	A	38	D	58	C	78	B	98	C
19	B	39	A	59	B	79	C	99	A
20	A	40	D	60	A	80	C	100	B

Analyze

ID Number	Section	Instructor Code	Subject Code
14207081	ECE4A	ECE012	ELE8
1	B	21	C
2	C	22	B
3	A	23	A
4	C	24	B
5	B	25	D
6	C	26	B
7	B	27	A
8	A	28	C
9	B	29	A
10	B	30	A
11	A	31	D
12	A	32	A
13	A	33	C
14	B	34	D
15	B	35	A
16	D	36	D
17	A	37	A
18	A	38	D
19	B	39	A
20	A	40	D

Results:  
 Name : Barnido, Lorin C. Jr  
 Section : ECE4A  
 Subject : Industrial Electronics, Lec.  
 Instructor : Engr. Jessica S. Velasco  
 Score : 52  
 Set : A


	<b>Technological University of the Philippines</b> College of Engineering Electronics Engineering Department	
ID NO.:	14207099	
SECTION:	ECE4B	
INSTRUCTOR CODE:	ECE012	
SUBJECT CODE:	ELE8	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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ID Number	Section	Instructor Code	Subject Code
14207099	ECE4B	ECE012	ELE8
1	B	A	C
2	C	D	B
3	C	A	A
4	C	D	A
5	B	B	B
6	B	B	C
7	D	C	C
8	A	C	B
9	C	A	C
10	A	30	50
11	C	31	51
12	C	32	52
13	C	33	53
14	B	34	54
15	A	35	55
16	C	36	56
17	B	37	57
18	A	38	58
19	C	39	59
20	B	40	60
21	A	41	C
22	D	42	B
23	A	43	A
24	D	44	A
25	B	45	B
26	B	46	C
27	C	47	C
28	C	48	B
29	A	49	C
30	B	50	C
31	D	51	A
32	B	52	D
33	C	53	A
34	A	54	A
35	A	55	D
36	D	56	D
37	A	57	C
38	C	58	B
39	C	59	B
40	D	60	A
41	C	61	B
42	B	62	A
43	A	63	C
44	A	64	C
45	B	65	B
46	C	66	B
47	C	67	C
48	B	68	A
49	C	69	A
50	A	70	D
51	D	71	B
52	D	72	B
53	A	73	D
54	A	74	B
55	D	75	C
56	D	76	A
57	C	77	D
58	B	78	C
59	B	79	A
60	A	80	C
61	C	81	D
62	A	82	C
63	C	83	B
64	C	84	D
65	B	85	B
66	B	86	B
67	C	87	D
68	A	88	D
69	A	89	A
70	D	90	D
71	B	91	A
72	B	92	A
73	D	93	D
74	B	94	B
75	C	95	B
76	A	96	D
77	D	97	B
78	C	98	B
79	A	99	A
80	C	100	B

Results:  
 Name : Apuang, Jonathan G.  
 Section : ECE4B  
 Subject : Industrial Electronics, Lec.  
 Instructor : Engr. Jessica S. Velasco  
 Score : 56  
 Set : A



**Technological University of the Philippines**  
 College of Engineering  
 Electronics Engineering Department

ID NO.:	14207040	INSTRUCTOR CODE:	ECE012
SECTION:	ECE 4B	SUBJECT CODE:	ELE8

1	21	41	61	81
2	22	42	62	82
3	23	43	63	83
4	24	44	64	84
5	25	45	65	85
6	26	46	66	86
7	27	47	67	87
8	28	48	68	88
9	29	49	69	89
10	30	50	70	90
11	31	51	71	91
12	32	52	72	92
13	33	53	73	93
14	34	54	74	94
15	35	55	75	95
16	36	56	76	96
17	37	57	77	97
18	38	58	78	98
19	39	59	79	99
20	40	60	80	100

Analyze

ID Number	Section	Instructor Code	Subject Code
14207040	ECE4B	ECE012	ELE8
1	B	21	B
2	C	22	D
3	A	23	A
4	C	24	B
5	B	25	B
6	B	26	B
7	B	27	D
8	A	28	C
9	B	29	A
10	A	30	B
11	C	31	D
12	D	32	A
13	C	33	C
14	B	34	A
15	A	35	A
16	C	36	D
17	B	37	A
18	A	38	A
19	C	39	C
20	D	40	B

Results:

Name : Dela Cruz, Francis Paul G.  
 Section : ECE4B  
 Subject : Industrial Electronics, Lec.  
 Instructor : Engr. Jessica S. Velasco  
 Score : 70  
 Set : A

**Check**

**Back**


databaseCNTRL X

NEXT ANSWER SHEET

Activate Windows OK

Go to Settings to activate Windows.

Results:  
Name : Guinto, John Francis R.  
Section : ECE4B  
Subject : Industrial Electronics  
Lec.  
Instructor : Engr. Jessica S. Velasco  
Score : 47  
Set : A  
MC : 48

ID NO.:		INSTRUCTOR CODE:	
14207109		ECE012	
SECTION:		SUBJECT CODE:	
ECE 4B		ELE8	
1		21	C
2		22	D
3		23	A
4		24	A
5		25	D
6		26	B
7		27	D
8		28	C
9		29	B
10		30	A
11		31	C
12		32	D
13		33	C
14		34	A
15		35	B
16		36	D
17		37	A
18		38	B
19		39	C
20		40	B
21		41	D
22		42	B
23		43	D
24		44	A
25		45	D
26		46	C
27		47	B
28		48	B
29		49	B
30		50	B
31		51	D
32		52	C
33		53	A
34		54	A
35		55	B
36		56	B
37		57	B
38		58	C
39		59	B
40		60	C
41		61	D
42		62	C
43		63	C
44		64	A
45		65	C
46		66	C
47		67	A
48		68	A
49		69	D
50		70	A
51		71	B
52		72	A
53		73	B
54		74	A
55		75	A
56		76	D
57		77	D
58		78	C
59		79	C
60		80	A
61		81	B
62		82	A
63		83	D
64		84	C
65		85	A
66		86	C
67		87	B
68		88	C
69		89	C
70		90	D
71		91	A
72		92	A
73		93	C
74		94	B
75		95	A
76		96	A
77		97	A
78		98	C
79		99	B
80		100	A

Analyze

ID Number	Section	Instructor Code	Subject Code
14207109	ECE4B	ECE012	ELE8
1		1	C
2		2	C
3		3	B
4		4	B
5		5	D
6		6	B
7		7	B
8		8	B
9		9	C
10		10	A
11		11	C
12		12	D
13		13	C
14		14	D
15		15	B
16		16	B
17		17	A
18		18	A
19		19	C
20		20	B
		21	B
		22	D
		23	A
		24	A
		25	D
		26	B
		27	D
		28	C
		29	B
		30	B
		31	D
		32	C
		33	B
		34	A
		35	B
		36	D
		37	A
		38	B
		39	C
		40	B
		41	D
		42	B
		43	D
		44	A
		45	B
		46	C
		47	B
		48	B
		49	B
		50	B
		51	D
		52	C
		53	A
		54	A
		55	B
		56	B
		57	B
		58	C
		59	B
		60	C
		61	D
		62	C
		63	C
		64	A
		65	C
		66	C
		67	A
		68	A
		69	D
		70	A
		71	B
		72	A
		73	B
		74	A
		75	A
		76	D
		77	D
		78	C
		79	C
		80	A
		81	B
		82	A
		83	D
		84	C
		85	A
		86	C
		87	B
		88	C
		89	C
		90	D
		91	A
		92	A
		93	E
		94	B
		95	A
		96	A
		97	A
		98	C
		99	B
		100	A



Results:  
Name : Guinto, John Francis R.  
Section : ECE4B  
Subject : Industrial Electronics, Lec.  
Instructor : Engr. Jessica S. Velasco  
Score : 47  
Set : A

Check

Back

databaseCNTRL

NEXT ANSWER SHEET

OK

Activate Windows  
Go to Settings to activate Windows.

  
**Technological University of the Philippines**  
 College of Engineering  
 Electronics Engineering Department

ID NO.:	16207078	INSTRUCTOR CODE:	ECE012
SECTION:	ECE4A	SUBJECT CODE:	ELE8

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01	B	21	B	41	D	61	C	81	D
02	C	22	D	42	D	62	B	82	C
03	B	23	A	43	A	63	C	83	B
04	C	24	C	44	D	64	C	84	D
05	B	25	A	45	D	65	C	85	C
06	B	26	B	46	B	66	C	86	A
07	B	27	C	47	C	67	B	87	B
08	A	28	C	48	B	68	A	88	A
09	B	29	A	49	B	69	C	89	B
10	A	30	B	50	A	70	B	90	D
11	C	31	D	51	A	71	B	91	A
12	D	32	C	52	D	72	A	92	A
13	C	33	C	53	A	73	A	93	C
14	B	34	A	54	A	74	C	94	B
15	A	35	A	55	D	75	C	95	B
16	C	36	D	56	D	76	A	96	A
17	A	37	A	57	C	77	D	97	D
18	A	38	C	58	B	78	C	98	B
19	C	39	C	59	B	79	C	99	C
20	D	40	B	60	A	80	C	100	A

Results:  
 Name : Isoy, John Erick L.  
 Section : ECE4A  
 Subject : Industrial Electronics  
 Instructor : Engr. Jessica S. Velasco  
 Score : 73  
 Set : A  
 MC : 76

  
**TECHNICAL UNIVERSITY OF THE PHILIPPINES**  
 1901

  
**COLLEGE OF ENGINEERING**  
 TECHNICAL UNIVERSITY OF THE PHILIPPINES  
 1979

ID Number	16207078	Section	ECE4A	Instructor Code	ECE012	Subject Code	ELE8
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1	B	21	B	41	D	61	C	81	D
2	C	22	D	42	D	62	B	82	C
3	B	23	A	43	A	63	C	83	B
4	C	24	C	44	D	64	C	84	D
5	B	25	A	45	D	65	C	85	C
6	B	26	B	46	B	66	C	86	A
7	B	27	C	47	C	67	B	87	D
8	A	28	C	48	B	68	A	88	A
9	B	29	A	49	B	69	C	89	B
10	A	30	B	50	A	70	B	90	D
11	C	31	D	51	A	71	B	91	A
12	D	32	C	52	D	72	A	92	A
13	C	33	C	53	A	73	A	93	C
14	B	34	A	54	A	74	C	94	B
15	A	35	A	55	D	75	C	95	D
16	C	36	D	56	D	76	A	96	A
17	A	37	A	57	C	77	D	97	D
18	A	38	C	58	B	78	C	98	B
19	C	39	C	59	B	79	C	99	C
20	D	40	B	60	A	80	C	100	A

Results:  
 Name : Isoy, John Erick L.  
 Section : ECE4A  
 Subject : Industrial Electronics  
 Instructor : Engr. Jessica S. Velasco  
 Score : 73  
 Set : A

databaseCNTRL

NEXT ANSWER SHEET

Activate Windows  
Go to Settings to activate Windows.


**Technological University of the Philippines**  
 College of Engineering  
 Electronics Engineering Department

ID NO.:	16207057	INSTRUCTOR CODE:	ECE012
SECTION:	ECE4B	SUBJECT CODE:	ELE8

1	
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18	
19	
20	

01	B	21	B	41	D	61	C	81	D
02	C	22	C	42	A	62	B	82	C
03	A	23	A	43	A	63	C	83	B
04	B	24	B	44	A	64	C	84	D
05	B	25	D	45	C	65	C	85	C
06	B	26	B	46	A	66	C	86	A
07	B	27	B	47	C	67	C	87	B
08	A	28	C	48	D	68	A	88	A
09	B	29	A	49	B	69	A	89	A
10	A	30	B	50	A	70	B	90	D
11	C	31	D	51	A	71	B	91	A
12	D	32	A	52	D	72	A	92	A
13	C	33	C	53	A	73	C	93	C
14	A	34	C	54	A	74	C	94	B
15	A	35	A	55	A	75	C	95	C
16	C	36	D	56	A	76	A	96	A
17	A	37	A	57	B	77	C	97	D
18	A	38	A	58	B	78	C	98	B
19	A	39	C	59	B	79	C	99	C
20	D	40	B	60	A	80	A	100	A

Name : Jacinto, Niezamae T.  
 Section : ECE4B  
 Subject : Industrial Electronics, Lec.  
 Instructor : Engr. Jessica S. Velasco  
 Score : 78  
 Set : A  
 M-C. : 80

ID Number	Section	Instructor Code	Subject Code						
16207057	ECE4B	ECE012	ELE8						
1	B	21	B	41	D	61	C	81	D
2	C	22	C	42	A	62	B	82	C
3	A	23	A	43	A	63	C	83	B
4	B	24	B	44	A	64	C	84	D
5	B	25	D	45	C	65	C	85	C
6	B	26	B	46	A	66	C	86	A
7	B	27	B	47	C	67	C	87	B
8	A	28	C	48	D	68	A	88	A
9	B	29	A	49	B	69	A	89	A
10	A	30	B	50	A	70	B	90	D
11	C	31	D	51	A	71	D	91	A
12	D	32	A	52	D	72	A	92	A
13	C	33	C	53	A	73	C	93	C
14	A	34	C	54	A	74	C	94	B
15	A	35	A	55	A	75	C	95	C
16	C	36	D	56	A	76	A	96	A
17	A	37	A	57	B	77	C	97	D
18	A	38	A	58	B	78	C	98	B
19	A	39	C	59	B	79	C	99	C
20	D	40	B	60	A	80	A	100	A




Results:  
 Name : Jacinto,  
 Niezamae T.  
 Section : ECE4B  
 Subject : Industrial  
 Electronics, Lec.  
 Instructor : Engr.  
 Jessica S. Velasco  
 Score : 78  
 Set : A

databaseCNTRL

Activate Windows  
[Go to Settings to activate Windows.](#)



Technological University of the Philippines  
College of Engineering  
Electronics Engineering Department

ID NO.:	14207066	INSTRUCTOR CODE:	ECEO12
SECTION:	ECE4B	SUBJECT CODE:	ELE8

1	B	D	B	C	B	D
2	C	D	B	D	D	C
3	A	B	A	D	C	B
4	C	B	C	C	D	D
5	B	A	C	C	C	C
6	B	B	A	B	C	A
7	B	B	C	A	B	B
8	A	A	B	B	B	B
9	B	B	B	A	A	A
10	A	B	C	C	D	D
11	C	D	B	B	B	A
12	D	A	D	D	D	C
13	C	B	A	A	B	B
14	C	D	A	B	B	B
15	A	A	D	C	C	A
16	C	D	A	A	A	A
17	A	C	B	B	B	D
18	A	B	C	B	C	B
19	C	C	B	B	C	C
20	A	D	A	A	A	A

Results:  
Name : Naag Luigi Angelo V.  
Section : ECE4B  
Subject : Industrial Electronic  
.Lec.  
Instructor : Engr. Jessica S. V  
Lasco  
Score : 71  
Set : A  
M.C : 72

Analyze

ID Number	Section	Instructor Code	Subject Code
14207066	ECE4B	ECEO12	ELE8
1	B	D	B
2	C	D	B
3	A	B	A
4	C	B	C
5	B	A	C
6	B	B	A
7	B	B	C
8	A	A	B
9	B	B	B
10	A	B	C
11	C	D	B
12	D	A	D
13	C	B	A
14	C	D	A
15	A	A	D
16	C	D	A
17	A	C	B
18	A	B	C
19	C	C	B
20	A	D	A
21	D	41	B
22	D	42	B
23	B	43	A
24	B	44	C
25	A	45	C
26	B	46	A
27	B	47	C
28	A	48	B
29	B	49	B
30	B	50	C
31	D	51	B
32	A	52	D
33	B	53	A
34	D	54	A
35	A	55	D
36	D	56	A
37	C	57	B
38	C	58	B
39	C	59	B
40	D	60	A
41	B	61	C
42	B	62	D
43	A	63	C
44	C	64	C
45	C	65	C
46	A	66	C
47	C	67	A
48	B	68	A
49	B	69	A
50	C	70	B
51	B	71	B
52	D	72	A
53	A	73	B
54	A	74	B
55	D	75	C
56	A	76	A
57	B	77	C
58	B	78	C
59	B	79	C
60	A	80	A
81	D	82	C
82	C	83	B
83	B	84	D
84	C	85	C
85	A	86	A
86	A	87	B
87	B	88	D
88	D	89	A
89	A	90	D
90	D	91	A
91	A	92	C
92	C	93	A
93	A	94	B
94	B	95	A
95	A	96	A
96	A	97	D
97	D	98	B
98	B	99	C
99	C	100	A

Results:  
Name : Naag Luigi Angelo V.  
Section : ECE4B  
Subject : Industrial Electronics, Lec.  
Instructor : Engr. Jessica S. Velasco  
Score : 71  
Set : A

databaseCNTRL X  
 NEXT ANSWER SHEET OK  
 Activate Windows  
 Go to Settings to activate Windows.

# **APPENDIX D**

## **Program Codes**

## A. Feature Extraction

```
import imutils
import numpy as np
import mahotas
import cv2

def load_digits(datasetPath):
    data = np.genfromtxt(datasetPath, delimiter = ", ", dtype = "uint8")
    target = data[:, 0]
    data = data[:, 1:].reshape(data.shape[0], 28, 28)
    return (data, target)

def deskew(image, width):
    (h, w) = image.shape[:2]
    moments = cv2.moments(image)

    skew = moments["mu11"] / moments["mu02"]
    M = np.float32([[1, skew, -0.5 * w * skew],[0, 1, 0]])
    image = cv2.warpAffine(image, M, (w, h),
    flags = cv2.WARP_INVERSE_MAP | cv2.INTER_LINEAR)

    image = imutils.resize(image, width = width)

    return image

def center_extent(image, size):
    (eW, eH) = size

    if image.shape[1] > image.shape[0]:
        image = imutils.resize(image, width = eW)

    else:
        image = imutils.resize(image, height = eH)
        extent = np.zeros((eH, eW), dtype = "uint8")
        offsetX = (eW - image.shape[1]) // 2
        offsetY = (eH - image.shape[0]) // 2
        extent[offsetY:offsetY + image.shape[0], offsetX:offsetX + image.shape[1]] =
        image
        CM = mahotas.center_of_mass(extent)
        (cY, cX) = np.round(CM).astype("int32")
        (dX, dY) = ((size[0] // 2) - cX, (size[1] // 2) - cY)
        M = np.float32([[1, 0, dX], [0, 1, dY]])
        extent = cv2.warpAffine(extent, M, size)
```

```

    return extent
from skimage import feature

class HOG:
    def __init__(self, orientations = 9, pixelsPerCell = (8, 8),cellsPerBlock = (3, 3),
transform = False):
        self.orientations = orientations
        self.pixelsPerCell = pixelsPerCell
        self.cellsPerBlock = cellsPerBlock
        self.transform = transform

    def describe(self, image):
        hist = feature.hog(image,orientations = self.orientations,pixels_per_cell =
self.pixelsPerCell, cells_per_block = self.cellsPerBlock,transform_sqrt = self.transfor
return hist

```

## B. Cropping for Datasets

```

import numpy as np
import argparse
import cv2
from PIL import Image
import os

def cropconts(filename):
    image = cv2.imread(filename+".jpg")
    orig= image.copy()
    gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
    blurred = cv2.GaussianBlur(gray, (5, 5), 0)
    edged = cv2.Canny(blurred, 30, 150)
    (_, cnts, _) = cv2.findContours(edged.copy(),
cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)

```

```

cnts = sorted([(c, cv2.boundingRect(c)[0]) for c in cnts], key =lambda x: x[1])

```

```

z=0

```

```

for (c,_) in cnts:

```

```

    (x, y, w, h) = cv2.boundingRect(c)

```

```

    if w >= 7 and h >= 20:

```

```

        z=z+1

```

```

        cv2.rectangle(image, (x, y), (x + w, y + h), (0, 255, 0), 1)

```

```

#cv2.imshow("image", image)

```

```

#cv2.waitKey(0)

```

```

cropImageAndSave(x, w, y, h, orig, filename+str(z)+".jpg")

```

```

def cropImageAndSave(x,xwidth,y,ywidth,image,filename):
    #path=os.path.dirname(os.path.realpath(__file__)) + "\\tesseract-ocr"
    c=image[y:y+ywidth,x:x+xwidth]
    cv2.imwrite(filename,c)
    im= Image.open(filename)
    im.save(filename, dpi=(300,300))

def cropImageAndSaveBinary(x,xwidth,y,ywidth,image,filename):
    #path=os.path.dirname(os.path.realpath(__file__)) + "\\tesseract-ocr"
    c=image[y:y+ywidth,x:x+xwidth]
    #hsv = cv2.cvtColor(c, cv2.COLOR_BGR2HSV)
    ri = cv2.resize(c, (1*xwidth, 1*ywidth))
    gray = cv2.cvtColor(ri, cv2.COLOR_BGR2GRAY)
    gray = cv2.bilateralFilter(gray, 11, 17, 17)
    ret,c = cv2.threshold(gray,127,255,cv2.THRESH_BINARY)
    kernel = np.ones((5,5),np.uint8)
    c=cv2.erode(c, kernel, iterations=0)
    cv2.imwrite(filename,c)
    im= Image.open(filename)
    im.save(filename, dpi=(300,300))

def sort_contours(cnts, method="left-to-right"):
    # initialize the reverse flag and sort index
    reverse = False
    i = 0

    # handle if we need to sort in reverse
    if method == "right-to-left" or method == "bottom-to-top":
        reverse = True

    # handle if we are sorting against the y-coordinate rather than
    # the x-coordinate of the bounding box
    if method == "top-to-bottom" or method == "bottom-to-top":
        i = 1

    # construct the list of bounding boxes and sort them from top to
    # bottom
    boundingBoxes = [cv2.boundingRect(c) for c in cnts]
    (cnts, boundingBoxes) = zip(*sorted(zip(cnts, boundingBoxes),
                                         key=lambda b:b[1][i], reverse=reverse))

    # return the list of sorted contours and bounding boxes
    return (cnts, boundingBoxes)

```

```

def draw_contour(image, c, i):
    # compute the center of the contour area and draw a circle
    # representing the center
    M = cv2.moments(c)
    cX = int(M["m10"] / M["m00"])
    cY = int(M["m01"] / M["m00"])

    # draw the countour number on the image
    cv2.putText(image, "#{}".format(i + 1), (cX , cY), cv2.FONT_HERSHEY_SIMPLEX,
               1.0, (0, 0, 255), 2)

    # return the image with the contour number drawn on it
    return image

def croppingcontt(filename,bb,xx,yy,adjx,adjy):
    # load the image and initialize the accumulated edge image
    screenCnt = None
    screenCntrs = []
    d=cnts[bb]
    # approximate the contour
    peri = cv2.arcLength(d, True)
    approx = cv2.approxPolyDP(d, 0.01* peri, True)

    # if our approximated contour has four points, then
    # we can assume that we have found our screen
    if len(approx) == 4:
        screenCnt = approx

    cv2.drawContours(image, [screenCnt], -1, (0, 255, 0), 3)
    pts = screenCnt.reshape(4, 2)
    rect = np.zeros((4, 2), dtype = "float32")

    # the top-left point has the smallest sum whereas the
    # bottom-right has the largest sum
    s = pts.sum(axis = 1)
    rect[0] = pts[np.argmin(s)]
    rect[2] = pts[np.argmax(s)]

    # compute the difference between the points -- the top-right
    # will have the minumum difference and the bottom-left will
    # have the maximum difference
    diff = np.diff(pts, axis = 1)
    rect[1] = pts[np.argmin(diff)]
    rect[3] = pts[np.argmax(diff)]

    # now that we have our rectangle of points, let's compute

```

```

# the width of our new image
(tl, tr, br, bl) = rect
widthA = np.sqrt(((br[0] - bl[0]) ** 2) + ((br[1] - bl[1]) ** 2))
widthB = np.sqrt(((tr[0] - tl[0]) ** 2) + ((tr[1] - tl[1]) ** 2))

# ...and now for the height of our new image
heightA = np.sqrt(((tr[0] - br[0]) ** 2) + ((tr[1] - br[1]) ** 2))
heightB = np.sqrt(((tl[0] - bl[0]) ** 2) + ((tl[1] - bl[1]) ** 2))

# take the maximum of the width and height values to reach
# our final dimensions
maxWidth = max(int(widthA), int(widthB))
maxHeight = max(int(heightA), int(heightB))

# construct our destination points which will be used to
# map the screen to a top-down, "birds eye" view
dst = np.array([
    [0, 0],
    [maxWidth - 1, 0],
    [maxWidth - 1, maxHeight - 1],
    [0, maxHeight - 1]], dtype = "float32")

# calculate the perspective transform matrix and warp
# the perspective to grab the screen
M = cv2.getPerspectiveTransform(rect, dst)
warp = cv2.warpPerspective(orig, M, (maxWidth, maxHeight))
# convert the warped image to grayscale and then adjust
# the intensity of the pixels to have minimum and maximum
# values of 0 and 255, respectively
warp = cv2.cvtColor(warp, cv2.COLOR_BGR2GRAY)
cv2.imwrite(filename,warp)
im=cv2.imread(filename)
cropImageAndSave(xx,maxWidth-adjx,yy,maxHeight-adjy,im,filename)

def croppingcont(filename,bb,xx,yy,adjx,adjy):
    # load the image and initialize the accumulated edge image
    screenCnt = None
    d=cnts[bb]
    # approximate the contour
    peri = cv2.arcLength(d, True)
    approx = cv2.approxPolyDP(d, 0.01* peri, True)

    # if our approximated contour has four points, then
    # we can assume that we have found our screen
    if len(approx) == 4:
        screenCnt = approx

```

```

cv2.drawContours(image, [screenCnt], -1, (0, 255, 0), 3)
pts = screenCnt.reshape(4, 2)
rect = np.zeros((4, 2), dtype = "float32")

# the top-left point has the smallest sum whereas the
# bottom-right has the largest sum
s = pts.sum(axis = 1)
rect[0] = pts[np.argmin(s)]
rect[2] = pts[np.argmax(s)]

# compute the difference between the points -- the top-right
# will have the minimum difference and the bottom-left will
# have the maximum difference
diff = np.diff(pts, axis = 1)
rect[1] = pts[np.argmin(diff)]
rect[3] = pts[np.argmax(diff)]

# now that we have our rectangle of points, let's compute
# the width of our new image
(tl, tr, br, bl) = rect
widthA = np.sqrt(((br[0] - bl[0]) ** 2) + ((br[1] - bl[1]) ** 2))
widthB = np.sqrt(((tr[0] - tl[0]) ** 2) + ((tr[1] - tl[1]) ** 2))

# ...and now for the height of our new image
heightA = np.sqrt(((tr[0] - br[0]) ** 2) + ((tr[1] - br[1]) ** 2))
heightB = np.sqrt(((tl[0] - bl[0]) ** 2) + ((tl[1] - bl[1]) ** 2))

# take the maximum of the width and height values to reach
# our final dimensions
maxWidth = max(int(widthA), int(widthB))
maxHeight = max(int(heightA), int(heightB))

# construct our destination points which will be used to
# map the screen to a top-down, "birds eye" view
dst = np.array([
    [0, 0],
    [maxWidth - 1, 0],
    [maxWidth - 1, maxHeight - 1],
    [0, maxHeight - 1]], dtype = "float32")

# calculate the perspective transform matrix and warp
# the perspective to grab the screen
M = cv2.getPerspectiveTransform(rect, dst)
warp = cv2.warpPerspective(orig, M, (maxWidth, maxHeight))

```

```

# convert the warped image to grayscale and then adjust
# the intensity of the pixels to have minimum and maximum
# values of 0 and 255, respectively
warp = cv2.cvtColor(warp, cv2.COLOR_BGR2GRAY)
cv2.imwrite(filename,warp)
im=cv2.imread(filename)
cropImageAndSaveBinary(xx,maxWidth-adjx,yy,maxHeight-adjy,im,filename)

```

for cc in range(3,10):

```

i=cc+1
print (str(i)+" Reading the Image")
image = cv2.imread(str(i)+".jpg")

accumEdged = np.zeros(image.shape[:2], dtype="uint8")

# loop over the blue, green, and red channels, respectively
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
gray = cv2.bilateralFilter(gray, 11, 17, 17)
edged = cv2.Canny(gray, 30, 200)

(_, cnts, _) = cv2.findContours(edged.copy(),
cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
cnts = sorted(cnts, key=cv2.contourArea, reverse=True)[:10]
orig = image.copy()

(cnts, boundingBoxes) = sort_contours(cnts, method="right-to-left")

print ("Contour And Crop")

for a in range(5):
    croppingcontt("paraktis" + str(a)+ ".jpg",a,80,5,85,10)

print ("Cropping the Characters")
image = cv2.imread('paraktis4.jpg')

accumEdged = np.zeros(image.shape[:2], dtype="uint8")

# loop over the blue, green, and red channels, respectively
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
gray = cv2.bilateralFilter(gray, 11, 17, 17)
edged = cv2.Canny(gray, 30, 200)

(_, cnts, _) = cv2.findContours(edged.copy(),
cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)

```

```

cnts = sorted(cnts, key=cv2.contourArea, reverse=True)[:20]
orig = image.copy()

(cnts, boundingBoxes) = sort_contours(cnts, method="top-to-bottom")

for b in range(20):
    croppingcontt(str(i)+"_mc_" + str(b)+".jpg",b,10,10,20,20)
    cropconts(str(i)+"_mc_" + str(b))

image = cv2.imread("paraktis3.jpg")

accumEdged = np.zeros(image.shape[:2], dtype="uint8")

# loop over the blue, green, and red channels, respectively
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
gray = cv2.bilateralFilter(gray, 11, 17, 17)
edged = cv2.Canny(gray, 30, 200)

(_, cnts, _) = cv2.findContours(edged.copy(),
cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
cnts = sorted(cnts, key=cv2.contourArea, reverse=True)[:20]
orig = image.copy()

(cnts, boundingBoxes) = sort_contours(cnts, method="top-to-bottom")

for b in range(20):
    croppingcontt(str(i)+"_mc_" + str(20+b)+".jpg",b,7,7,15,13)
    cropconts(str(i)+"_mc_" + str(20+b))

image = cv2.imread("paraktis2.jpg")

accumEdged = np.zeros(image.shape[:2], dtype="uint8")

# loop over the blue, green, and red channels, respectively
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
gray = cv2.bilateralFilter(gray, 11, 17, 17)
edged = cv2.Canny(gray, 30, 200)

(_, cnts, _) = cv2.findContours(edged.copy(),
cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
cnts = sorted(cnts, key=cv2.contourArea, reverse=True)[:20]
orig = image.copy()

(cnts, boundingBoxes) = sort_contours(cnts, method="top-to-bottom")

```

```

for b in range(20):
    croppingcontt(str(i)+"_mc_" + str(40+b)+".jpg",b,7,7,15,13)
    cropconts(str(i)+"_mc_" + str(40+b))

image = cv2.imread("paraktis1.jpg")

accumEdged = np.zeros(image.shape[:2], dtype="uint8")

# loop over the blue, green, and red channels, respectively
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
gray = cv2.bilateralFilter(gray, 11, 17, 17)
edged = cv2.Canny(gray, 30, 200)

(_, cnts, _) = cv2.findContours(edged.copy(), cv2.RETR_EXTERNAL,
                                cv2.CHAIN_APPROX_SIMPLE)
cnts = sorted(cnts, key=cv2.contourArea, reverse=True)[:20]
orig = image.copy()

(cnts, boundingBoxes) = sort_contours(cnts, method="top-to-bottom")

for b in range(20):
    croppingcontt(str(i)+"_mc_" + str(60+b)+".jpg",b,7,7,15,13)
    cropconts(str(i)+"_mc_" + str(60+b))

image = cv2.imread("paraktis0.jpg")

accumEdged = np.zeros(image.shape[:2], dtype="uint8")

# loop over the blue, green, and red channels, respectively
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
gray = cv2.bilateralFilter(gray, 11, 17, 17)
edged = cv2.Canny(gray, 30, 200)

(_, cnts, _) = cv2.findContours(edged.copy(),
                                cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
cnts = sorted(cnts, key=cv2.contourArea, reverse=True)[:20]
orig = image.copy()

(cnts, boundingBoxes) = sort_contours(cnts, method="top-to-bottom")

for b in range(20):
    croppingcontt(str(i)+"_mc_" + str(80+b)+".jpg",b,7,7,15,13)
    cropconts(str(i)+"_mc_" + str(80+b))

```

### C. Training for Dataset

```
from sklearn.externals import joblib
from sklearn.svm import LinearSVC
import HOG
import dataset2
import cv2
import os
import sys
import argparse
from PIL import Image
from matplotlib import pyplot as plt
from sklearn.model_selection import train_test_split
import numpy as np

IMG_ROWS, IMG_COLS = 28, 28
INPUT_SHAPE = (1, IMG_ROWS, IMG_COLS)

np.random.seed(1983) # for reproducibility

def load_images_from_folders(folders, root_dir):
    print('Acquiring images...')
    images = []
    labels = []
    name_map = {}
    for folder in folders:
        b=0
        for filename in os.listdir(os.path.join(root_dir,folder)):
            if any([filename.endswith(x) for x in ['.jpeg', '.jpg','.pgm','png']]):
                img = cv2.imread(os.path.join(root_dir, folder, filename),
cv2.IMREAD_GRAYSCALE)
                if img is not None:
                    ret,thresh2 = cv2.threshold(img,127,255,cv2.THRESH_BINARY_INV)
                    image = cv2.resize(thresh2, (IMG_COLS, IMG_ROWS))
                    image = np.array(image, 'uint8')# convert to numpy array
                    images.append(image)
                    label = os.path.split(folder)[1].split("_")[1] # number from person_0_
                    labels.append(label)
                    name = os.path.split(folder)[1].split("_")[2]
                    name_map[label] = name
    return images, labels, name_map;

folders = [
    'character_0_A',
    'character_1_B',
    'character_2_C',
```

```
'character_3_D',
'character_4_E',
'character_5_F',
'character_6_G',
'character_7_H',
'character_8_I',
'character_9_J',
'character_10_K',
'character_11_L',
'character_12_M',
'character_13_N',
'character_14_O',
'character_15_P',
'character_16_Q',
'character_17_R',
'character_18_S',
'character_19_T',
'character_20_U',
'character_21_V',
'character_22_W',
'character_23_X',
'character_24_Y',
'character_25_Z',
```

```
]
```

```
root_dir = r'C:\Users\testpaperchecker01\Desktop\HOG\dataset'
```

```
#name_map = { }
```

```
(images, labels, name_map) = load_images_from_folders(folders, root_dir)
```

```
print('No. of images = %s.' % len(images))
```

```
print('No. of labels = %s.' % len(labels))
```

```
print(labels[0])
```

```
for bb in range(5):
```

```
    print('name_map['+str(bb)+ '] = %s.' % name_map[str(bb)] )
```

```
# Convert to NumPy array
```

```
digits= np.array(images)
```

```
target= np.array(labels)
```

```
data = []

hog = HOG.HOG(orientations = 18, pixelsPerCell = (10, 10), cellsPerBlock = (1, 1),
transform = True)

for image in digits:
    image = dataset2.deskew(image, 20)
    image = dataset2.center_extent(image, (20, 20))

    hist = hog.describe(image)
    data.append(hist)

model = LinearSVC(random_state = 42)
model.fit(data, target)

joblib.dump(model, "ALPHATUP2.cpickle")
```

## D. Graphical User Interface (GUI)

- **Checking of Answer Sheet**

```
Private Sub Analyze()
    Dim rs As New ADODB.Recordset
    Dim cnt As Integer
    cnt = 0

    subject = GetSingleRec("Subject", "Code", txtSc, "Subject")
    studname = GetSingleRec("Student", "ID", txtIDno, "Name")
    Section = GetSingleRec("Student", "ID", txtIDno, "Sec")
    ic = GetSingleRec("InstructorCode", "IC", txtIR, "Name")
    If Dialog.Label1.Caption = "Set A" Then
        setno = "A"
    Else
        setno = "B"
    End If
    rs.Open "select * from Answer where SetAB ='" & setno & "' ORDER by
    ItemNumber", conn, adOpenStatic, adLockOptimistic
    If rs.RecordCount <> 0 Then
        For a = 0 To rs.RecordCount - 1
            If Val(rs!ItemNumber) = a + 1 Then
                If rs!Answer = txtAnswer(a).Text Then
                    txtAnswer(a).ForeColor = vbBlue
                    cnt = cnt + 1
                Else
                    txtAnswer(a).ForeColor = vbRed
                End If
            Else
                MsgBox "check ItemNumber " & a & " for " & rs!subject
            End If
            rs.MoveNext
        Next
    End If

    txtResult = "Results:" & vbCrLf & "Name : " & studname & vbCrLf &
    "Section : " & Section & vbCrLf & "Subject : " & subject & vbCrLf & "Instructor
    : " & ic & vbCrLf & "Score : " & cnt & vbCrLf & "Set : " & setno

    frmmain.printResult "Results:" & vbCrLf & "Name : " & studname & vbCrLf &
    "Section : " & Section & vbCrLf
    Msec 1000
    frmmain.printResult "Subject : " & subject & vbCrLf
    Msec 1000
    frmmain.printResult "Instructor : " & ic & vbCrLf & "Score : " & cnt & vbCrLf &
    "Set : " & setno & vbCrLf & vbCrLf & vbCrLf & vbCrLf & vbCrLf
    Msec 1000
```

```

    AddStudentScore (cnt)
End Sub
Function rep(str As Variant) As String
    rep = Replace(str, Chr(10), "")
    rep = Replace(rep, Chr(13), "")
End Function
Private Sub AnalyzeNow()
    ID = getFileStr(App.Path & "\HOG\id0.txt")
    ic = frmuser.txtuser.Text
    sc = frmuser.txtsubject.Text
    sec = getFileStr(App.Path & "\HOG\sec2.txt")

    txtIDno = rep(ID)
    txtIR = rep(ic)
    txtIR = Replace(txtIR, "O", "0")
    txtSc = rep(sc)
    txtSection = GetSingleRec("Student", "ID", txtIDno, "Sec")
    txtSc = Replace(txtSc, "Z", "2")

    ans = rep(getFileStr(App.Path & "\HOG\pra0.txt"))
    txtAnswer(0).Text = ans
    For a = 0 To 18
        ans = getFileStr(App.Path & "\HOG\pro" & a & ".txt")
        txtAnswer(a + 1).Text = rep(ans)
    Next

    B = 20
    For a = 0 To 99
        ans = getFileStr(App.Path & "\HOG\mc" & a & ".txt")
        txtAnswer(B + a).Text = rep(ans)
    Next

End Sub

Private Sub AddAnalyzer()
Dim rs As New ADODB.Recordset
    For a = 1 To 120
        rs.Open "select * from Analyzer", conn, adOpenStatic, adLockOptimistic
        rs.AddNew
        rs!Code = txtSc
        rs!ItemNumber = a
        If txtAnswer(a - 1).ForeColor = vbBlue Then
            rs!Mark = "1"
        Else
            rs!Mark = "0"
        End If
    Next

```

```

        rs.Update
        rs.Close
    Next
End Sub

Private Sub IndvualChecking()
Const SCANNER = "E:\DCIM\IRIS_IS1"
'Analyze 'for test only

    If Dir(App.Path & "\HOG\pra0.txt") <> "" Then Kill App.Path &
"\HOG\pra0.txt"
        ChDir App.Path & "\VB_pythonChecker\
        If Dir(App.Path & "\HOG\pra0.jpg") <> "" Then Kill App.Path &
"\HOG\pra0.jpg"
            ChDir App.Path & "\VB_pythonChecker\
            For a = 0 To 99
                If Dir(App.Path & "\HOG\mc" & a & ".txt") <> "" Then Kill App.Path &
"\HOG\mc" & a & ".txt"
                    ChDir App.Path & "\VB_pythonChecker\
                    Next
                    For a = 0 To 99
                        If Dir(App.Path & "\HOG\mc" & a & ".jpg") <> "" Then Kill App.Path &
"\HOG\mc" & a & ".jpg"
                            ChDir App.Path & "\VB_pythonChecker\
                            Next
                            For a = 0 To 18
                                If Dir(App.Path & "\HOG\pro" & a & ".txt") <> "" Then Kill App.Path &
"\HOG\pro" & a & ".txt"
                                    ChDir App.Path & "\VB_pythonChecker\
                                    Next
                                    For a = 0 To 18
                                        If Dir(App.Path & "\HOG\pro" & a & ".jpg") <> "" Then Kill App.Path &
"\HOG\pro" & a & ".jpg"
                                            ChDir App.Path & "\VB_pythonChecker\
                                            Next
                                            x = Dir(SCANNER & "\")
                                            Do While (x <> "")
                                                If Dir(App.Path & "\img_0043.jpg") <> "" Then Kill App.Path &
"\img_0043.jpg"
                                                    FileCopy SCANNER & "\" & x, App.Path & "\img_0043.jpg"
                                                    Kill SCANNER & "\" & x
                                                    MsgBox ("Proceed to ICR")
                                                    Shell "explorer " & App.Path & "\Checker.py", vbNormalFocus
                                                Do While (1)
                                                    If Dir(App.Path & "\HOG\pro18.txt") <> "" Then Exit Do
                                                    DoEvents

```

```

        Loop
        Me.Caption = "Analyze"
        AnalyzeNow
        x = Dir(SCANNER)

    Loop
End Sub
Private Sub IndvualChecking2()
    Analyze
    AddAnalyzer
    MsgBox ("NEXT ANSWER SHEET")
    cleartextbox

End Sub

Private Sub AddStudentScore(cnt As Integer)
Dim rs As New ADODB.Recordset

    studname = GetSingleRec("Student", "ID", txtIDno, "Name")
    ID = GetSingleRec("Student", "ID", txtIDno, "ID")
    Section = GetSingleRec("Student", "ID", txtIDno, "Sec")

    ScoreStud = CStr(cnt)
    rs.Open "select * from StudentHistory", conn, adOpenStatic, adLockOptimistic
    rs.AddNew
    rs!Name = studname
    rs!ID = ID
    rs!Section = Section
    rs!Code = txtSc
    rs!Score = ScoreStud
    rs.Update
    rs.Close

End Sub

Private Sub cleartextbox()
    Dialog.Label1.Caption = "Set"
    txtSc = ""
    txtSection = ""
    txtIR = ""
    txtResult = "Result"
    txtIDno = ""

    ans = ""
    txtAnswer(0).Text = ans

```

```
For a = 0 To 18
    ans = ""
    txtAnswer(a + 1).Text = rep(ans)
Next
```

```
B = 20
For a = 0 To 99
    ans = ""
    txtAnswer(B + a).Text = rep(ans)
Next
```

End Sub

- **Item Analysis**

```
Private Sub Analyzer(sc As String)
Dim rs As New ADODB.Recordset
Dim rs2 As New ADODB.Recordset

rs2.Open "select * from AnalyzerBuf", conn, adOpenStatic, adLockOptimistic
For c = 1 To rs2.RecordCount
    rs2.Delete
    rs2.MoveNext
Next
rs2.Close
For a = 1 To 120
    rs.Open "select * from Analyzer where Code=''" & sc & "" and
    ItemNumber=''' & a & "", conn, adOpenStatic, adLockOptimistic
    If rs.RecordCount = 0 Then Exit Sub 'No Records yet
    cnt = 0
    Dim rs_RecordCount As Integer
    rs_RecordCount = rs.RecordCount
    For B = 1 To rs.RecordCount
        If rs!Mark = "0" Then
            cnt = cnt + 1
        End If
        rs.MoveNext
    Next
    rs.Close
    rs2.Open "select * from AnalyzerBuf", conn, adOpenStatic,
    adLockOptimistic
    rs2.AddNew
    rs2!ItemNumber = a
    rs2!difficulties = 100 - (FormatNumber((cnt / rs_RecordCount)) * 100)
    rs2!Score = cnt
```

```

        rs2.Update
        rs2.Close
    Next
End Sub

Private Sub Command1_Click()
Dim rs As New ADODB.Recordset
    Analyzer Combo1.Text
    If Check1.Value = 1 Then
        rs.Open "select * from AnalyzerBuf ORDER BY ItemNumber DESC", conn,
adOpenStatic, adLockOptimistic
    Else
        rs.Open "select * from AnalyzerBuf ORDER BY ItemNumber ASC", conn,
adOpenStatic, adLockOptimistic
    End If
    Set DataGrid1.DataSource = rs
    Label1 = GetSingleRec("Subject", "Code", Combo1, "Subject")
End Sub

Private Sub Command2_Click()
    frmmain.Show
    Unload Me

End Sub

Private Sub Form_Load()
    populateCbo Combo1, "Subject", "Code"
End Sub

```

- **Main**

```

Dim cmd_serOnline As New cls_Parser
Dim cmd_ser As New cls_Parser
Dim online As Integer

```

```

Public Sub printResult(str As String)
    MSComm1.Output = str
End Sub

```

```

Private Sub Command1_Click()
    frmuser.txtuser.Text = ""
    frmuser.txtsubject.Text = ""
    frmuser.txtpassword.Text = ""
    'Me.Hide

```

```

Unload Me
frmuser.Show

End Sub

Private Sub Form_Load()
Dim createconn As New dsnCREATE
    createconn.Test "Database", "database"
    Set createconn = Nothing
    Connect
    'ConnectMySql "dblasalle"
    MSComm1.RThreshold = 1
    MSComm1.PortOpen = True

    cmd_serOnline.Header "WTA_ONLINE", Chr(13)
    cmd_ser.Header "WTA", Chr(13)
End Sub

```

```

Private Sub MSComm1_OnComm()
    Dim str As String
    str = MSComm1.Input
    Do While (True)

        'code part cmd_ser
        If cmd_ser.Pool(str) = True Then
            Me.Caption = Len(cmd_ser.Databuffer) & " " & cmd_ser.Databuffer
            'str1 = getCSV(0, ",", cmd_ser.Databuffer) 'this doesnt include header

        End If
        'code part cmd_ser

        'code part cmd_ser
        If cmd_serOnline.Pool(str) = True Then
            online = 5
        End If
        'code part cmd_ser

        str = ""                      'dont modify this part
        If cmd_ser.HasRemainingData = False Then Exit Do  'dont modify this part
        Loop
    End Sub

```

```

Private Sub Timer1_Timer()
    If online <> 0 Then
        online = online - 1
        lblOnline = "Status : Connected"
        lblOnline.ForeColor = lblOnline.ForeColor Xor vbBlue

    End If
    If online = 0 Then
        'MSComm1.Output = "WTA_ONLINE" & Chr(13)
        lblOnline = "Status : Offline"
        'lblOnline.ForeColor = vbBlack
    End If
End Sub
'PlayAudio App.Path & "\audio.wav"
Private Sub PlayAudio(str As String)
    MMControl1.FileName = str
    MMControl1.Command = "Close"
    MMControl1.Wait = True
    MMControl1.Command = "Open"
    MMControl1.Wait = False
    MMControl1.Command = "Play"
End Sub
Private Sub Command2_Click()

    frmAnalyzer.Show
    frmmain.Hide
End Sub

```

```

Private Sub Command4_Click()
    frmAnswerSheet.Show
    frmmain.Hide
End Sub

```

- **User Log-in**
- ```

Dim ok As Boolean
Private Sub Form_Load()
    txtpassword.PasswordChar = "*"
Dim createconn As New dsnCREATE
    createconn.Test "Database", "database"
    Set createconn = Nothing
    Connect
End Sub

```

```

Private Sub Form_Unload(Cancel As Integer)
    If ok = False Then End

```

```
End Sub

Private Sub txtpassword_KeyPress(KeyAscii As Integer)
    If KeyAscii = 13 Then
        If GetSingleRec("InstructorCode", "password", txtpassword, "IC") = txtuser
Then
            userName = GetSingleRec("InstructorCode", "password", txtpassword,
"Name")
            ok = True
            frmuser.Hide
            frmmain.Show
        End If
    End If

End Sub
```

## E. Cropping and ICR

```
# import the necessary packages
import numpy as np
import argparse
import cv2
from PIL import Image
import os
path=os.path.dirname(os.path.realpath(__file__))
path2=os.path.dirname(os.path.realpath(__file__)) + "\\HOG"
from sklearn.externals import joblib
import HOG
import dataset
import argparse
import mahotas
import cv2
import numpy as np

def name_map(digits):
    string=""
    if digits=='0':
        string="A"
    elif digits=='1':
        string="B"
    elif digits=='2':
        string="C"
    elif digits=='3':
        string="D"
    elif digits=='4':
        string="E"
    elif digits=='5':
        string="F"
    elif digits=='6':
        string="G"
    elif digits=='7':
        string="H"
    elif digits=='8':
        string="I"
    elif digits=='9':
        string="J"
    elif digits=='10':
        string="K"
    elif digits=='11':
        string="L"
    elif digits=='12':
        string="M"
```

```

        elif digits=='13':
            string="N"
        elif digits=='14':
            string="O"
        elif digits=='15':
            string="P"
        elif digits=='16':
            string="Q"
        elif digits=='17':
            string="R"
        elif digits=='18':
            string="S"
        elif digits=='19':
            string="T"
        elif digits=='20':
            string="U"
        elif digits=='21':
            string="V"
        elif digits=='22':
            string="W"
        elif digits=='23':
            string="X"
        elif digits=='24':
            string="Y"
        elif digits=='25':
            string="Z"
        return string

def recognizeletters(model,img,filename):

    model = joblib.load(model)

    hog = HOG.HOG(orientations = 18, pixelsPerCell = (10, 10),cellsPerBlock = (1, 1),
transform = True)

    image = cv2.imread(img)
    gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

    blurred = cv2.GaussianBlur(gray, (5, 5), 0)
    edged = cv2.Canny(blurred, 30, 150)
    (_, cnts, _) = cv2.findContours(edged.copy(),
cv2.RETR_EXTERNAL,cv2.CHAIN_APPROX_SIMPLE)

    cnts = sorted([(c, cv2.boundingRect(c)[0]) for c in cnts], key =lambda x: x[1])

```

```

b=0
for (c,_) in cnts:
    (x, y, w, h) = cv2.boundingRect(c)

    if w >= 7 and h >= 30:
        roi = gray[y:y + h, x:x + w]
        thresh = roi.copy()
        T = mahotas.thresholding.otsu(roi)
        thresh[thresh > T] = 255
        thresh = cv2.bitwise_not(thresh)

        thresh = dataset.deskew(thresh, 20)
        thresh = dataset.center_extent(thresh, (20, 20))

        hist = hog.describe(thresh)
        digit = model.predict([hist])[0]
        stringc= name_map(digit)
        b=b+1
        globals()['string%s' % b] = stringc

string=""

if b==1:
    string= globals()['string%s' % b]
elif b>1:
    for v in range(b):
        nn=v+1
        string += globals()['string%s' % nn]
else:
    string=""

text_file = open(filename, "w")

text_file.write(string)

text_file.close()
print(filename)

def getFirstFromLeftToRight(img,x1,y1):
    x=-1
    y=-1
    for xx1 in range(x1,image.shape[1]):
        #print image[a][b]      # output=[255,255,255]
        if image[y1][xx1][2]<200:

```

```

x=xx1
y=y1
break
return x,y

def getFirstFromTopToBottom(img,x1,y1):
    x=-1
    y=-1
    for yy1 in range(y1,image.shape[0]):
        #print image[a][b]      # output=[255,255,255]
        if image[yy1][x1][2]<200:
            x=x1
            y=yy1
            break
    return x,y

def recognizeA2E(model,img,filename):

    model = joblib.load(model)

    hog = HOG.HOG(orientations = 18, pixelsPerCell = (10, 10),cellsPerBlock = (1, 1),
transform = True)

    image = cv2.imread(img)
    #ww=image.shape[0]*(2)
    #hh=image.shape[1]*(2)
    #image = cv2.resize(image, (int(hh), int(ww)))
    gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

    blurred = cv2.GaussianBlur(gray, (5, 5), 0)
    edged = cv2.Canny(blurred, 30, 150)
    (_, cnts, _) = cv2.findContours(edged.copy(),
cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)

    cnts = sorted([(c, cv2.boundingRect(c)[0]) for c in cnts], key =lambda x: x[1])

    b=0
    for (c,_) in cnts:
        #(x, y, w, h) = cv2.boundingRect(c)
        x=0
        y=0
        h=image.shape[0]
        w=image.shape[1]
        if w >= 7 and h >= 30:
            roi = gray[y:y + h, x:x + w]

```

```

thresh = roi.copy()
T = mahotas.thresholding.otsu(roi)
thresh[thresh > T] = 255
thresh = cv2.bitwise_not(thresh)

thresh = dataset.deskew(thresh, 20)
thresh = dataset.center_extent(thresh, (20, 20))

hist = hog.describe(thresh)
digit = model.predict([hist])[0]
stringc= name_map(digit)
b=b+1
globals()['string%s' % b] = stringc

#cv2.rectangle(image, (x, y), (x + w, y + h), (0, 255, 0), 1)
#cv2.putText(image, stringc, (x + 10, y +30), cv2.FONT_HERSHEY_SIMPLEX,
1.2, (0, 255, 0), 2)
#cv2.imshow("image", image)
#cv2.waitKey(0)

string=""
n=len(cnts)
if n==1:
    string= globals()['string%s' % n]
elif n>1:
    string= globals()['string%s' % 1]

text_file = open(filename, "w")

text_file.write(string)

text_file.close()
print(filename)

def recognize(model,img,filename):

    model = joblib.load(model)

    hog = HOG.HOG(orientations = 18, pixelsPerCell = (10, 10),cellsPerBlock = (1, 1),
transform = True)

    image = cv2.imread(img)
    gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

    blurred = cv2.GaussianBlur(gray, (5, 5), 0)

```

```

edged = cv2.Canny(blurred, 30, 150)
(_, cnts, _) = cv2.findContours(edged.copy(),
cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)

cnts = sorted([(c, cv2.boundingRect(c)[0]) for c in cnts], key =lambda x: x[1])

b=0
for (c,_) in cnts:
    (x, y, w, h) = cv2.boundingRect(c)

    if w >= 7 and h >= 30:
        roi = gray[y:y + h, x:x + w]
        thresh = roi.copy()
        T = mahotas.thresholding.otsu(roi)
        thresh[thresh > T] = 255
        thresh = cv2.bitwise_not(thresh)

        thresh = dataset.deskew(thresh, 20)
        thresh = dataset.center_extent(thresh, (20, 20))

        hist = hog.describe(thresh)
        digit = model.predict([hist])[0]
        b=b+1
        globals()['string%s' % b] = format(digit)

string=""

if b==1:
    string= globals()['string%s' % b]
elif b>1:
    for v in range(b):

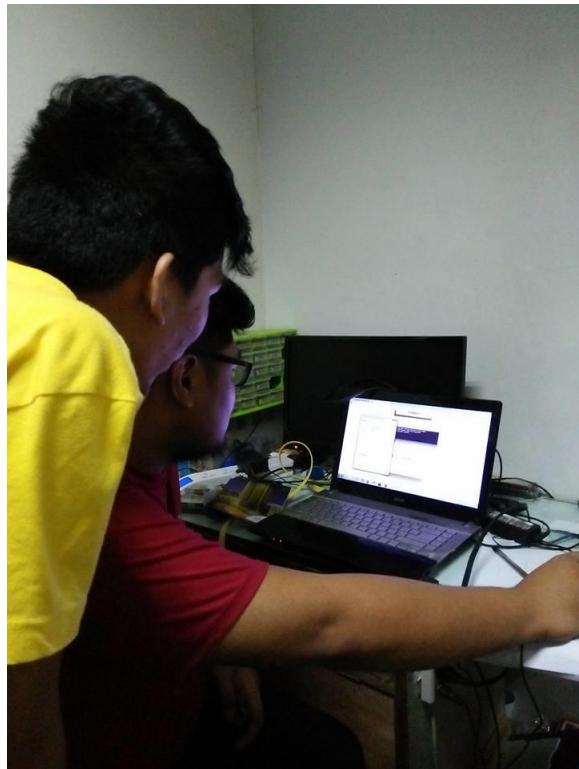
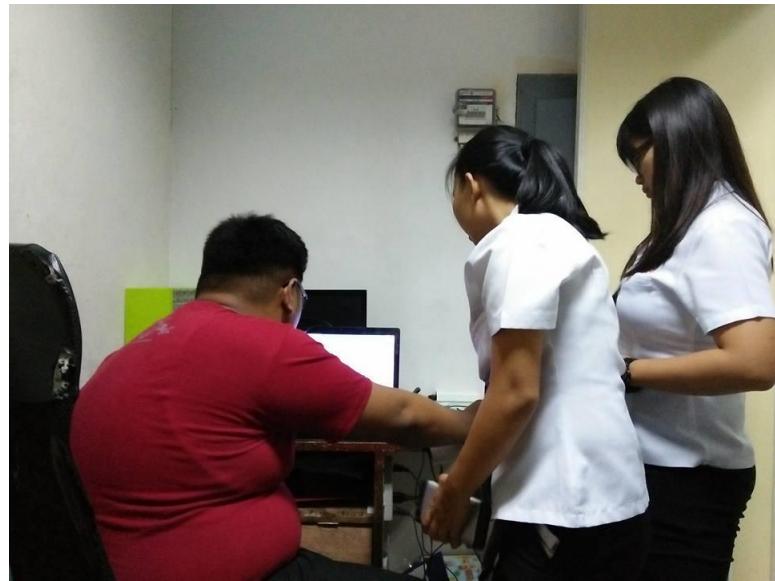
end

```

# **APPENDIX E**

## **Documentation**

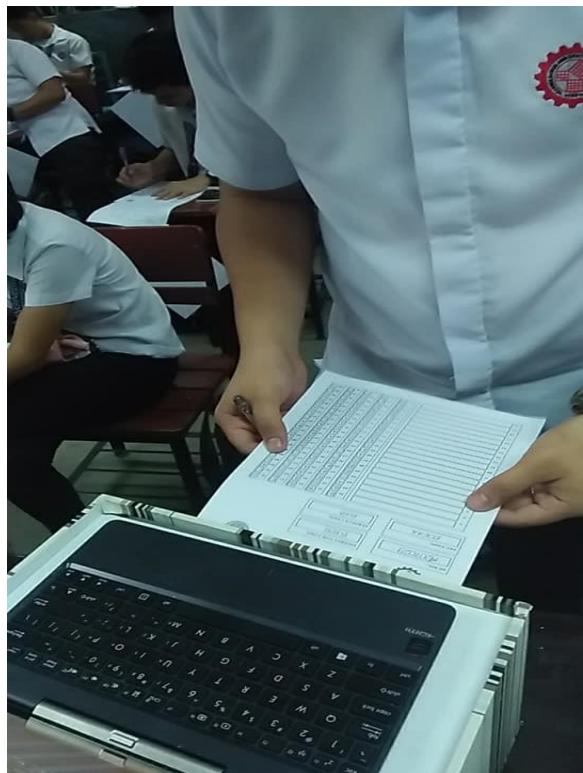
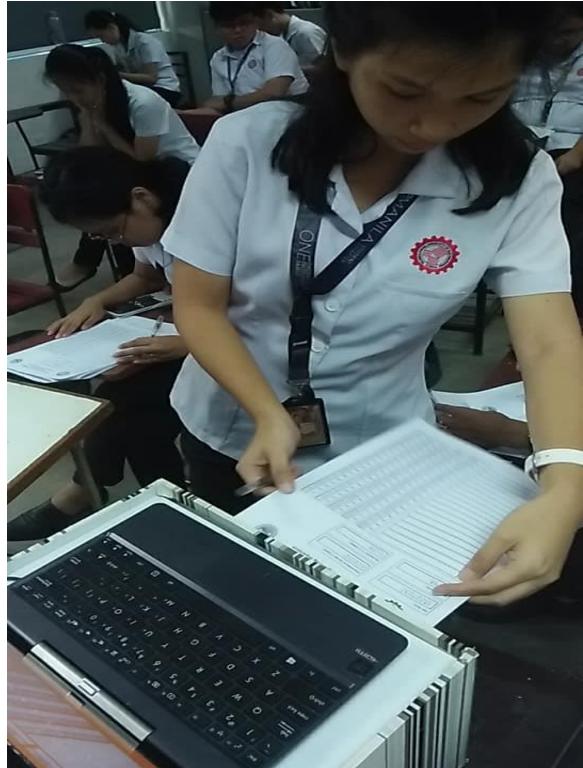
## Program Preparations



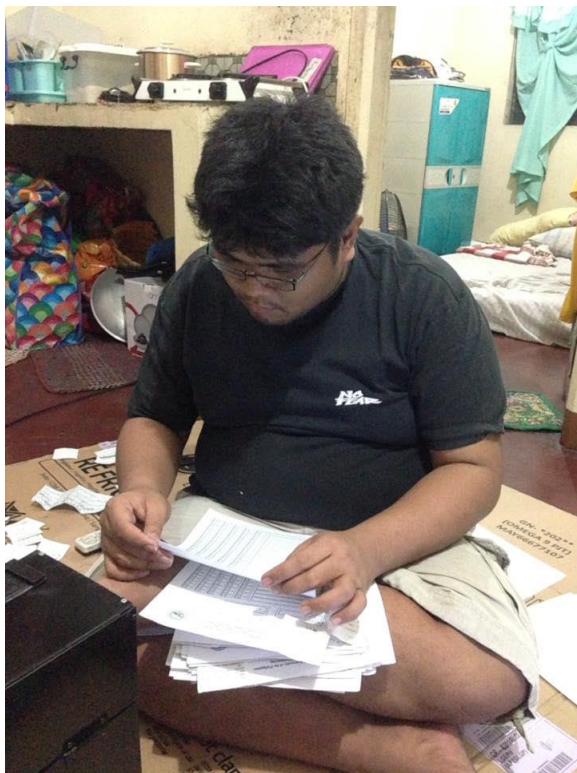
## Data Sets Gathering



## Deployment



## Data Gathering



### Testing During Final Defense



## **APPENDIX F**

### **Answer Sheet**



Technological University of the Philippines  
College of Engineering  
Electronics Engineering Department



|         |  |
|---------|--|
| ID NO.: |  |
|---------|--|

|                  |  |
|------------------|--|
| INSTRUCTOR CODE: |  |
|------------------|--|

|          |  |
|----------|--|
| SECTION: |  |
|----------|--|

|               |  |
|---------------|--|
| SUBJECT CODE: |  |
|---------------|--|

|    |  |
|----|--|
| 1  |  |
| 2  |  |
| 3  |  |
| 4  |  |
| 5  |  |
| 6  |  |
| 7  |  |
| 8  |  |
| 9  |  |
| 10 |  |
| 11 |  |
| 12 |  |
| 13 |  |
| 14 |  |
| 15 |  |
| 16 |  |
| 17 |  |
| 18 |  |
| 19 |  |
| 20 |  |

|    |  |    |  |    |  |    |  |     |  |
|----|--|----|--|----|--|----|--|-----|--|
| 01 |  | 21 |  | 41 |  | 61 |  | 81  |  |
| 02 |  | 22 |  | 42 |  | 62 |  | 82  |  |
| 03 |  | 23 |  | 43 |  | 63 |  | 83  |  |
| 04 |  | 24 |  | 44 |  | 64 |  | 84  |  |
| 05 |  | 25 |  | 45 |  | 65 |  | 85  |  |
| 06 |  | 26 |  | 46 |  | 66 |  | 86  |  |
| 07 |  | 27 |  | 47 |  | 67 |  | 87  |  |
| 08 |  | 28 |  | 48 |  | 68 |  | 88  |  |
| 09 |  | 29 |  | 49 |  | 69 |  | 89  |  |
| 10 |  | 30 |  | 50 |  | 70 |  | 90  |  |
| 11 |  | 31 |  | 51 |  | 71 |  | 91  |  |
| 12 |  | 32 |  | 52 |  | 72 |  | 92  |  |
| 13 |  | 33 |  | 53 |  | 73 |  | 93  |  |
| 14 |  | 34 |  | 54 |  | 74 |  | 94  |  |
| 15 |  | 35 |  | 55 |  | 75 |  | 95  |  |
| 16 |  | 36 |  | 56 |  | 76 |  | 96  |  |
| 17 |  | 37 |  | 57 |  | 77 |  | 97  |  |
| 18 |  | 38 |  | 58 |  | 78 |  | 98  |  |
| 19 |  | 39 |  | 59 |  | 79 |  | 99  |  |
| 20 |  | 40 |  | 60 |  | 80 |  | 100 |  |

## **APPENDIX G**

### **Proponents Profile**

## **JOIE ANN C. ALAYON**

85 Orchid St. Bernabe Subd. Phase 2 San Dionisio, Parañaque City

Contact No.: +63 935 3865588

Email: [joiealayon@gmail.com](mailto:joiealayon@gmail.com)



---

### **OBJECTIVE:**

To continue to grow in leadership and knowledge regarding technical skills related to electronic aspects, to interact and know how to deal to the people around and to apply what I have learned.

---

### **EDUCATIONAL BACKGROUND:**

|                  |                      |                                                                                                                                       |
|------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>TERTIARY</b>  | <b>2012- present</b> | <b>Technological University of the Philippines</b><br>Bachelor of Science in Electronics Engineering<br>Ayala., Blvd., Ermita, Manila |
| <b>SECONDARY</b> | <b>2008-2011</b>     | <b>Parañaque National High School – Main</b><br>Kay Talise St. Dr. A. Santos Ave. Parañaque City                                      |
| <b>PRIMARY</b>   | <b>2002-2008</b>     | <b>Parañaque Elementary School Central</b><br>Kabighasan, San Dionisio, Parañaque City                                                |

### **SEMINARS ATTENDED:**

- “SYNERGY: Electrical and Electronics Engineering Summit 2017 - Techno Talk”  
University of the Philippines - Diliman  
November 2017
- “SYNERGY: Electrical and Electronics Engineering Summit 2017 – Ingenious Idea”  
University of the Philippines - Diliman  
November 2017
- “Introduction to Data Science”  
Vista Verde Hotel & Resort, Pampanga  
January 2018

### **AFFILIATIONS:**

- Organization of Electronics Engineering Students  
Member (2012 - Present)
- Institute of Electronics Engineering of the Philippines – Student Chapter  
Member (2017 - Present)

**ON-THE-JOB TRAINING:**

- **TRACE ALARM & SECURITY SYSTEMS, INC.**

Shop Personnel (240HRS)

April 2017 – May 2017

**SKILLS:****Personal**

Highly organized and efficient in fast-paced multitasking environment; able to prioritize effectively to accomplish objectives with creativity and enthusiasm

**Technical**

- Proficient with Microsoft Office (MS Word, PowerPoint)
- Proficient with Electronic Workbenches (Multisim, Circuit Wizard)
- Proficient with Internet
- Familiar with electronics tools

**PERSONAL DATA:**

|                     |   |                  |
|---------------------|---|------------------|
| <b>Age</b>          | : | 21 years old     |
| <b>Birth date</b>   | : | January 29, 1996 |
| <b>Birth Place</b>  | : | Taguig City      |
| <b>Religion</b>     | : | Roman Catholic   |
| <b>Height</b>       | : | 150 cm           |
| <b>Weight</b>       | : | 47 kg            |
| <b>Civil Status</b> | : | Single           |
| <b>Citizenship</b>  | : | Filipino         |

**CHARACTER REFERENCES:****THELMA B. MAYUGA**

HRD Staff

United Power Systems Philippines Inc.

+63 9275455770

*I hereby certify that above information is true and correct to the best of my knowledge*

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**JOIE ANN C. ALAYON**

Applicant

# **ANTHONY ALDRIN V. BELTRAN**

1772 Putohan St. Pasay City  
Contact No.: +63 926 997 7973  
Email: aa.beltran0321@gmail.com8



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## **OBJECTIVE:**

I am seeking for a company where I can apply my knowledge that can contribute for your company success.

---

## **EDUCATIONAL BACKGROUND:**

|                  |                      |                                                                                                                                       |
|------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>TERTIARY</b>  | <b>2012- present</b> | <b>Technological University of the Philippines</b><br>Bachelor of Science in Electronics Engineering<br>Ayala., Blvd., Ermita, Manila |
| <b>SECONDARY</b> | <b>2008-2012</b>     | <b>Pasay City Science High School</b><br>2888 P. Vergel St. Pasay City                                                                |
| <b>PRIMARY</b>   | <b>2002-2008</b>     | <b>Rafael Palma Elementary School</b><br>Dominga St. Pasay City                                                                       |

## **AFFILIATIONS:**

- Organization of Electronics Engineering Students  
Member (2012 – Present)

## **WORK EXPERIENCE:**

- **INKTECH PISO PRINT**  
Taft Avenue, Malate, Manila  
Service Crew FEBRUARY 1, 2015- APRIL 30, 2015

## **ON-THE-JOB TRAINING**

- **WIRE THE MALL Co.**  
System Developer Trainee (240HRS) NOV – DEC 2017

## **SKILLS:**

- Knowledgeable in Application Software such as: MS WORD, MS EXCEL, MS POWERPOINT, Adobe Photoshop, and AUTOCAD.
- Knowledgeable in Computer Programming such as: Arduino, MATLAB, JAVA, and Visual Basic.

- I possess good communication skill.

**PERSONAL DATA:**

|                     |   |                      |
|---------------------|---|----------------------|
| <b>Age</b>          | : | 20 years old         |
| <b>Birth date</b>   | : | August 3, 1996       |
| <b>Birth Place</b>  | : | Pasay, City          |
| <b>Religion</b>     | : | Born-Again Christian |
| <b>Height</b>       | : | 178 cm               |
| <b>Weight</b>       | : | 116 kg               |
| <b>Civil Status</b> | : | Single               |
| <b>Citizenship</b>  | : | Filipino             |

**CHARACTER REFERENCES:**

**DR. MARIO REGINO M. NORBE**

Technological University of the Philippines  
 Ayala. Blvd., Ermita, Manila  
 College Professor  
 +63 9199100533

**ENGR. MARY GRACE C. BAUTISTA**

Technological University of the Philippines  
 Ayala. Blvd., Ermita, Manila  
 College Professor  
 +639194571092

*I hereby certify that above information is true and correct to the best of my knowledge*

---

**ANTHONY ALDRIN V. BELTRAN**

Applicant

## **PAUL EDGAR B. MARANAN**

065 Salvador St, Baesa Rd, Caloocan City

Contact No.: +639277293583

Email: [pauledgarmaranan@yahoo.com](mailto:pauledgarmaranan@yahoo.com)



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### **OBJECTIVE:**

To work as an effective electronics engineer in your company, in order to apply, share my skills and learning to develop products in pursuing excellence and global competitiveness.

---

### **EDUCATIONAL BACKGROUND:**

|                  |                      |                                                                                                                                       |
|------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>TERTIARY</b>  | <b>2014- present</b> | <b>Technological University of the Philippines</b><br>Bachelor of Science in Electronics Engineering<br>Ayala., Blvd., Ermita, Manila |
|                  | <b>2011-2014</b>     | <b>Technological University of the Philippines</b><br>Electronics Engineering Technology<br>Ayala., Blvd., Ermita, Manila             |
| <b>SECONDARY</b> | <b>2007-2011</b>     | <b>Occidental Mindoro National High School</b><br>Mamburao, Occidental Mindoro                                                        |

### **AFFILIATIONS:**

- Organization of Electronics Engineering Students  
Member (2012 – Present)

### **SEMINARS ATTENDED:**

- *"Calculator Technique for ECE Board Exam"*  
Technological University of the Philippines – Manila  
November 2016
- *"Ureka E-Cadets Training"*  
SM Megatrade Conference Center Function Rooms A and B, 5<sup>th</sup> floor  
SM Megamall Building B  
November 2016

## **ON-THE-JOB TRAINING**

- **ADVANTIX Marketing - XENON**  
Service Technician (720 HRS) OCTOBER 2013 – MARCH 2014
- **UITC – TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES – MANILA**  
Network Engineer Trainee (240 HRS) APRIL – JUNE 2017

## **SKILLS:**

- Oriented in Microsoft Office (Excel, Word, PowerPoint)
- Electronic Workbenches (MultiSim, DipTrace)
- Computer aided design (AutoCAD)
- Familiar with Electronic tools
- Hardware Troubleshooting

## **PERSONAL DATA:**

|                     |   |                              |
|---------------------|---|------------------------------|
| <b>Age</b>          | : | 22 years old                 |
| <b>Birth date</b>   | : | October 16, 1994             |
| <b>Birth Place</b>  | : | Mamburao, Occidental Mindoro |
| <b>Religion</b>     | : | Roman Catholic               |
| <b>Height</b>       | : | 160 cm                       |
| <b>Weight</b>       | : | 44 kg                        |
| <b>Civil Status</b> | : | Single                       |
| <b>Citizenship</b>  | : | Filipino                     |

## **CHARACTER REFERENCES:**

**ENGR. MARY GRACE C. BAUTISTA**  
Technological University of the Philippines  
Ayala. Blvd., Ermita, Manila  
College Professor  
+639194571092

*I hereby certify that above information is true and correct to the best of my knowledge*

---

**PAUL EDGAR B. MARANAN**  
Applicant

# **CHEZA MARIE A. MASCARDO**

070 Paliparan II, City of Dasmariñas, Cavite

Contact No.: +6309065793028

Email: [chezamascardo@gmail.com](mailto:chezamascardo@gmail.com)



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## **OBJECTIVE:**

To work as an effective electronics engineer in your company, in order to apply, share my skills and learning to develop products in pursuing excellence and global competitiveness.

---

## **EDUCATIONAL BACKGROUND:**

|                  |                      |                                                                                                                                       |
|------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>TERTIARY</b>  | <b>2014- present</b> | <b>Technological University of the Philippines</b><br>Bachelor of Science in Electronics Engineering<br>Ayala., Blvd., Ermita, Manila |
|                  | <b>2011-2014</b>     | <b>Technological University of the Philippines</b><br>Electronics Engineering Technology<br>Salawag, City of Dasmariñas, Cavite       |
| <b>SECONDARY</b> | <b>2007-2011</b>     | <b>Mahonri Academy and Science High School</b><br>Phase 3, Mabuhay Homes 2000,<br>Paliparan II, City of Dasmariñas, Cavite            |
| <b>PRIMARY</b>   | <b>2001-2007</b>     | <b>Mahonri Academy and Science High School</b><br>Phase 3, Mabuhay Homes 2000,<br>Paliparan II, City of Dasmariñas, Cavite            |

## **AFFILIATIONS:**

- Organization of Electronics Engineering Students  
Member (2012 – Present)

## **SEMINARS ATTENDED:**

- *"Calculator Technique for ECE Board Exam"*  
Technological University of the Philippines – Manila  
November 2016
- *"Ureka E-Cadets Training"*  
SM Megatrade Conference Center Function Rooms A and B, 5<sup>th</sup> floor  
SM Megamall Building B  
November 2016

## **ON-THE-JOB TRAINING**

- **AMKOR TECHNOLOGY PHILIPPINES**  
Production Technician (720 HRS) MAY – OCTOBER 2013
- **PHILIPPINE LONG DISTANCE TELEPHONE COMPANY (PLDT)**  
Field Engineer Apprentice (240HRS) APRIL – JUNE 2017

## **PERSONAL DATA:**

|                     |   |                    |
|---------------------|---|--------------------|
| <b>Age</b>          | : | 22 years old       |
| <b>Birth date</b>   | : | August 12, 1994    |
| <b>Birth Place</b>  | : | Dasmariñas, Cavite |
| <b>Religion</b>     | : | Christian          |
| <b>Height</b>       | : | 157 cm             |
| <b>Weight</b>       | : | 44 kg              |
| <b>Civil Status</b> | : | Single             |
| <b>Citizenship</b>  | : | Filipino           |

## **CHARACTER REFERENCES:**

### **MR. AMIEL RIEL**

Production Supervisor  
Amkor Technology Philippines  
+639157842345

### **ENGR. MARY GRACE C. BAUTISTA**

Technological University of the Philippines  
Ayala. Blvd., Ermita, Manila  
College Professor  
+639194571092

*I hereby certify that above information is true and correct to the best of my knowledge*

---

**CHEZA MARIE A. MASCARDO**  
Applicant

## **JUSTINE MAE B. SOMBrito**

Blk. 32. Lot 32. Northville 5 Brgy. Batia, Bocaue, Bulacan

Contact No.: +63 9954618122

Email: [jsombrito@ymail.com](mailto:jsombrito@ymail.com)



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### **OBJECTIVE:**

Seeking for position where I can share my knowledge, skills, and to enhance my abilities for professional growth and development.

---

### **EDUCATIONAL BACKGROUND:**

|                  |                      |                                                                                                                                       |
|------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>TERTIARY</b>  | <b>2014- present</b> | <b>Technological University of the Philippines</b><br>Bachelor of Science in Electronics Engineering<br>Ayala., Blvd., Ermita, Manila |
|                  | <b>2011-2014</b>     | <b>Technological University of the Philippines</b><br>Electronics Engineering Technology<br>Ayala., Blvd., Ermita, Manila             |
| <b>SECONDARY</b> | <b>2007-2011</b>     | <b>Ramon Magsaysay High School</b><br>Espana, Manila                                                                                  |
| <b>PRIMARY</b>   | <b>2001-2007</b>     | <b>Legarda Elementary School</b><br>J. Fajardo St. Sampaloc, Manila                                                                   |

### **SEMINARS ATTENDED:**

- *"Calculator Technique for ECE Board Exam"*  
Technological University of the Philippines – Manila  
November 2016
- *"Ureka E-Cadets Training"*  
SM Megatrade Conference Center Function Rooms A and B, 5<sup>th</sup> floor  
SM Megamall Building B  
November 2016

### **AFFILIATIONS:**

- Organization of Electronics Engineering Students  
Member (2012 – Present)

**ON-THE-JOB TRAINING:**

- **WORLD ELECTRICALMECH SYSTEM MANAGEMENT, INC.**  
Marketing Assistant (720 HRS) JUNE – SEPTEMBER 2013
- **PHILIPPINE LONG DISTANCE TELEPHONE COMPANY (PLDT)**  
Central Office Department (270 HRS) APRIL – MAY 2017

**PERSONAL DATA:**

|                     |   |                  |
|---------------------|---|------------------|
| <b>Age</b>          | : | 21 years old     |
| <b>Birth date</b>   | : | December 5, 1995 |
| <b>Birth Place</b>  | : | Manila           |
| <b>Religion</b>     | : | Christian        |
| <b>Height</b>       | : | 157 cm           |
| <b>Weight</b>       | : | 60 kg            |
| <b>Civil Status</b> | : | Single           |
| <b>Citizenship</b>  | : | Filipino         |

**CHARACTER REFERENCES:****ODEZA HEART HERNANDEZ**

Technological University of the Philippines  
Ayala. Blvd., Ermita, Manila  
College Professor  
+639192893760

**ENGR. MARY GRACE C. BAUTISTA**

Technological University of the Philippines  
Ayala. Blvd., Ermita, Manila  
College Professor  
+639194571092

*I hereby certify that above information is true and correct to the best of my knowledge*

---

**JUSTINE MAE B. SOMBRITO**  
Applicant









## **APPENDIX H**

## **SURVEY FORM**



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## NEEDS ASSESSMENT SURVEY

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### PROFILE

Pangalan: \_\_\_\_\_ Petsa: \_\_\_\_ / \_\_\_\_ / \_\_\_\_  
Lokasyon/Address: \_\_\_\_\_  
Phone number (mobile, if available) \_\_\_\_\_ Kasarian (Gender): \_\_\_\_\_

---

Instruction: Lagyan ng tsek(/) sa naayon.

**Q1. Katauang Sibil**

Single  Kasal  iba pa: \_\_\_\_\_

**Q2. Edad ng sumesagot.**

18-24  25-34  35-44  45-54  55 pataas

**Q3. Katawan ng pagtuturo sa eskwelahan.**

Part Time  Full Time  iba pa: \_\_\_\_\_

**Q4. Ilan taon ka na nagtuturo sa paaralan?**

5 pababa  6-10  11-20  21 pataas

**Q5. Bilang ng subject na hinahawakan mo sa isang semester.**

3 pababa  4-6  7 pataas

**Q6. Bilang ng subject na itinuturo mo sa sa isang araw.**

3 pababa  4-6  7 pataas

**Q7. Bilang ng yunits ng isang guro sa isang semester.** \_\_\_\_\_

**Q8. Pinakamataas na yunit na kinukuha mo sa isang semester.**

3 pababa  4-6  7 pataas

**Q9. Pinakamataas na bilang ng estudyante sa isang regular na klase.**

15-20  20-30  30-40  40 pataas

**Q10. Oras ng pananetili sa loob ng eskwelahan sa isang araw.**

1-3  3-5  5-8  8 pataas

**Q11. Bilang ng pagsusulit sa isang semester.**

5 pababa  6-8  9 pataas

**Q12. Uri ng pagsusulit na medelas mong gingamit.**

multiple choice

identification

Problem Solving

iba pa: \_\_\_\_\_

**Q13. Bilang ng oras ng pagtatama ng pagsusulit sa isang araw.**

3 pababa  4-6  7 pataas

**Q14. Pagkatapos itama ang mga pagsusulit, naitatala ba ito ng mabilis?**

Oo  Hindi

**Q15. Saan mo medelas gawin ang pagtatala sa mga pagsusulit?**

Paaralan/Unibersidad  Tahanan  Iba pa: \_\_\_\_\_

**Q16. Ilang araw bago maibigay ang resulta ng pagsusulit sa mga estudyante?**

1-3 days  4-6 days  7 days pataas

**Q17. Naitatala ba kung gaano kahirap ang bawat tanong sa pagsusulit?**

Oo  Hindi

**Q18. Marka sa pagpasa ng isang estudyante sa subject na iyong itinuturo.**

50-55%  66-60%  60-65%  70% pataas

**Q19. Nakagamit ka na ba ng aparato o imbensyon na awtomatikong nagmamarika ng pagsusulit?**

Oo  Hindi

**Q20. Maganda bang ideya ang pagkakaroon ng aparato na awtomatikong nagmamarika ng pagsusulit?**

Oo  Hindi

**Q21. Bilang isang guro, makakatulong ba ng malaki kapag may bagong imbensyon na awtomatikong nagmamarika ng pagsusulit?**

Oo  Hindi

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Signature