Development of Weight Acquisition and Growth Analysis System for Broiler Chickens through Image Processing and Statistical Analysis

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The Authors

ABSTRACT

In this study, a non-intrusive weight acquisition system specifically designed for broiler chickens was developed as an alternative to the traditional manual weighing. Providing a substitute to manual weighing indicates eliminating factors it causes, namely, being labor-intensive and time consuming to the grower and stressful to chickens resulting to poor health and produce. The significance of this study is being able to monitor the growth progression of chickens without the need for physical contact, thus being efficient and giving poultry farm owners the liberty to improve the quality of their production.

The system is developed using image processing and statistical analysis and is composed of chicken recognition, various parameters acquisition, and result and weight recommendation. A depth camera is used to acquire video data subjected to image processing in order to segment and obtain necessary frames for chicken recognition. With the use of cascading system, the program classifies and detects the chicken images in the captured frame. Different image reduction schemes are generated in the captured chicken image of the depth camera allowing only the needed parameters for data calculation. Computed weight and other considerations are displayed in the computer using Python.

The implementation of this study was done by evaluating the manual and computed weight of the gathered data samples using statistical analysis. Four trend lines were observed to determine the best fit for the correlation of the volume and weight. With a value of R^2 = 0.9791, the power trend line shows the best fit to the data set for this being the closest value to 1. Using the acquired equation $y=63.323x^{0.2573}$ in the power

trend line, the system produced a strong correlation coefficient of 0.7063 which signifies the closeness of data or simply the accuracy and reliability of predicted data.

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CHAPTER 1

THE PROBLEM AND ITS BACKGROUND

1.1 Introduction

In animal enterprises, Filipino poultry farming is still one of the most competitive and efficient in Asia. The growth in the poultry industry had been remarkable as it expands every year. For the year of 2017, the output gross for the poultry subsector rise by 4.62 percent (Chicken Situation Report, 2017). As the economic development grow along with the population, the outlook for the chicken industry appears optimistic. In Philippines, they consider chicken broiler as one of the most progressive animal enterprises.

In the chicken industry, broiler chickens are the one reared specifically for meat, which have yellowish skin and soft white feathers. The broilers are raised to their full size and health to give quality product to the consumers. After one breeding process, chickens weighing from 4-7lbs are collected and transported from farm to a processing plant (From Farm to Table: the Journey of All-American Chicken, n.d.).

Chicken body weight is a very important parameter. It supplies the information about consistency, growth, and feeding efficiency. It is needed to determine the average weight and allows the poultry farmer to check if the expected growth curve is succeeding and give a sign to the management quality (Ali, 2010). Using image analysis, the extracted images of broiler are acquired. Segmentation algorithm are recommended to locate the object and partitioning of the digital image to separate the broiler from the background. The data obtained from each feature and its effect are examine on the recognition accuracy (Pereira, 2013; Zhuang, 2018).

Automatic platform weighing systems are available in the market today that are less stressful for the chickens. However, these platforms must be visited by the broilers voluntarily (Manual Versus Automatic Electronic Poultry Scales, n.d.). Advancement of digital imaging technology offers an alternative way of weighing live broiler indirectly by the use of image processing (Lotufo, 1999). In digital image acquisition, a 3D vision camera is used that is equip with depth sensor technology that has a higher resolution and higher acquisition rate. It gives numerous benefits in weighing and surveillance of broilers. Remote sensing system and digital analysis is clearly a benefit and does not cause any additional stress (Ali, 2010; Abdanan Mehdizadeh, 2015; Abdul Jabbar, 2017; Aydin, 2017).

In this study, the proponents focused on developing a weighing system to eliminate manual weighing. As it is labor-intensive and often handling of chicken is not good considering that frequent handling is important especially for health checks, chasing the bird around for a run every time is not helpful. The group developed a monitoring system for direct measurement of the chickens while it is in its natural environment. This system is developed to reduce manpower, especially in live poultry so that the weighing is faster and easier.

1.2 Background of the Study

Manual weighing is stressful to the chickens, labor-intensive, and time-consuming (Turner, 1984). Automatic platform weighing systems are available in the market today that are less stressful for the chickens. However, these platforms have to be visited by the broilers voluntarily.

A camera-based system that is non-intrusive is used for weighing chickens in the field of view (FOV) of the camera. This can cover a wider area and therefore get weight of several birds. The size of the chicken increases in both width and length as it grows. The width of the broiler is a more stable feature than the length, due to the movement of the chicken when it pecks or walks. The perimeter of the chicken broiler has been used for weight prediction and a 7.8% average relative error between reference and predicted weights was achieved (Mortensen, 2016).

The depth images can be utilized for features that relates to the 3-D shape of the chicken broiler. The back height, back width, volume, convex surface area, convex volume, and surface area were used as 3-D features (Mathiassen, 2011). Using convex hull and numerical integration, the volume of a chicken broiler was approximated. As volume increase, the surface-area must also increase. 3-D Delaunay triangulation and convex hull are used for surface-area approximations. The back-width of the chicken broiler used the depth information, to define the cross-section, where the width was computed, the minor axis was used. Lastly, back height was determined by the difference between the depth value on top of the broiler’s back and the average depth value on the contour of the segmented broiler (Mortensen, 2016).

The accuracy of weight prediction is determined by many elements such as age, breed, and type of image analysis techniques. For image quality, careful camera positioning, lighting and image analysis software development was relevant (Ali, 2010).

Digital imaging equipment provides numerous benefits in weighing and surveillance of broilers. Remote sensing system and digital analysis is clearly a benefit and does not cause any additional stress (Ali, 2010). This establishes the significance for weight acquisition and growth analysis system of chicken broilers based on its physical appearance through image processing and deep learning.

1.3 Statement of the Problem

The proponents will ease the following problems:

1. Stress of chickens caused by poor physical handling upon manual weighing
2. Intense labor and longer time consumption of manual weighing
3. Inconvenient interface of an automatic weighing system

There are related studies about determining the weight of chickens which need improvements that will be conducted in this project study. According to the 2016 study of Anders entitled "Weight Prediction of Broiler Chickens using 3D Computer Vision", a fixed camera or having a stable low-cost camera does not acquire the best result of the depth images of the subject which limits of having an accurate prediction of the weight of the chicken. It then limits the data needed for the image processing. Also, at the beginning of the night the birds are at its heaviest, so not having an operating system available for day and night time is not advisable (Ali, 2010). Using a more improved technology has more advantages when it comes to efficient and faster results than using just a low-tech camera.

1.4 Objectives of the Study

The general objective of the study is to develop a weight acquisition and growth analysis system of chicken broilers based on its physical appearance through image processing. Specifically, it aims to:

1. To specify camera positioning to maximize the information it can gather in the broiler house.
2. To develop a program that will segment and extract features from the images captured from the video by cascade detection.
3. To develop a program that will compute the weight equivalent of the extracted features such as the projected area, volume, height, and back width of the broiler.
4. To design a GUI that will display three (3) video stream, video-labeled weight measurements and the corresponding recommendations.
5. To design and configure a wireless transmission system.

1.5 Significance of the Study

This study would be an upscale for traditional poultry farms that have struggles in monitoring growth progression of chickens. Direct measurement of weight of chickens eliminates the need for human contact, which certainly eliminates the need for manual and individual measurement of chickens. It would also diminish possible emergence of stress for chickens, thus improving their mental health, which would have a remarkable impact on the physical side. Also, poultry farm owners can improve the quality standards of production on account of advancement of monitoring routine provided a database system and recommendations for different weight brackets.

1.6 Scope and Delimitations

The study focuses on developing a weight acquisition system that is capable of video capturing, transmitting and analyzing 3-dimensional images of chickens through image processing for weight determination of chickens in a traditional poultry farm. The program developed will compute the pixel composition of the images into equivalent weight measurement using OpenCV-Python.

The proponents narrow this research study to specifically chickens which are normally consumed in the country. The study, moreover, will accommodate one (1) broiler house containing a total of 2,000 chickens.

1.7 Definition of Terms

Broiler Chicken – first commercially produced in 1930, a broiler chicken is a fast-growing chicken developed at Beltsville, Maryland by the USDA (Broiler Chicken, n.d.).

Cascade Classification – the word “cascade” indicates that the resultant classifier comprises a number of simpler stages that are then applied to a region of interest (ROI) until all stages are passed or rejected (Cascade Classification, n.d.).

Contour – a curve or arc connecting all the continuous points, having same intensity or color. It is a valuable tool for object detection and recognition and shape analysis (Contours: Getting Started, n.d.).

Image Processing – a method used to perform procedures on an image, to be able to extract useful information or acquire an image with enhanced quality. It is a category of signal processing in which an image can be both input and output, however, an output can also be features related with the image (Introduction to image processing, n.d.).

Local Binary Pattern - an effective texture descriptor for images that thresholds the adjacent pixels based on the value of the current pixel (Aakarsh Malhotra, 2017). Its computational simplicity, which makes it possible to evaluate images in real-time situation, is an important property (Pietikäinen, 2010).

OpenCV-Python – a library of Python bindings intended to solve computer vision problems. It uses Numpy, an approvingly enhanced library for numerical operations with a syntax in MATLAB-style (Introduction to OpenCV-Python Tutorials, n.d.).

Statistical Analysis – includes analyzing and gathering every data sample in a set from which samples can be drawn (Statistical Analysis, n.d.).

CHAPTER 2

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter presents the related literature and studies incorporated in the development of this research. The proponents included discussions of concepts and facts to which the present study is related. They also included studies already conducted to which the present proposed study relates, has some similarity or bearing.

2.1 Conceptual Literature

2.1.1 Chicken Breeds

2.1.1.1 Summary of Chicken Breeds

There are a lot of types of birds in the world, chickens are one of the most common and widespread domesticated animals, the most populated one. The different breeds and varieties of chickens is a subspecies of the red jungle fowl. Rather than food the earlier fowls are domesticated for cockfighting. When the western world suppressed cockfighting, the exhibition of poultry production started. Chickens became the mainly as one source of food that is being kept by humans for meat and eggs and seldom as a pet.

Table 1 Chicken Breeds

Chicken Breeds	***Primary Use***
American Game Fowl	Ornamental, Cockfighting
Old English Game Fowl	Cockfighting, Meat
Orpington Chicken	Dual-purpose meat/eggs, Ornamental
Leghorn Chicken	Eggs
Broiler Chicken	Meat

Note. Data for chicken breeds from Chicken Situation Report (2017)

2.1.1.2 Broiler Chicken Breeding Period/Growth

Hens and roosters are bred in the farm to produce fertilize eggs. the fertilized eggs are collected and delivered to hatcheries where they are incubated in the setter. 18 days in the setter, the eggs are transferred from setter to hatchers basket via tray. After 3 days the chicks are hatch, resulting in a 21 days of total incubation period. Immediately after hatching, the chicks are relatively mature enough that they can walk around on their own. The day 1 old chicks are moved to local farms and live in barns. After 33 days of the breeding process, chickens weighing from ranges 4-7lbs are collected and transported from the farm to a processing plant (Broiler Production).

2.1.2 Chicken Products Production and Consumption in the Philippines

One of the fastest rising in the world as meat eaters is the Philippines. Proven by the inclusion on the top 10 of the fastest growing meat consuming nations statistics, the country has one of the highest continuing growth rates. Over 30% a year for chicken, pork, and beef is the compound manual growth rate prediction from 2011-2021 (Salazar, 2016).

All major meat products in the Philippines namely cattle, hog and chicken meat exhibited output growth over the period 2014-2017. Specifically, at 3.01% per annum, chicken meat showed the highest growth rate, pork being the second at 2.89%, and beef at 0.736% as shown from the table below.

Table 2 Chicken Meat Volume of Production by Quarter and Semester

	2013	*2014*	*2015*	*2016*	*2017*	
			Annual (Meat)			
Cattle	258.45	261.32	266.90	270.42	266.30	
Hog	2012.17	2032.30	2120.33	2231.66	2265.01	
Chicken	1555.07	1571.76	1660.81	1674.51	1745.89	
			Growth Rate			**Ave**
Cattle		1.098%	2.0907%	1.3017%	-1.547%	0.73585%
Hog		0.9905%	4.1517%	4.988663%	1.4724%	2.89%
Chicken		1.061%	5.36%	0.81%	4.0885%	3.01%

Note. Data for chicken meat volume of production from Livestock and Poultry: Volume of Production by Animal Type, by Quarter and by Semester, 1980-2018

Chicken meat is one of the most popular consumed and produced meat in the Philippines, making it second to the pork. Through years, the demand for the chicken meat than that of other meats is increasing quickly as a result of its lower fat content, lower price, and more versatile and convenient meal preparation methods compared to other meats (Landes, 2004).

The figure shows that Central Luzon recorded the highest broiler chicken inventory in the Philippines at 26.53 percent share followed by 17.53 percent share of CALABARZON and Northern Mindanao with 13.47 percent. These regions contributed 57.53 percent to the total broiler chicken inventory in the country (Chicken Situation Report, 2017).

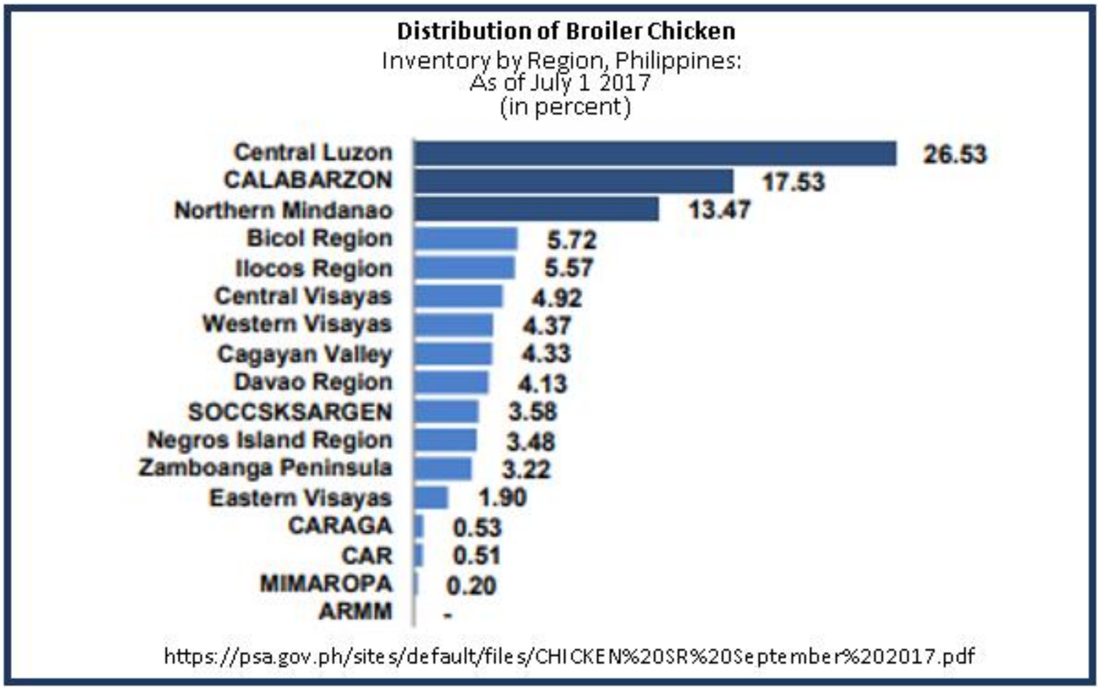


Figure 1 Distribution of Broiler Chicken

2.1.3 Weighing Scale System

2.1.3.1 Types of Weighing System

Determining the weight of an object is done using a weighing scale It is used for measuring different physical objects in the industry, agriculture, commercial and scientific fields. Monitoring the bird weight is a very important management tool for a poultry industry. To determine which type is more suitable to use depends on the heaviness of the objects to be weighed. A comparison between a manual and automatic weighing (Buddy, 2017).

2.1.3.1.1 Manual Weighing

The average of the random samples is considered as the general average of the whole in a manual weighing– for example, the mean of the 20 chickens that are weighed manually by placing the chickens on a traditional weighing scale or by a hooking system (Manual Versus Automatic Electronic Poultry Scales, n.d.).

2.1.3.1.1.1 Causes/Effects of Manual Weighing

The manual weighing is labor-intensive to the farmer and often handling of the bird is not good. Regular handling of chicken can cause them physical stress. The chickens are a prey species so naturally when they are being chased, caught, and picked up, they become stressed. A stressed bird produces a rapid release of glucose resulting in the depletion of glycogen that made its respiratory rate to be altered. The stress can cause to lower the pH in the gut and this creates 'gram negative bacteria', a respiratory tract disease in the poultry. Birds that are stressed, may experience a loss in their appetite, a sluggish in their attitude and may lose their weight (Beebe, 2014).

2.1.3.1.2 Automatic Weighing

In automatic weighing, an elevated platform is installed at some place in the rearing floor where the chicken had to voluntarily step or jump into it for their weight to be determined and recorded automatically. The automatic weighing run continuously at 24 hours a day, and it reduces the labor cost since no human effort is needed. The price of an automatic weighing is higher than the previous, and slightly less accurate than manual weighing for the reason of the weighing system being visited less by the heavier chickens at the end of the rearing period (Manual Versus Automatic Electronic Poultry Scales, n.d.).

2.1.3.2 Weighing Process/Period

The chicken in the farms are weighed almost 10 times throughout the breeding process. They weigh the chicken at least once a week. The weighing should be done the same day each week. e.g. weigh every Monday and Thursday. It is essential to weigh the chicken the same time each weigh day, to ensure gain development of the chicken (Brenda Schneider, 2004).

2.1.3.3 Weighing Importance

Body weighing are very essential parameters to determine the chicken condition it provides a valuable information about the health if there are occurrence of disease in a flock and growth development. The weighing of the bird enables the farmer to monitor if the expected growth curve is succeeding or if there are feed conversion rate, implicating about the management quality (Ali, 2010).

2.1.3.4 Weighing Standards in the Market

It takes 33-45 days of breeding process for a broiler chicken to grow and attained a marketable weight, and once they enter the right age and size, they are all harvested together for processing. The chickens weighing from ranges 4-7lbs or 1.8-3 kgs are collected and transported from farm to a processing plant. The location where market weight broilers are transported for harvesting is the processing plant (From Farm to Table: the Journey of All-American Chicken, n.d.).

2.1.4 Hardware

2.1.4.1 3D Camera

The study will be using a 3D or Kinect camera that could cover a large area of the pen. It has specifications that are more advanced than the normal cameras for yielding more accurate results. Through the camera, image processing will be used to have an electronic weighing system. The Kinect camera will directly record a video of the subject which will then be converted into frames to acquire the depth image. Recording 3D information, easing of image segmentation and construction, and adapting in any lighting conditions due to its IR sensor are the capabilities required to be suitable for computer vision application and depth subject representation.

2.1.4.1.1 Intel RealSense Depth Camera D435

The Intel RealSense Depth Camera D400-Series uses stereo camera to capture image and calculates its depth; then, through the process a 3D image will be acquired. This D435 USB-powered depth camera is composed of a pair of depth sensors, an RGB sensor, and an infrared projector. Another commonly encountered problems for cameras based on the captured images is the ability to determine the difference of the color of the subject or object being reflected from the color sensed by the photodetector with the amount of ambient light present. The presence of combined sensors: RGB and IR, and the capability of color sensor to sense color helps the camera to perform the determination more easily. Conclusively the camera is ideal to the prototype development of the study for adding depth perception and producing depth image of the test subject.

2.1.4.1.1.1 RGB Image

The images that are captured through the RGB camera are called RGB images. This RGB image is used as the input for the system; the image will be processed and segmented to produce the desired output. The physical structure of the subject as shown from the RGB camera will be the basis in weight prediction of the test subject. The produced, processed and segmented images will then be used for the volume calculation through the elliptical method, wherein the physical construction of the subject will be enclosed in the ellipse to determine its area in pixel that will be used in calculating volume to determine its weight.

2.1.4.1.1.2 Depth Image

The images that are captured through the depth camera are called depth images. A depth image can be defined as an image channel in which each pixel relates to a distance between the corresponding object and the image plane in the RGB image. This depth image is used as an input for the system, to determine and calculate the height of the subject that will be used to determine its volume.

2.1.4.2 Sensor

2.1.4.2.1 RGB Sensor

The RGB sensor is the metering sensor of the camera for it eases the difficulties in analyzation process of the scene that is being captured by the camera. It also helps to determine the right amount of light needed to produce the desired and well-produced output depth images. The sensor gathers data from the test subject regarding its color and brightness, and then it will optimize the exposure by adjusting the aperture, ISO sensitivity and the shutter speed according to its prerequisite. The advancement of this sensor enables the camera to produce high-quality depth images.

2.1.4.2.2 Depth Sensor

The depth sensor is an in-built sensor in the Kinect camera. The ability to detect the depth distance and produce the depth image is made possible by this sensor. Its presence makes the camera more suitable for 3D construction and computer vision applications.

2.1.4.2.3 IR Sensor

The Kinect has a built-in Infrared sensor that can emit infrared pattern to estimate depth that will result to be completely operating in any light conditions that can happen inside the broiler's house. It can even work perfectly in complete darkness because of this feature. The IR patterns are generated through a laser; thus, the camera will be mounted above the spectral sensitivity of the broiler so that they will not be affected by the IR pattern and will not be disturbed in their day and night cycles.

2.1.4.3 Laptop

The system will be using a computer for the receiver of all the necessary data or information. It will also run the program created through Open CV Python in order to process the algorithm.

2.1.5 Software

2.1.5.1 OpenCV-Python

All algorithms in OpenCV are implemented in C++. Other languages such Java or Python can also be used to established and performed the algorithm. This is made possible using the binding generators. These generators enable users to call from Python the C++ functions that serve as a bridge between C++ and Python (How OpenCV-Python bindings are generated?, n.d.).

There are many techniques in OpenCV-Python that can be used for image processing. Smoothing images, image thresholding, canny edge detection, changing color spaces, image gradients, geometric transformation of images, morphological transformations, contours in OpenCV, image pyramids, histograms in OpenCV, image segmentation with watershed algorithm, image transforms in OpenCV, template matching, Hough circle transform, Hough line transform, and interactive foreground extraction using GrabCut algorithm are some of the techniques and algorithms that can be used in OpenCV-Python (Image Processing in OpenCV, n.d.).

2.1.5.1.1 Image Processing

Image processing is an algorithm applied in a digital data and variety of techniques to get an output characteristic associated with that image. It allows generation of 3D parametric maps and implies calculations to maximize the information that can be extracted in a picture. In this study, the image processing includes the segmentation of chickens and extraction of features from the segmented broiler. In which the weight prediction will be based on the features extracted from the image. The 3D features that will be obtained are the volume, back height, back width, surface area, and convex volume of the chicken.

2.1.5.1.2 Statistical Analysis

In this study, the volume of the broiler chickens will be computed through the formulated formula through the examination of statistical trend lines. The trend line that shows better and more accurate results will be used to determine the formula to be used in the system. The volume of the subject that will be gathered from the images captured is the parameter used for the analysis to correlates with the subject’s weight.

2.1.5.1.3 Deep Learning

In deep learning, computational models that are composed of multiple processing layers can learn representations of data with multiple levels of abstraction. These methods have intensely improved the up-to-date visual object recognition, speech recognition, and object detection. By using the back propagation algorithm to specify how a machine must change its interior parameters that are used to calculate the representation in each layer from the representation in the previous layer, deep learning discovers intricate structure in large data sets (Yann LeCun, 2015).

In this study, cascade detection will be used to train the positive and negative sample of the images. The positive images are composed of the chicken images captured by the RGB camera, while the negative images are composed of the background images without the test subjects. Haar, histogram of oriented gradients (HOG), and local binary patterns (LBP) classifiers will be examined in this study to determine which classifier is the best method to produce more accurate results.

2.2 Related Studies

In the study Digital Image Analysis to Estimate the Live Weight of Broiler, a chicken coop was constructed to hold chickens together while photos were being taken. For determining the surface-area pixels of the broiler, 1200 digital images were captured and analyzed using IDRISI 32. Dilation and erosion techniques were used to add and remove pixels at the edges of images. Lastly, linear regression model in R programming to analyze the correlation of the manual weight and surface area of the chicken (Ali, 2010).

Physical actions of the broilers affect body dimension measurement. Representative sample images must be acquired for the precision of prediction. The camera must be placed strategically for these images (Ali, 2010; Tasdemir, 2011). However, using digital camera creates problems regarding the feathers of the chicken, lighting and threshold points of the image, and observed it's difficult to determine the difference between the chicken and the background.

In the study entitled Weight Prediction of Broiler Chickens using 3D Computer Vision, a low-priced 3-D camera was employed to adapt in varying light conditions. To segment the image, watershed algorithm was used, afterwards, extract features from each segmented image, and lastly, used the Bayesian Artificial Neural Network to predict the weight of the broilers (Mortensen, 2016).

Four other regression models were also examined, and Bayesian ANN was chosen. In this study, Bayesian ANN will be used since it gives a coherent approach to detecting the outliers. This will be used to eliminate chickens from an established data of weight predictions since incorrect segmentations will be caused if they're spreading their wings.

From the study Automated Monitoring of Dairy Cow Body Condition, Mobility and Weight Using a Single 3D Video Capture Device, the use of 3D imaging technology to acquire different animal condition data enables them to monitor multiple animal health parameters (Song, 2018). By means of removing unnecessary information from the location, the cow was segmented. Using a depth camera rather than a standard RGB camera made the process easier. A background image was taken with no cows detected, then to segment a cow from a detected frame with the region of interest is present, the background depth image is subtracted (Hansen, 2018).

In the study Evaluation of a Depth Sensor for Mass Estimation of Growing and Finishing Pigs, a program to acquire the volume of a pig by the elimination of areas that were outside the threshold value in the depth image was created in MATLAB software. By deducting the distance between the camera and the pig to the distance between the camera and the floor, the height of the pig was calculated. To find out the effect of volume on weight of the pigs, a multiple linear regression was created. Results showed that obtaining the mass of grow and finishing pigs using volume calculated from depth images was possible (Condotta, 2018).

In Application of Computer Vision and Support Vector Regression for Weight Prediction of Live Broiler Chicken, frequent collection of accurate body weights is a very important component for a productive broiler feeder flock. Support vector regression (SVR) and image processing were used in this study to avoid handling of the chickens. Using Hough transform, an ellipse fitting algorithm was executed to segment the chickens within the pen. Whereas, using the Chan-Vese method, the tail and head of the chickens were removed. Afterwards, six features were extracted from the broiler images such as area, perimeter, major axis length, minor axis length, convex area, and, eccentricity (Amraei, 2017).

In Cascade Method for Image Processing Based People Detection and Counting, people detection provides important information for establishing awareness, therefore it is fundamental in intelligent video surveillance systems. Detection of people can be used for tracking and counting of people. Tracking and counting people efficiently and effectively would be beneficial and fundamental to a lot of applications such as in security, safety, transport, business intelligence and behavioral economics, and energy management applications (Al-zaydi, 2016). In this study, cascade method is implemented for detection of broiler chickens that can be utilized for broiler counting and tracking to help calculate and obtain its weight.

CHAPTER 3

METHODOLOGY

This chapter presents the methods and procedures used in the development and implementation of the project. The proponents also included research flow process, hardware parts acquisition, software selection, equipment interfacing, user interface creation, system flow charts and programming, testing and evaluation procedures in making the whole system.

3.1 Research Design

3.1.1 Conceptual Framework

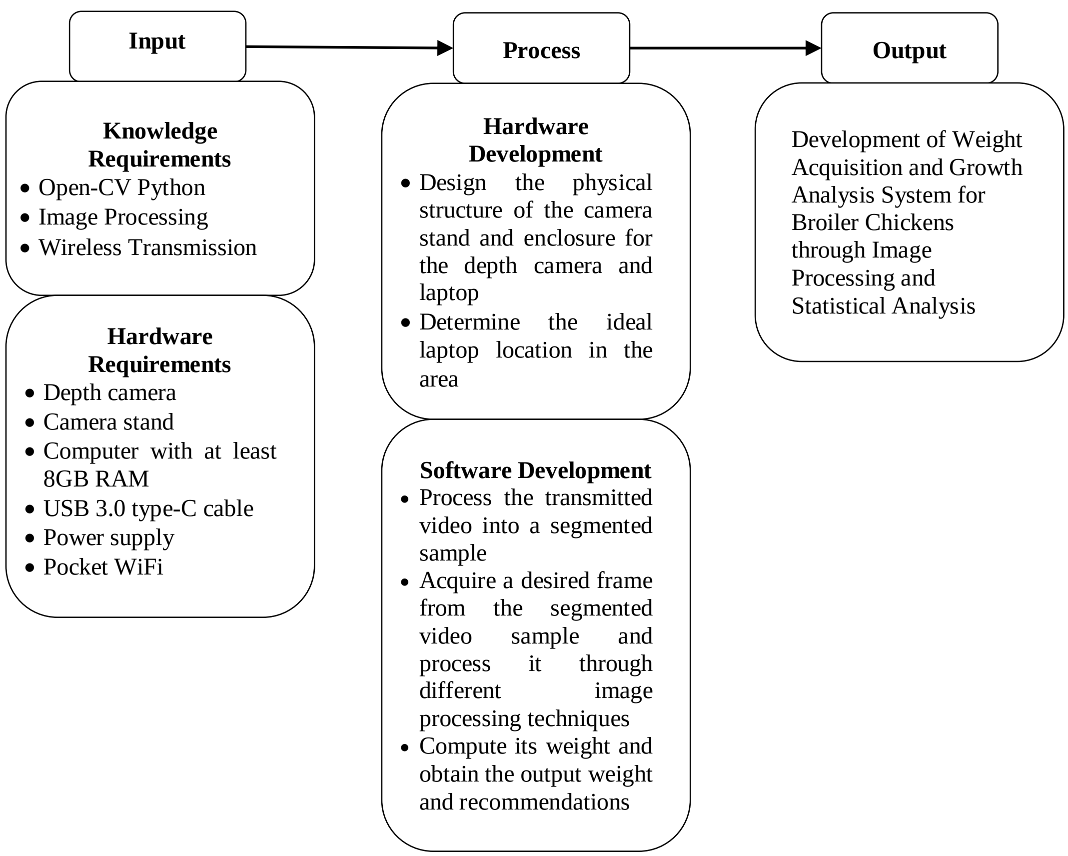


Figure 2 Input-Process-Output Diagram

Figure 2 shows the input, process, and output of the system. A video data will be acquired using a depth camera and will be propagated through a wired system which later on be processed through programming techniques, primarily video and image processing, using Open-CV Python and a computer. Obtaining the knowledge and hardware requirements will also be needed to develop the system. The basic knowledge is consisted of topics relating to Python programming including video and image processing particularly object tracking and detection, video segmentation algorithm, and wired and wireless transmission. The hardware requirements include an Intel RealSense Depth Camera D435, main server computer, and a receiving-end device. These will be used to develop the weight acquisition system.

The process of the development of the hardware and software section of the system will be simultaneous. The videos taken using the depth camera will be transmitted to the main server computer through a proposed wired transmission system and the results through wireless transmission system. Python will be used to develop video and image processing programs for precise and accurate weight prediction, which will be used for tagging and labeling of data. A graphical user interface (GUI) will be used to display the results and interpretations for an ease of understanding of the acquired data throughout the whole system. The output after the development of the hardware and software section will be the weight acquisition and growth analysis system for broiler chickens.

3.1.2 Block Diagram

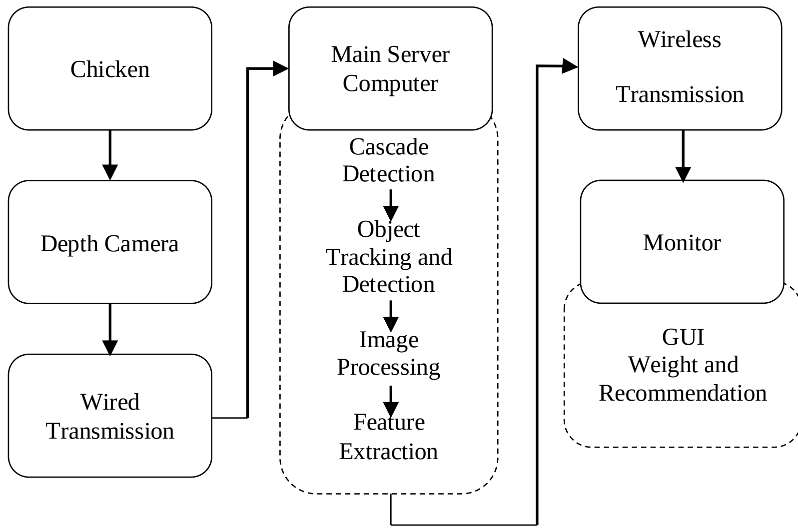


Figure 3 Block Diagram

Figure 3 shows the block diagram of the system. From the cameras, chicken data are captured and transmitted to the main server computer where cascade detection, object tracking and detection, image processing, feature extraction are performed. The output is transmitted to a server and is displayed on a monitor.

3.1.2.1 Video Capturing

In video capturing section, it is required to use a depth camera to acquire depth video of the broiler chickens. The robustness of the system is dependent on the resolution and accuracy of the depth measurement provided by the depth camera. Since the depth camera has a built-in infrared sensor, there is no lighting requirements is needed which also adds on the robustness off the system.

3.1.2.2 Wired Transmission

The recorded video data by each depth cam will be transmitted to the main server computer through USB 3.0 cables into a main USB hub.

3.1.2.3 Main Server Computer

The video data acquired is subjected to a sequence of programming techniques developed using Python on a required specification of laptop. Initially, the video data is segmented wherein the user can select a chicken subject for object detection and tracking using Cascade Object Classifiers, Local Binary Pattern (LBP) Classifier specifically. After the object was tracked, frame from the segmented video will be then selected for processing of individual images of broiler chickens upon tracking. From this, contours of broiler's image will be obtained and will be improved by using morphological reconstruction. In the morphological reconstruction, the head and tail of the chicken will be removed since the length of the broiler will be affected if it pecks or walks. The feature composition of the chicken broiler images will be analyzed to acquire weight measurement through the aid of linear relationship of the broiler's volume and its actual weight. Certain features will be used as shown in table 3.

Table 3 Extracted Features

1D Feature	*2D Features*	*3D Features*
• Age	• Minor axis of the ellipse • Major axis of the ellipse	• Volume • Height with relevance to depth

The age is the 1D feature that is traditionally used by the farmers. The 2D features will be based on the digital image acquired. The 3D features will use the depth image obtained using the 3D camera.

The predicted weight and recommendation will be tagged as label on the broiler's body as the video progresses.

3.1.2.4 Graphical User Interface

A GUI will be developed on Python, presenting three (3) video streams simultaneously. It will have interactive blocks for user to manage each video streams, and ready for weight measurement of the preferred broiler cell by the user on a selected video stream.

3.1.3 Research Development Flowchart

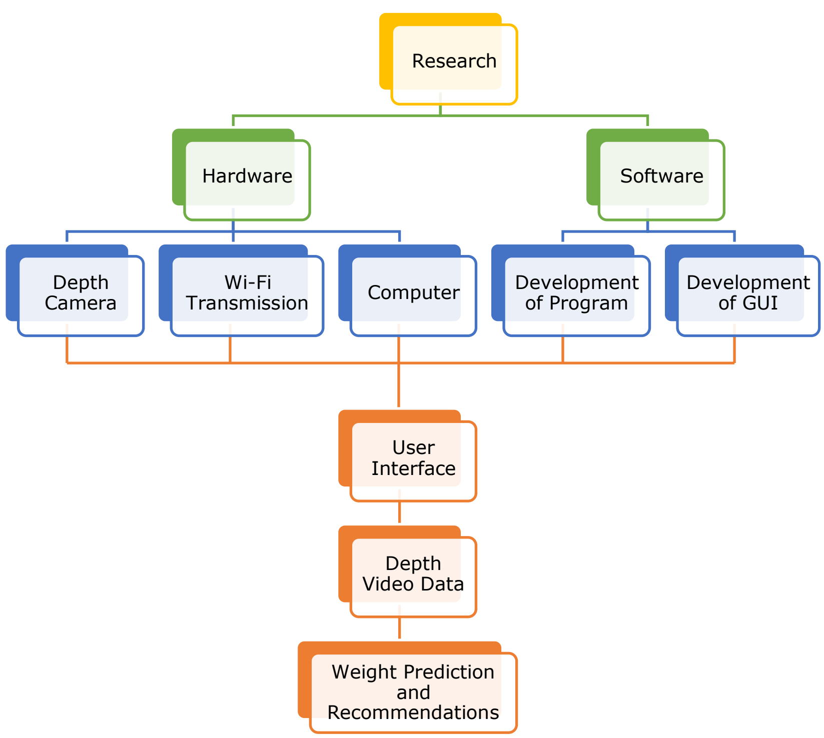


Figure 4 Research Flow Process Diagram

Figure 4 is the research flow process diagram where the proponents will conduct a research about converting manual chicken weighing into a weight prediction and growth analysis monitoring system. The research will include the hardware and software needed to create the system for faster weight acquisition. The researchers will create a program for image segmentation of frames of the taken videos of the chickens. For the hardware section, the researchers will provide the laptop, camera, wired and wireless transmission systems. To acquire the weight of the chicken, the camera will be interfaced in the GUI in the laptop which will display the weight and growth analysis.

3.2 Project Development

3.2.1 Hardware

The researchers came up with the idea of developing a weight acquisition and growth analysis system for the monitoring of broiler chickens in a traditional poultry farm using depth cameras, and computer.

3.2.1.1 Depth Camera

Figure 5 Depth Camera

Figure 5 shows a depth camera that is IR and RGB activated. This housed stereo camera has a max. depth frame rate (fps) and max. depth resolution of 90 and 1280x720 pixels, respectively. Its minimum depth distance is 200mm. It has a max. RGB frame rate (fps) and max. RGB resolution of 60 and 1920x1080, respectively. This camera provides wider field of view and better high-speed image capture, it includes: D4 Vision Processor, D430 Depth Module and RGB Camera. Maximum Range: 10m+ (Intel RealSense Depth Camera D435 (starter kit incl. USB cable and tripod), n.d.).

3.2.1.2 Laptop

Figure 6 Toshiba dynabook R732/H Laptop

This Toshiba dynabook R732/H Laptop, as shown in Figure 6 has an Intel Core i5-3340M Processor 2.70GHz processor, 8GB DDR3 memory, 320GB HDD storage, and Windows 7 Ultimate OS. This laptop has a 13.3” 1366X768 display and 12.5”X9” size.

3.2.1.3 Camera Set-up

To determine the specific camera positioning to maximize the information it can gather, the proponents examined three different height locations starting from the maximum height of the ceiling in the broiler house.

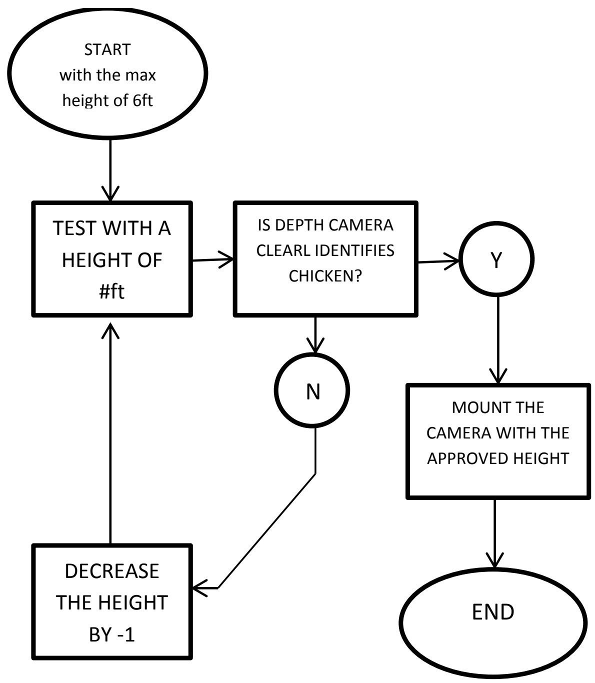


Figure 7 Camera Height Set-up Flowchart

Figure 7 shows the flowchart used for the camera height set-up.

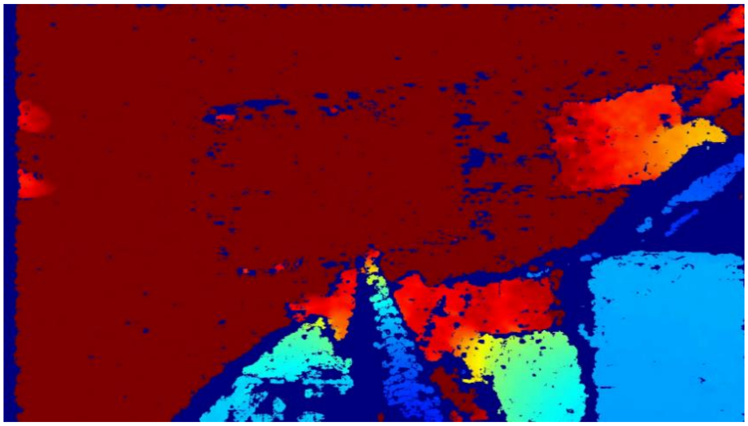


Figure 8 6ft Camera Placement

Figure 8 shows a frame capture from the videos taken for a 6ft camera placement. The depth camera cannot distinguish the difference between the chicken (positive) and the floor or background (negative).

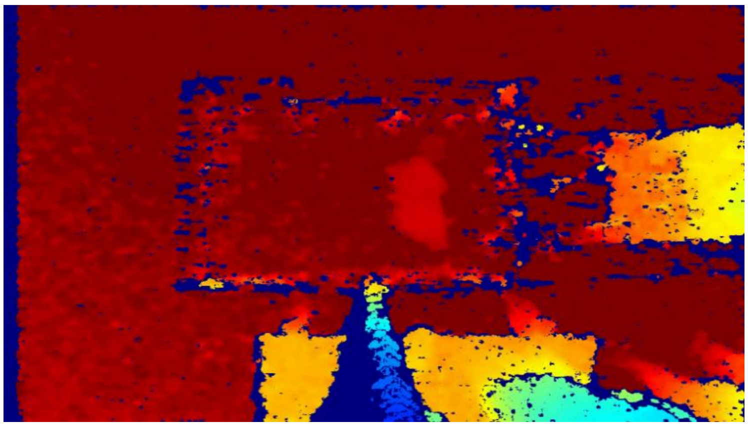


Figure 9 5ft Camera Placement

Figure 9 shows a frame capture from the videos taken for a 5ft camera placement. The depth camera can hardly distinguish the difference between the chicken (positive) and the floor or background (negative).

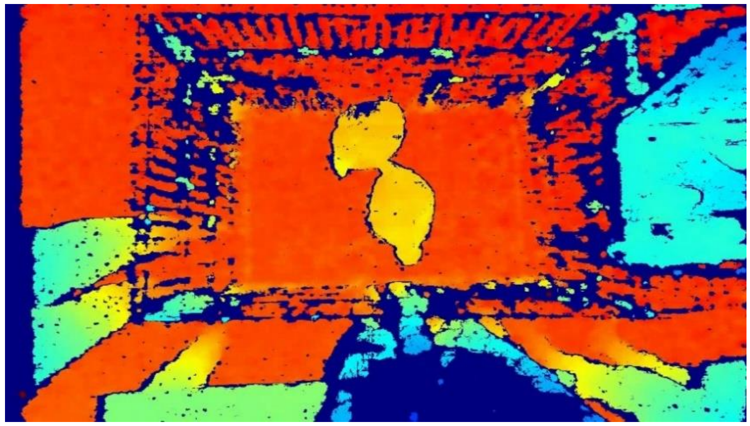


Figure 10 4ft Camera Placement

Figure 10 shows a frame capture from the videos taken for a 4ft camera placement. The depth camera can fully detect and distinguish the difference between the chicken (positive) and the floor or background (negative).

3.2.2 Software Development

The researchers emerged with the idea of developing a weight acquisition and growth analysis system for the monitoring of broiler chickens in a traditional poultry farm. With this system, the users will be able to automatically determine and monitor the weight of chickens and acquire the recommendation for the chickens.

3.2.2.1 Python

Python is defined as an object-oriented, interpreted, high-level programming language with dynamic semantics. Its easy to learn and simple syntax highlights readability and therefore decreases the cost of program maintenance. Python supports packages and modules, which boosts program modularity and code reuse. Python is open source; hence, interpreter and extensive standard library are available without charge and can be distributed freely (What is Python? Executive Summary, n.d.). Moreover, this study will be using OpenCV-Python, designed for computer vision.

3.2.2.2 System Process Flowchart

Figure 11 shows the flow chart of the overall system. The system will start with the display of the three (3) depth videos, where the user can choose the cell of broiler house subject for weighing. Upon choosing the desired cell, the system will display the individual depth video data of the selected cell. A button can be pressed to formally start the process of chicken weighing. The user will be asked to select the desired chicken to be weighed on the displayed video data. The process of video segmentation and object tracking takes place right after the user select the desired chicken house. An underlaying process runs simultaneously upon selection, which is image segmentation and morphological reconstruction of the frames of the selected chicken on that time being, forming the individual contours of each chicken. The contour will be enclosed through an ellipse to calculate its volume, forming linear equation of its volume with relevance with its actual weight. The measured weight will be analyzed whether it was out of the appropriate weight based on the age of the chicken, for the recommendation scheme based from actual recommendations of veterinarians. The data acquired, mainly measured weight, will be brought back to the video data through video labeling. Moreover, the weight data and recommendations acquired will be uploaded through a server on web, which can be accessed by a monitoring device located on the farm owner.

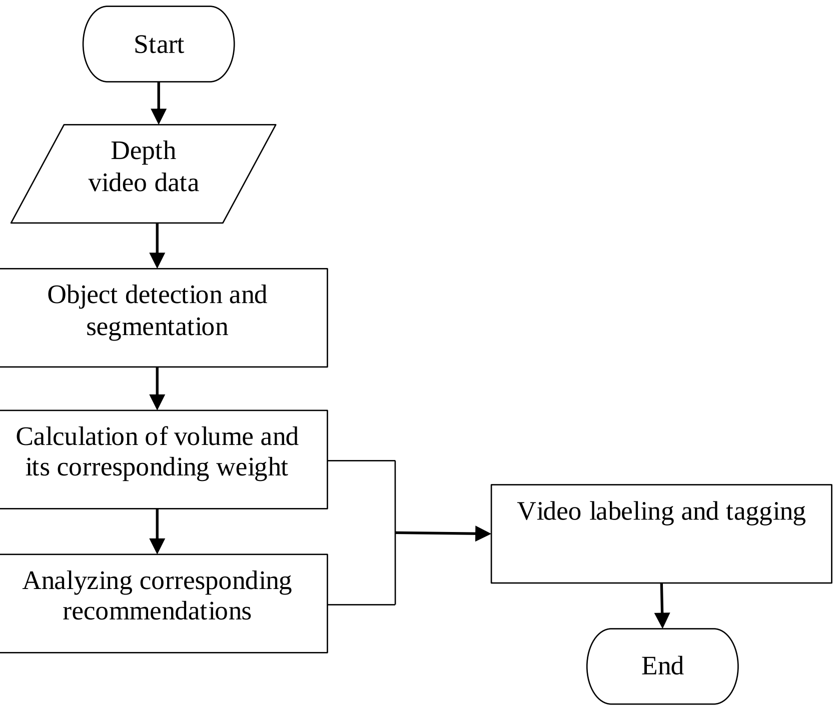


Figure 11 Flowchart of Overall System

3.2.2.3 Image Processing Flowchart

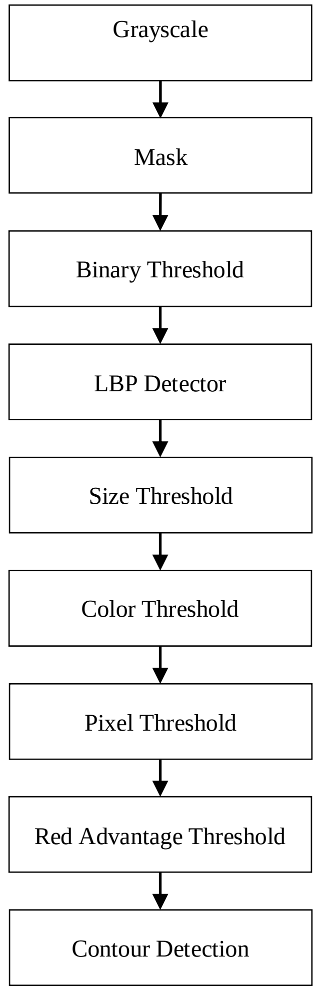
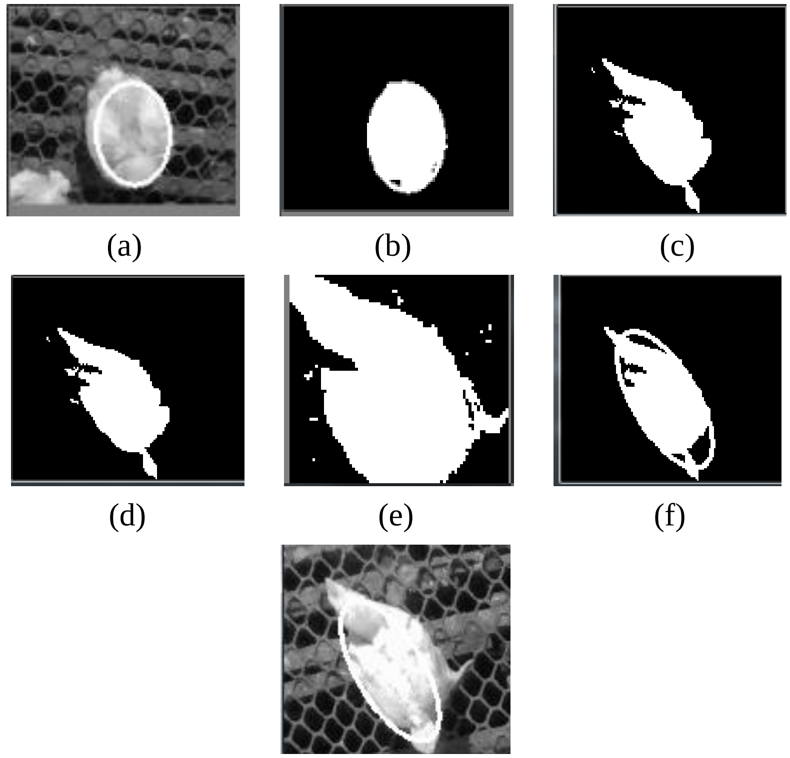


Figure 12 Image processing techniques used to filter the chicken image

Figure 12 shows the process of image processing techniques used to filter the chicken image. The raw images are processed and filtered from grayscale, mask, binary threshold, LBP detector, size threshold, color threshold, pixel threshold, red advantage threshold to contour detection as shown in figure 13.



(a) (b) (c) (d) (e) (f) (g)

Figure 13 Grayscale image of the ellipse of a broiler chicken (b) Mask image of the ellipse of a broiler chicken (c) Bitwisenot image of the broiler chicken (d) Bitwiseand image of the broiler chicken (e) Local binary pattern of the broiler chicken (f) Contour image of the broiler chicken (g) Grayscale contour image of the broiler chicken

The system was trained using cascade detection, consists of two stages: training and identification.

The training stage requires positive and negative samples as shown in figure 14. For negative samples, the system was trained with images containing only the background without chickens recognized. For positive samples, regions of interest were set for each image.

The identification stage gives three types of classifiers: Hog, Haar, and LBP. Through testing, the LBP classifier which detects based on binary pattern is the most ideal detector.

(a) (b)

Figure 14 (a) Positive sample with region of interest (b) Negative sample

3.2.2.4 Image Segmentation

3.2.2.4.1 Parameters Considered

Parameters such as volume, surface area, and back width are considered for the weight computation of the system as shown in figure 15.

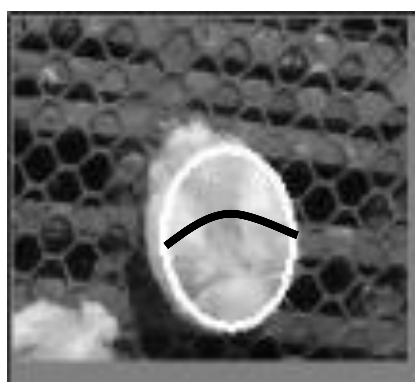


Figure 15 Back width

3.2.2.4.2 Volume

Minor and major axis are obtained from the two radii of the ellipse while the height is calculated from the center point of the ellipse with relevance to the depth of the broiler chicken. Using the formula for the volume of the ellipse given

$$V = \frac{4}{3}\pi abc$$

where a, b, and c are the major axis, minor axis, and height, respectively.

3.2.2.5 Statistical Process

The process used for the statistical analysis to determine the relationship between the weight and volume of a broiler chicken is shown in figure 16.

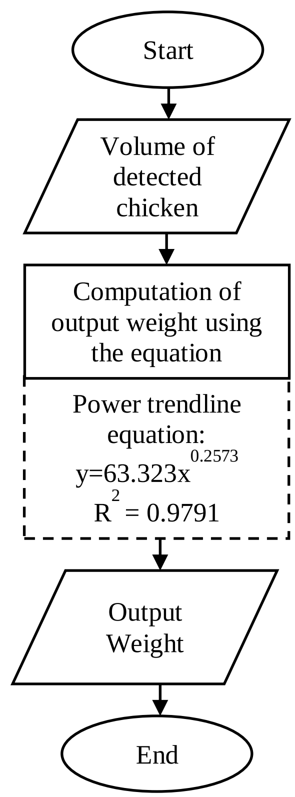


Figure 16 System flowchart for Weight Computation

3.2.2.6 Graphical User Interface

This section presents the GUI of the system. Figure 17 shows the screen of the laptop displaying the video stream from the depth camera as well as its equivalent depth stream. The computed weight of the system is displayed along with the RGB video. The total chickens detected, and the average weight are displayed on a separate dialog box where the user can also input the age of the broiler chickens being weighed to determine whether the current weight equates to the ideal corresponding weight of a certain age.

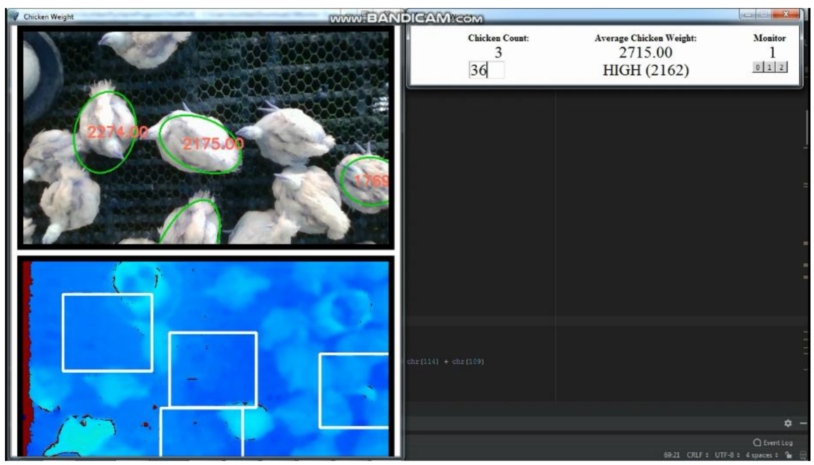


Figure 17 Graphical User Interface

CHAPTER 4

RESULTS AND DISCUSSION

This chapter provides the interpretation of the data gathered from the samples and tests acquired throughout the whole study and the analysis drawn from the data.

4.1 Project Technical Description

The study Development of Weight Acquisition of Growth Analysis System for Broiler Chickens through Image Processing and Statistical Analysis or ChickPic is a non-intrusive weighing system for weight prediction of broiler chickens in a traditional broiler house. The said system can detect individual and grouped or flock of broiler chickens and compute its equivalent weight. Average weight of the total chickens is computed and displayed for grouped broiler chickens detected from the system.

ChickPic is mostly consisted of Python programming. A laptop computer, depth camera, camera holder, camera stand, laptop enclosure, and a prepaid wifi are the hardware required for this study.

Python is used as the programming language for the system. Python offers a lot of libraries and modules to choose from making it useful for research and developing production system.

4.2 Project Limitations and Capabilities

The following are the limitations of this study.

1. The area that the camera can cover limits the number of chickens that can be weighed.

2. The camera settings should be properly adjusted to the required specifications needed to capture image.
3. The height of the camera placement should not exceed 4ft. If not, it cannot determine the difference between the chicken and the floor that is needed parameters for data processing.

4.2.1 Camera Positioning

Figure 18 Actual set-up of three (3) depth cameras in the broiler house

Figure 18 shows the actual set-up of the three (3) depth cameras used in the broiler house. The maximum height for the camera to gather the most data in the broiler house is 4 ft as shown in figure 19.

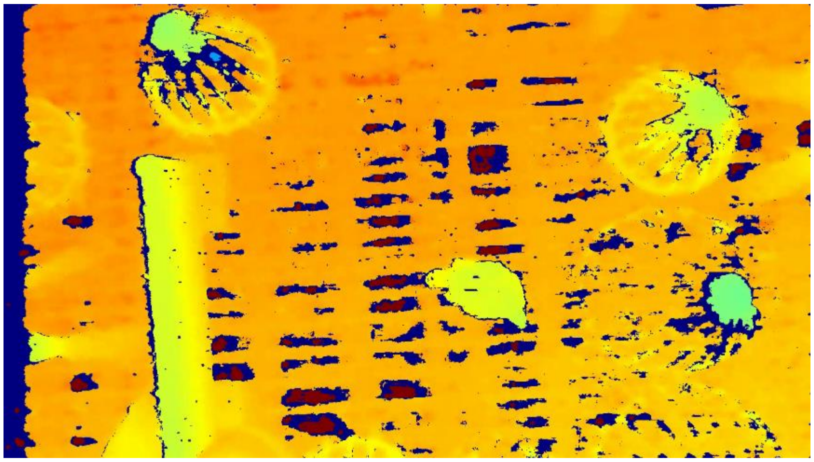


Figure 19 Depth image for 4ft camera placement

Figure 19 shows captured frame of the depth cameras mounted on a height of 4ft. It can fully detect and distinguish the difference between the chicken (positive) and the floor or background (negative).

4.3 Results of Field Testing

The field testing is verified by Baby Faylona farm grower, Lester Pandan and approved by YCP Farms technical veterinarian, Dr. Zenaida R. Rondilla.

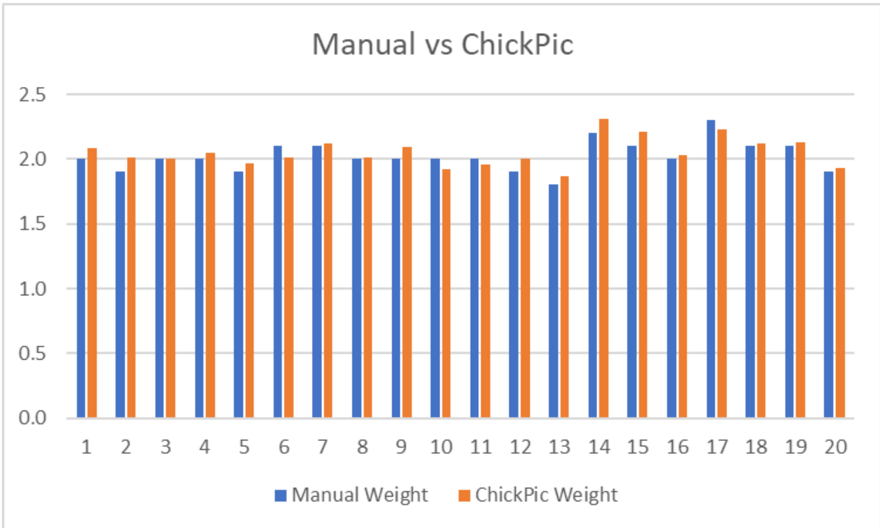


Figure 20 Manual vs ChickPic Weight

Figure 20 shows the comparison between the manual and computed weight of 20 random individual broiler chickens.

4.4 Examined Trendlines

This section presents the trendlines examined in order to obtain the best fit for the data set. Four trendlines were observed namely power, exponential, linear, and logarithmic trendlines. The data used for examining the trendline is shown in Table 4. The volume is acquired through the computed value from our system using the formula for the volume of the eclipse $V = \frac{4}{3}\pi abc$, where a, b, and c are the major axis, minor axis, and height, respectively. The weight is acquired by manually weighing the broilers.

Table 4 Volume vs Weight

Volume (pixel cube)	***Weight (g)***
4970.7	600
51211.15385	900
163068.8824	1400
220332.625	1500
247659.1667	1600
355194.4375	1700
396514.5	1800
663260	2000

4.4.1 Power Trendline

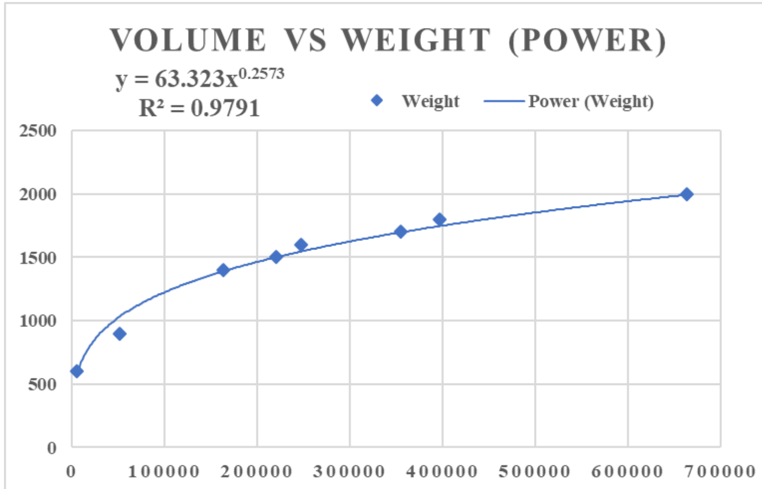


Figure 21 Volume vs Weight (Power)

Figure 21 shows the correlation of volume and weight in a power trendline. The value of the R^2 acquired is 0.9791 and the equation acquired for weight computation is $y=63.323x^{0.2573}$.

4.4.2 Exponential Trendline

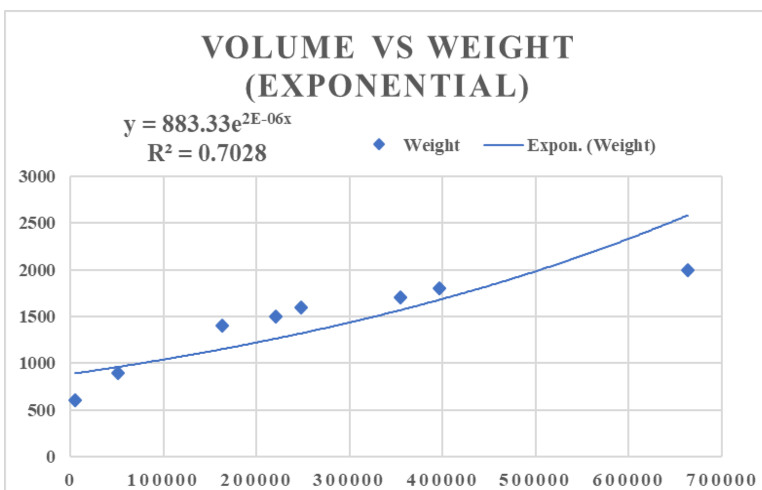


Figure 22 Volume vs Weight (Exponential)

Figure 22 shows the correlation of volume and weight in an exponential trendline. The value of the R^2 acquired is 0.7028 and the equation acquired for weight computation is $y=883.33\ e^{2E-06x}$.

4.4.3 Linear Trendline

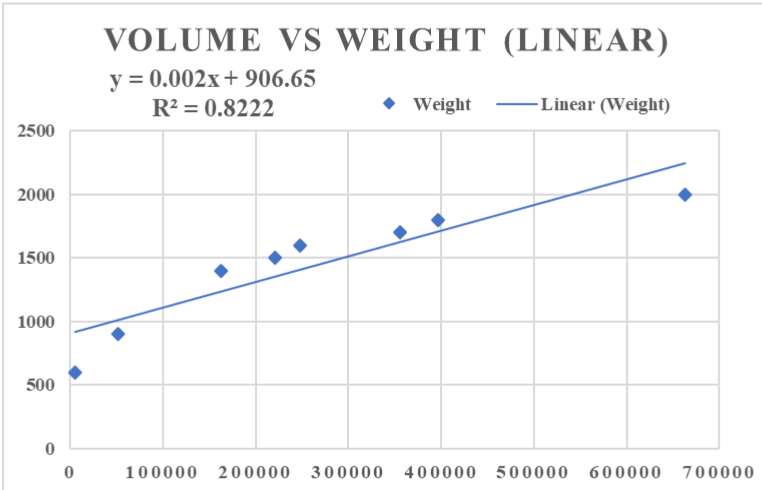


Figure 23 Volume vs Weight (Linear)

Figure 23 shows the correlation of volume and weight in a linear trendline. The value of the R^2 acquired is 0.8222 and the equation acquired for weight computation is $y=0.002x+906.65$.

4.4.4 Logarithmic Trendline

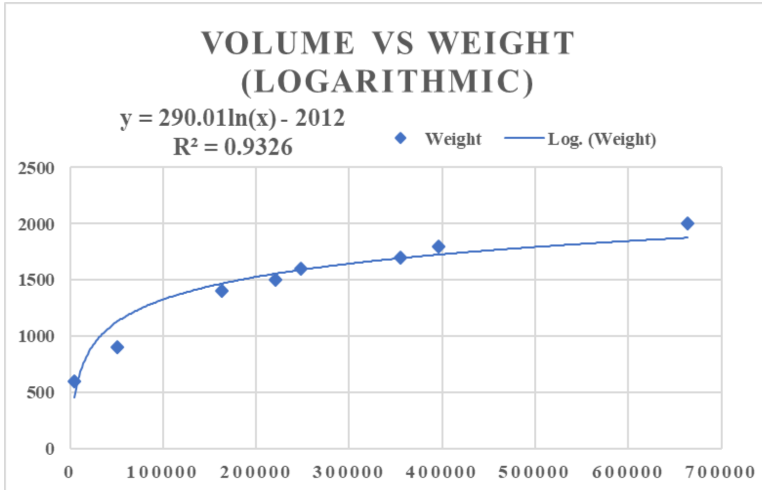


Figure 24 Volume vs Weight (Logarithmic)

Figure 24 shows the correlation of volume and weight in a logarithmic trendline. The value of the R^2 acquired is 0.9326 and the equation acquired for weight computation is y=290.01ln(x)-2012.

Different trendlines were examined to determine the most suitable to the gathered data such as power, exponential, linear, and logarithmic trendline as shown in figures 21 to 24. The fitness of the line is determined by the value of the output R^2. The value of the R^2 that is closest to value of 1 is the best fit trendline to the data set.

4.5 Statistical Analysis

4.5.1 Statistical Correlation of Manual and ChickPic Weight

Table 5 Field Testing of ChickPic

Bird Sample	*Manual Weight (kg)*	*ChickPic Weight (kg)*	*Volume (pixel cube)*
1	2.0	2.081	788541.7738
2	1.9	2.015	691767.408
3	2.0	2.001	673262.9639
4	2.0	2.053	743898.4493
5	1.9	1.966	628610.5318
6	2.1	2.015	691767.408
7	2.1	2.125	850604.8377
8	2.0	2.015	691767.408
9	2.0	2.1	812346.6725
10	2.0	1.928	582661.8929
11	2.0	1.963	624888.3651
12	1.9	2.007	681147.8326
13	1.8	1.87	517399.5569
14	2.2	2.313	1182742.09
15	2.1	2.215	999493.5233
16	2.0	2.034	717481.3851
17	2.3	2.234	1033246.957
18	2.1	2.126	852162.468
19	2.1	2.133	863125.2656
20	1.9	1.936	592120.8429
21	1.9	2.009	683791.296

Table 5 shows the ChickPic weight results and corresponding manual weight along with the volume, weight difference, and percentage error for 21 bird samples aged 36 days in Baby Faylona Farm. To test the accuracy of the device, a comparison was done between the actual and the measured weight of the broiler chicken. Table 4 showed all the data gathered from the broiler chickens weighing 1.9kg to 2.3kg and its corresponding weight measured by the system. The weight difference of these sample ranges from 0.001 to 0.115. With the data acquired, it was manifested that the actual and measured weight were almost equal as it only has a mean percentage error of 3.231%.

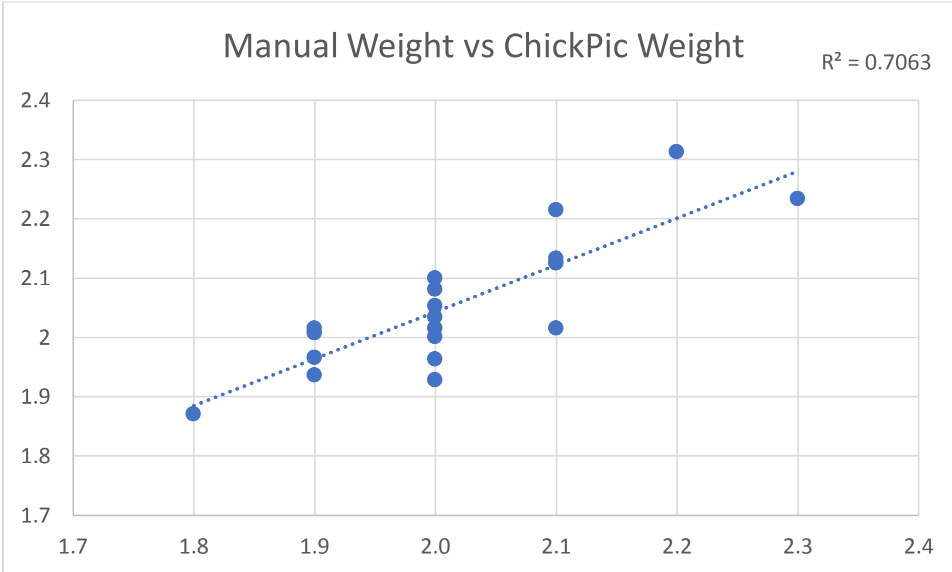


Figure 25 Scatter plot of Manual and ChickPic weight with its corresponding coefficient of correlation

The proponents used linear relationship to measure the correlation of manual weight corresponding to its output ChickPic weight. Having a correlation coefficient of 0.7063, the manual weight and ChickPic weight are said to have a strong correlation with a scaling from 0 (no correlation) to 1 (perfect correlation) as shown in figure 25. The correlation coefficient signifies how the data are closed to each other or simply the accuracy of the ChickPic weighing.

CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATION

This chapter includes the summary of the whole project, the conclusion derived from the results discussed in chapter 4, and recommendation for future development of the study.

5.1 Summary of Findings

The project Development of Weight Acquisition and Growth Analysis System for Broiler Chickens through Image Processing and Statistical Analysis is a study that aims to develop a weight acquisition system using image processing and statistical analysis to decrease time and stress produced by manual weighing. The system involves the detection of chicken, acquisition of different parameters to be used for weight computation and displaying the results in a computer. The proponents learned that the system, having a mean percentage error of 3.231% for a data set of 21 samples of which 6.053% being the highest and 0.05% being the lowest, can compute and predict the weight of the broiler chickens, thus can be an alternative to the traditional manual weighing. The whole algorithm and graphical user interface were built in Python.

This project was implemented in Baby Faylona farm at Brgy. Palma, Purok II, Alaminos, Laguna and a total of 40 samples were tested for the accuracy of the system and for comparison of manual and predicted weight results.

5.2 Conclusion

From the conducted research study, the proponents conclude that:

1. The maximum height for the camera that shows significant data in the broiler house is 4 ft.
2. The cascade detection is used to segment and extract the gathered data through the process of training the cropped images from the RGB and depth values of the captured contour area, pixel area and volume of the chicken.
3. The weight of broiler varies linearly with its volume that makes the volume a suitable parameter for determining weight. The power trendline is the appropriate trendline that gives a better accuracy for weight calculation.
4. The Graphical User Interface displays the average weight of chickens detected with corresponding recommendation based on their age with 3 monitors for evaluation.
5. The data gathered is sent to a server that can be accessed everywhere through internet.

5.3 Recommendation

For further development of the study, these are the following recommendations:

1. Increase the maximum height for the camera placement to cover larger area.
2. Explore other settings of depth camera to improve the quality of depth image.
3. Enhance the algorithm for faster image processing.
4. Examine deep learning models to maximize the usage of depth-sensing capability of the camera, thus, reducing the use of image processing techniques and especially statistical analysis.
5. Integrate the system in raspberry pi for a more cost-effective project.

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APPENDIX A

GANTT CHART

APPENDIX A

GANTT CHART

The table below shows the Gantt Chart which served as the project time frame.

Table 6 Gantt Chart

	2018									2019	
Activity Descriptions	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
Site Visits of Chicken Farms											
Conceptualization of Topic for Project Study											
Research of Problem for Topic Defense											
Review for Related Literature and Studies											
IPO and Block Diagram Formulation											
Initial Hardware and Software Design											
Chapter 1 Formulations											
Consultation for the Topic Proposal											
Drafting and Finalization of Presentation for Topic Defense											
Topic Defense											
Visitation of Chicken Farm											
Meeting with the Veterinarian											
Meeting with the Farm Owners											
Consultation for the Title Proposal											
Consultation for the Hardware Design											
Finalization of Chapters 1, 2, and 3 of Project Documentation											
Title Defense											
Preparation for the Hardware Design											
Canvassing of Materials											
Testing of Materials											
Set-up and Installation of the Camera System											
Developing the Program for the Data Gathering and Weighing of the Chicken											
Analyzing the Process of Data Gathering											
Final Hardware and Software Design											
Finalizing Chapters 4 and 5											
Consultation of the Progress Defense											
Progress Defense											
Project Assembly											
Conduct Experiments											
Gathering of Data											
Comparing Data to Previous Studies											
Pre-Final Defense											
Documentation of Project for the Final Defense											
Final Defense											
Finalization of the Project Document and Book Binding											

APPENDIX B

EVALUATION SHEETS AND CERTIFICATION

APPENDIX B

EVALUATION SHEETS AND CERTIFICATION

1. Project Assessment

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
COLLEGE OF ENGINEERING
ELECTRONICS ENGINEERING DEPARTMENT
Ayala Boulevard, Ermita, Manila
Telefax No. 522-3524 | Website: http://www.tup.edu.ph

PROJECT ASSESSMENT

PROFILE

Name (Optional): Lester Pandan ____________ **Course/Yr/Sec:** ___________ **Date:** ____/____/____
Address/Location: ____
Phone number (mobile, if available) _________________ **Age:** _______ **Gender:** _________________

Instruction: Kindly rate your response to the statements below using the following scale value interpretation. 1 = Poor, 2 = Fair, 3 = Average, 4 = Good, 5 = Excellent
Put tick mark.
Do you have knowledge in chicken? ___ Yes ___ No

FUNCTIONALITY:	1	2	3	4	5
The software performed the assigned tasks.				X	
The software produced a result accurately.			X		
The software is equipped with acceptable security measure.					X
RELIABILITY:					
Most of the mistakes can be eliminated over time.				X	
The software can handle errors.					X
The software can resume working and restore data.			X		
USABILITY:					
The software can be understood easily.				X	
The software can be learn easily.				X	
The software can be operated with minimal effort					X
The interface of the software is appealing.					X
EFFICIENCY:					
The software responds in a timely manner.				X	
The software minimizes the labor required.					X

Overall Rating:

1	**2**	**3**	**4**	**5**
Poor	**Fair**	**Average**	**Good**	**Excellent**

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ELECTRONICS ENGINEERING DEPARTMENT
Ayala Boulevard, Ermita, Manila
Telefax No. 522-3524 | Website: http://www.tup.edu.ph

PROJECT ASSESSMENT

PROFILE

Name (Optional): DOC ZENNY _______ Course/Yr/Sec: ___________ Date: ____/____/____
Address/Location: ____
Phone number (mobile, if available) _________________ Age: _______ Gender: _________________

Instruction: Kindly rate your response to the statements below using the following scale value interpretation. 1 = Poor, 2 = Fair, 3 = Average, 4 = Good, 5 = Excellent
Put tick mark.
Do you have knowledge in chicken? ___ Yes ___ No

FUNCTIONALITY:	1	2	3	4	5
The software performed the assigned tasks.		X			
The software produced a result accurately.			X		
The software is equipped with acceptable security measure.				X	
RELIABILITY:					
Most of the mistakes can be eliminated over time.			X		
The software can handle errors.			X		
The software can resume working and restore data.			X		
USABILITY:					
The software can be understood easily.			X		
The software can be learn easily.				X	
The software can be operated with minimal effort					X
The interface of the software is appealing.				X	
EFFICIENCY:					
The software responds in a timely manner.			X		
The software minimizes the labor required.				X	

Overall Rating:

1	**2**	**3**	**4**	**5**
Poor	**Fair**	**Average**	**Good**	**Excellent**

2. Service Agreement

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
Ayala Blvd., cor San Marcelino St., Ermita, Manila
Telefax No. 522-3524; http://www.tup.edu.ph

COLLEGE OF ENGINEERING
ELECTRONICS ENGINEERING DEPARTMENT

SERVICE AGREEMENT

Title of Activity: **(Deployment)** "DEVELOPMENT OF WEIGHT ACQUISITION AND GROWTH ANALYSIS SYSTEM FOR BROILER CHICKENS THROUGH IMAGE PROCESSING AND DEEP LEARNING"

Description of Activity:

The "ChickPic: DEVELOPMENT OF WEIGHT ACQUISITION AND GROWTH ANALYSIS SYSTEM FOR BROILER CHICKENS THROUGH IMAGE PROCESSING AND DEEP LEARNING" is a study that aims to develop a weight acquisition system using image processing and deep learning to decrease time and stress produced by manual weighing. The system involves the detection of chicken, acquisition of different parameters to be used for computation via deep learning, and displaying the results in the owner's computer.

Responsibilities of the Client:

1. Regarding for any potential development to the project study the client may suggest it to the researchers from TUP.
2. The parties hereto understand that during the technology adoption, the Transferor (TUP) shall give Transferee (Client) a gratis usage for four months.
3. Provide the necessary information in which the project is beneficial to its client.
4. Accommodate researchers from TUP if there are further studies that will be conducted related to the transferred technology/machine/prototype/project/study.

Responsibilities of TUP:

1. Provide the device, instruction manual and necessary training to operate the machine to ensure a satisfactory turn-over to the Client.
2. Give necessary information about the limitation of the device.
3. Provide technical support in case of device malfunction.

The parties hereto agree to keep any information identified as confidential by the disclosing party confidential using methods at least as stringent as each party uses to protect its own confidential information. "Confidential Information" shall include the Proprietor's development plan, the Option Technology and all information concerning it and any other information marked confidential or accompanied by correspondence indicating such information is confidential exchanged between the parties hereto prior to or during the Option Period.

This agreement has been signed by authorized representatives of the Parties and shall enter effect upon signature by the parties.

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Conforme:

Project Proponents/Researchers from TUP:

ENGR. NILO M. ARAGO
Adviser

BARCO, KYLA MARRY R.
ECE 5TH Year Student

BARNIDO, LORIN JR. C.
ECE 5TH Year Student

DOMINGO, ALEXANDER ANTHONY D.P.
ECE 5TH Year Student

MERCADO, ANTHONY JAM
ECE 5TH Year Student

NAZAIRE, JOCHELLE P.
ECE 5TH Year Student

SANCHEZ, JOHN CONRAD I.
ECE 5TH Year Student

Client: 2/7/19

DR. MAXIMO CABILITAZAN
Production Manager-Broiler, YCP Farms
CM Recto, Lipa City, Batangas 4217
(043) 756-6163

Witness: **ENGR. LEAN KARLO S. TOLENTINO**
Head, ECE Department

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(043) 756-6163

ENGR. BENEDICTO N. FORTALEZA
Dean, College of Engineering

Date Signed: 3/12/19

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3. Field testing results certified by YCP Farms

This is to certify that the given data below is true and verified by YCP Personnel, Mang Lester (grower).

FIELD TESTING RESULTS					
INDIVIDUAL					
Sample	Manual Weight (kg)	Estimated Weight (kg)	Sample	Manual Weight (kg)	Estimated Weight (kg)
1	0.7	0.98	11	0.83	1.02
2	0.8	0.9	12	0.6	0.83
3	0.8	0.99	13	0.89	0.95
4	0.9	0.91	14	0.81	0.87
5	0.9	1.04	15	1	1.13
6	1	0.96	16	0.7	0.85
7	0.98	0.92	17	0.8	0.83
8	1	0.94	18	0.9	1.02
9	0.95	1.01	19	1.1	1.02
10	0.9	0.92	20	1.1	0.92

Noted by:

2/6/19
Dr. Zenaida R. Rodilla
Technical Vet., YCP Farms

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APPENDIX C

BILL OF MATERIALS

APPENDIX C

BILL OF MATERIALS

Table 7 Camera Enclosure and set-up

Camera Enclosure	
Material	**Amount (Php)**
PLA Filament	2260
Socket hex cap head (M3 x 20 mm)	66
Socket hex cap head (M3 x 16 mm)	108
Socket hex cap head (M3 x 35 mm)	234
Gauge 10 (1.375 inch)	204
Brass insert	160
Wood (2x2x12)	560
Wood (2x2x8)	120
Wood (1x1x10)	230
Aluminum Sheet	450
Aluminum sheet cutter	200
Hinges	36
Shelve Bracket	105
Nails	70
Total:	**4803**

Table 8 Broiler chickens used in house testing and data gathering

Data gathering		
	Quantity	**Amount (Php)**
Broiler Chicken	7	650
Total:	**650**	

Table 9 Other materials used during testing

Chicken Materials	
Materials	**Amount (Php)**
Chicken feed	100
Poultry Water Drinker	35
Chicken Vitamins	26
Total:	**161**

Table 10 Total expenses

TOTAL	
Materials	**Amount**
Laptop	9000
Camera	28000
Camera Enclosure	4803
Data Gather	650
Chicken materials	161
USB 3.0 Cable	2160
USB Hub 3.0	450
Total:	**45224**

APPENDIX D

CHASSIS DESIGN

APPENDIX D

CHASSIS DESIGN

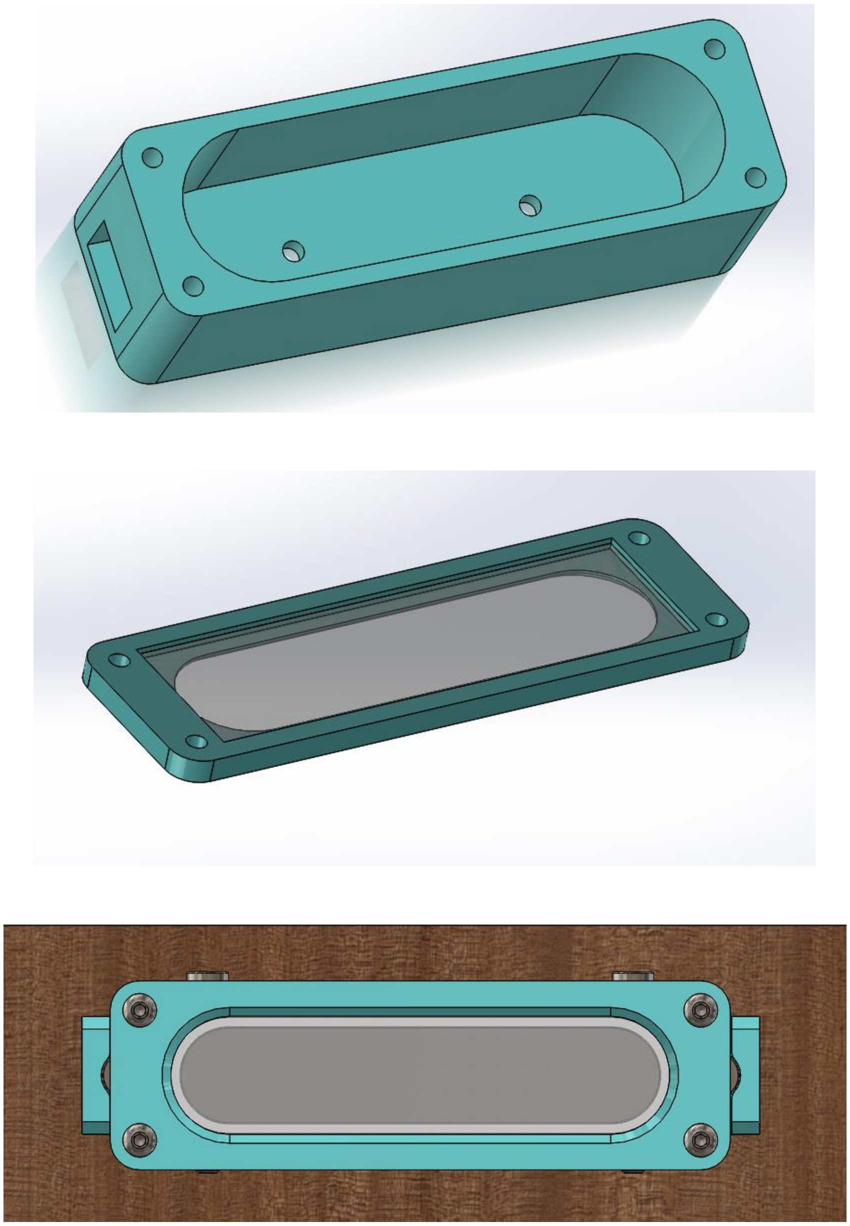

Figure 26 Chassis design for the camera

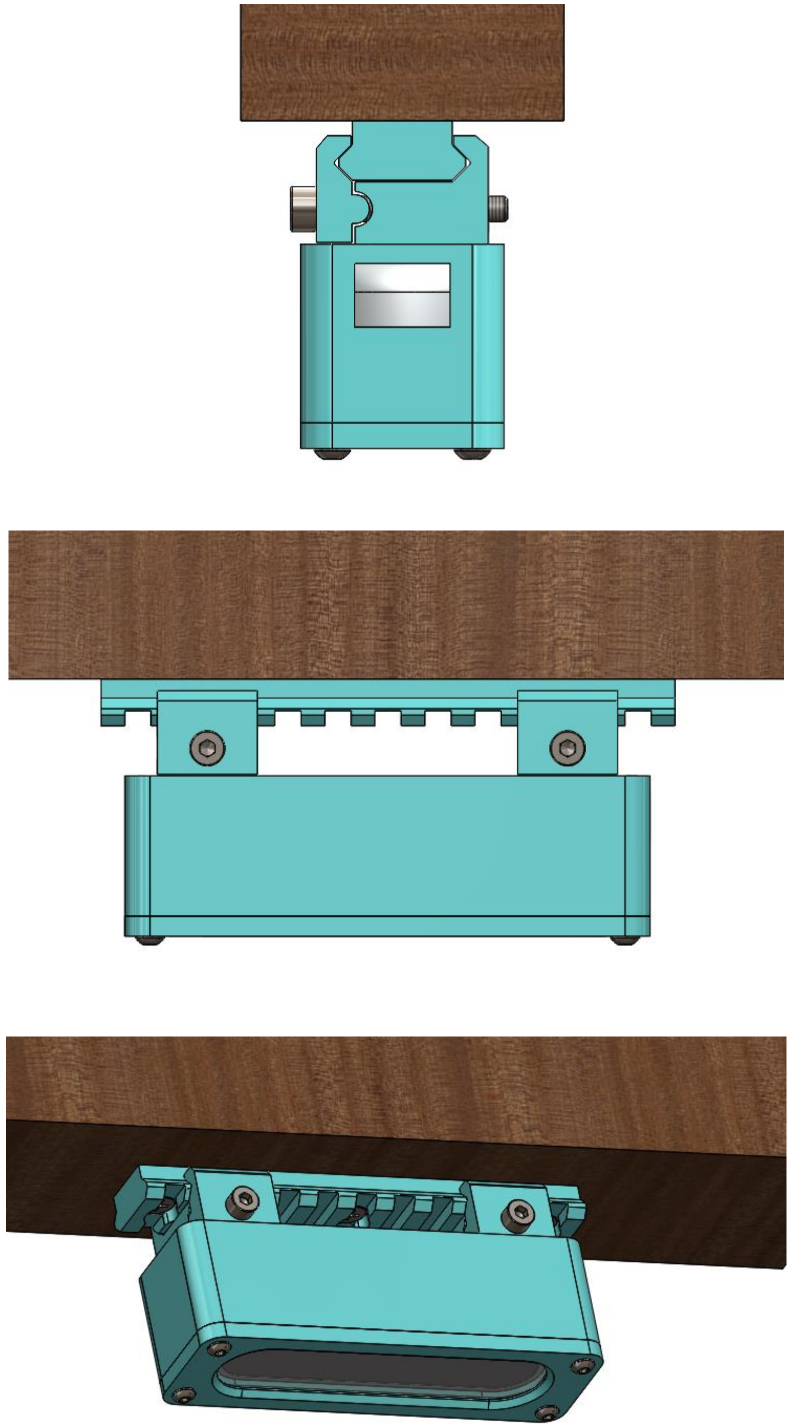

Figure 27 Mounted chassis design for the camera

APPENDIX E

DATA SHEET

TOSHIBA

This product specification is variable and subject to change prior to product launch.

Portege R930 Detailed Product Specification[1]

Model Name: R930-S9320	Part Number: PT331U-01C002	UPC: 022265195505

Operating System C1 2
- Genuine Windows® 7 Professional 64-bit , SP1
- Genuine Windows® 7 Professional 32-bit , SP1

Processor[3] and Graphics[4]
- Intel® Core™ i5-3320M Processor
  - 2.60 GHz (3.30 GHz with Turbo Boost Technology), 3MB Cache
- Mobile Intel® QM77 Express Chipset with AMT 8.0
- Mobile Intel® HD Graphics with 64MB-1696MB dynamically allocated shared graphic memory

Memory[5]
- Configured with 4GB DDR3 1600MHz (max 8GB)
- 2 memory slots. One slot occupied.

Storage Drive[6]
- 320GB (7200 RPM) Serial ATA hard disk drive
- TOSHIBA Hard Drive Impact Sensor (3D sensor)

Fixed Optical Disk Drive[7]
- DVD SuperMulti drive supporting 11 formats
  - Maximum speed and compatibility: CD-ROM (24x), CD-R (24x), CD-RW (16x), DVD-ROM (8x), DVD-R (8x), DVD-R DL (6x), DVD-RW (6x), DVD+R (8x), DVD+R DL (6x), DVD+RW (8x), DVD-RAM (5x)

Display[8]
- 13.3" diagonal widescreen TFT display at 1366 x 768 native resolution (HD)
  - Native support for 720p content
  - 16:9 aspect ratio
  - LED backlit

Sound
- Built-in stereo speakers

Input Devices
- Premium Keyboard
- Touch pad pointing device with multi-touch control
- Touch pad Enable/Disable
- Control Buttons:
  - TOSHIBA eco utility™ (Energy-saving mode)
  - Touchpad on/off
  - Presentation button

Communications
- Webcam and microphone
- Intel® 82579LM Gigabit Network Connection (10/100/1000)
- Intel® Centrino® Advanced-N 6235 (a/g/n)[9]
- Intel® Wireless Display Ready[10](WiDi Technology Capable)
- Bluetooth® version 4.0

Expandability
- ExpressCard™ /54 slot (supports ExpressCard™ /34)
- Memory Card Reader
  - Secure Digital, Secure Digital High Capacity, Mini SD Card, Micro SD Card, SDXC, Multi Media Card [shared slot may require adapter for use]

Ports
- Video
  - RGB
  - HDMI®
- Audio
  - Microphone input port
  - Headphone output port
- Data
  - 3 USB ports (2 USB 3.0[11] port + 1 USB v2.0 ports (eSATA/USB combo with USB Sleep and Charge[12]))
  - RJ-45 LAN port
  - Docking connector
- Security
  - Fingerprint Reader
  - Slot for security lock

Physical Description
- Magnesium Alloy Casing in Black
- Dimensions (W x D x H Front/H Rear): 12.44" x 8.94" x 0.72"/1.05" without feet
- Weight: Starting at 3.1 lbs. depending upon configuration[13]

Power
- 65W (19V 3.42A) 100-240V/50-60Hz AC Adapter.
- Dimensions (W x H x D): 4.25" x 1.81" x 1.16"
- Weight: starting at 0.49 lbs.

Battery[14]
- 6 cell/66Wh Lithium Ion battery pack
- Battery Life Rating (measured by MobileMark™ Productivity 2007)
  - Included 6 cell battery: up to 10 hours, 15 minutes

Toshiba EasyGuard®[15]
- Protect & Fix
  - HALT Tested Design
  - LCD Cover Face and Point pressure Resistant Design
  - Hinge Design Enhancement
  - Spill Resistant Keyboard
  - TOSHIBA HDD protection (3D Accelerometer)
  - TOSHIBA PC Diagnostic Tool
  - TOSHIBA PC Health Monitor
  - TOSHIBA Shock Protection System
- Secure
  - Execute Disable Bit
  - Fingerprint Reader (includes software for password and identity management)
  - Multiple-Level Password Utilities
  - Reinforced Security Cable Lock Slot
  - TOSHIBA Secure Digital Token Utility
  - Trusted Platform Module v1.2
- Connect
  - Bluetooth Stack for Windows by Toshiba
  - Diversity Antenna
  - TOSHIBA ConfigFree®
  - Voice-over-IP Ready Design
  - Wireless Communication On/Off
- Optimize
  - FN Shortcut Keys
  - TOSHIBA Assist
  - TOSHIBA eco Utility™
  - TOSHIBA Disc Creator
  - TOSHIBA Device Access Control
  - TOSHIBA Power Management Extension
  - TOSHIBA Password Utilities
  - TOSHIBA Recovery Media Creator
  - TOSHIBA Sleep Utility
  - TOSHIBA Zooming Utility

Software C1 16
- Toshiba Software and Utilities
  - Bluetooth Monitor
  - TOSHIBA App Place℠
  - TOSHIBA BookPlace™
  - TOSHIBA Bulletin Board
  - TOSHIBA Face Recognition
  - TOSHIBA Fingerprint Utility
  - TOSHIBA HDD/SSD Alert
  - TOSHIBA Password Utility
  - TOSHIBA ReelTime
  - TOSHIBA Laptop Check

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- TOSHIBA PC Health Monitor
- TOSHIBA Resolution+® Upconvert Technology for Media Player[17]
- TOSHIBA Service Station
- TOSHIBA Smart Client Manager
- TOSHIBA Value Added Package
- TOSHIBA Web Camera Application

- Third-party Software
  - Adobe® Acrobat® Reader
  - Google® Toolbar
  - Google® Chrome
  - Intel® Wireless Display 3.0[18]
  - Internet Explorer® 9
  - Microsoft® Office Starter 2010[19]
  - Microsoft® Windows Media Player 12
  - Microsoft® Silverlight™
  - Microsoft® Live Essentials
    - Photo Gallery
    - Messenger
    - Mail
    - Writer
    - Movie Maker
- Special Offers and Trial Software
  - Norton Internet Security™ 2012 (30-day trial subscription)
  - QuickBooks® Online Banking
  - Skype®
  - Toshiba Online Backup (30-day trial subscription)

3 YEAR STANDARD LIMITED WARRANTY[20]

- Includes International Limited Warranty for obtaining service when traveling outside the United States.

Environmental Specifications

- This product is RoHS[21] compatible
- ENERGY STAR® Qualified
- EPEAT™ Gold Rated

	Operating	Non-operating
Temperature[22]	5° to 35° C	-20° to 65° C
Thermal Gradient	15° C per hour (max)	20° C per hour
Relative Humidity (non-condensing)	20% to 80%	10% to 90%
Altitude (relative to sea level)	-60 to 3,000 meters	-60 to 10,000 meters
Shock	10G	60G
Vibration	0.5G, 0.25G w/ODD	1.0G

Service Upgrades and Extensions

Toshiba offers many different enhanced services such as SystemGuard®, On-Site Repair, and ServiceExpress to provide additional support to your notebook PC. For a full description and complete list of programs and program terms and conditions, please visit www.support.toshiba.com.

Accessories

For additional and most updated accessories, please visit www.accessories.toshiba.com

Memory Upgrade

Part Number	Description
PA5037U-1M2G	Toshiba 2GB DDR3-1600MHz Memory Module
PA5037U-1M4G	Toshiba 4GB DDR3-1600MHz Memory Module
PA5037U-1M8G	Toshiba 8GB DDR3-1600MHz Memory Module

Power

Part Number	Description
PA3714U-1ACA	Toshiba 65W Global AC Adapter
PA3929U-1BRS	Toshiba Primary Li Ion Battery Pack (6 Cell)
PA3930U-1BRS	Toshiba Primary Extended Capacity Li Ion Battery Pack (9 Cell)

Expansion

Part Number	Description
PA3916U-1PRP	Toshiba Hi-Speed Port Replicator II

Bluetooth

Part Number	Description
PA3847U-1ETB	Toshiba Bluetooth Laser Mouse

Carrying Case

Part Number	Description
PA1502U-1SN3	Toshiba 13.3" Neoprene Case
PA1503U-1SL3	Toshiba 14" Sling Extreme Back Pack
PA1445U-1CS4	Toshiba 14.1" Envoy Ballistic Polyester Carrying Case

Storage

Part Number	Description
PA3877U-1M8B	Toshiba 8GB USB Hi-Speed Swivel-Retractable Flash Drive
PA3877U-1MAB	Toshiba 16GB USB Hi-Speed Swivel-Retractable Flash Drive
PA3877U-1MBB	Toshiba 32GB USB Hi-Speed Swivel-Retractable Flash Drive
HDTC605XW3A1	Toshiba 500GB USB 3.0 Canvio Portable Hard Drive, White
HDTC607XK3A1	Toshiba 750GB USB 3.0 Canvio Portable Hard Drive, Black
HDTC610XS3B1	Toshiba 1TB USB 3.0 Canvio Portable Hard Drive, Silver

Subject to Change

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[C1] ***64-bit computing:***
64-bit computing requires that the following hardware and software requirements are met:
- 64-bit Operating System
- 64-bit CPU, Chipset and BIOS (Basic Input/Output System)
- 64-bit Device drivers
- 64-bit applications

Certain device drivers and/or applications may not be compatible with a 64-bit CPU and therefore may not function properly. See "Detailed Specs" for more information.

[1] **Product Series Legal Footnote**. The product specifications and configuration information are designed for a product Series. Your particular model may not have all the features and specifications listed or illustrated. For more detailed information about the features and specifications on your particular model, please visit Toshiba's Web site at pcsupport.toshiba.com.

Product Offering Legal Footnote. Toshiba America Information Systems, Inc. reserves the right to modify or withdraw this offer at anytime without notice

[2] **Operating System**.

Also see ***64-Bit Computing*** Legal Footnote, if applicable.

Certain Microsoft® software product(s) included with this computer may use technological measures for copy protection. IN SUCH EVENT, YOU WILL NOT BE ABLE TO USE THE PRODUCT IF YOU DO NOT FULLY COMPLY WITH THE PRODUCT ACTIVATION PROCEDURES. Product activation procedures and Microsoft's privacy policy will be detailed during initial launch of the product, or upon certain reinstallations of the software product(s) or reconfigurations of the computer, and may be completed by Internet or telephone (toll charges may apply).

Some software may differ from its retail version (if available), and may not include user manuals or all program functionality.

Offers. Offer terms, duration and product availability all subject to change without notice

[3] **Processor (Central Processing Unit)**. Also see ***64-Bit Computing*** Legal Footnote, if applicable.

CPU performance in your computer product may vary from specifications under the following conditions:

1. use of certain external peripheral products
2. use of battery power instead of AC power
3. use of certain multimedia, computer generated graphics or video applications
4. use of standard telephone lines or low speed network connections
5. use of complex modeling software, such as high end computer aided design applications
6. use of several applications or functionalities simultaneously
7. use of computer in areas with low air pressure (high altitude >1,000 meters or >3,280 feet above sea level)
8. use of computer at temperatures outside the range of 5°C to 30°C (41°F to 86° F) or >25°C (77°F) at high altitude (all temperature references are approximate and may vary depending on the specific computer model – please visit the Toshiba website at www.pcsupport.toshiba.com for details).

CPU performance may also vary from specifications due to design configuration.

Under some conditions, your computer product may automatically shut-down. This is a normal protective feature designed to reduce the risk of lost data or damage to the product when used outside recommended conditions. To avoid risk of lost data, always make back-up copies of data by periodically storing it on an external storage medium. Use your computer product only under recommended conditions. Read additional restrictions under "Environmental Conditions" in your product "Detailed Specs." Contact Toshiba Technical Service and Support for more information.

[4] **Graphics (Graphics Processing Unit)**. GPU performance may vary depending on product model, design configuration, applications, power management settings and features utilized. GPU performance is only optimized when operating in AC power mode and may decrease considerably when operating in battery power mode.

Total Available Graphics Memory is the total of, as applicable, Dedicated Video Memory, System Video Memory and Shared System Memory. Shared System Memory will vary depending on system memory size and other factors.

[5] **Memory (Main System)**. Part of the main system memory may be used by the graphics system for graphics performance and therefore reduce the amount of main system memory available for other computing activities. The amount of main system memory allocated to support graphics may vary depending on the graphics system, applications utilized, system memory size and other factors. Computers configured with a 32-bit operating system can address up to 3GB of system memory. Only computers configured with a 64-bit operating system can address 4 GB or more of system memory.

[6] **Storage Drive**
Computer (Internal) HDD Capacity. One Gigabyte (GB) means 10^9 = 1,000,000,000 bytes using powers of 10. The computer operating system, however, reports storage capacity using powers of 2 for the definition of 1 GB = 2^{30} = 1,073,741,824 bytes, and therefore shows less storage capacity. Available storage capacity will also be less if the computer includes one or more pre-installed operating systems, such as Microsoft Operating System and/or pre-installed software applications, or media content. Actual formatted capacity may vary.

[7] **Optical Drive**. Due to manufacturing and quality variations in third party optical media (e.g., CD or DVD) or optical media players/recorders, in certain cases, your Toshiba optical drive may not record on certain optical media that bear the applicable logo, or playback optical media recorded by other PCs or optical media recorders. Additionally, certain optical media recorded on your optical drive may not playback or operate properly on other PCs or optical media players. These problems are not due to any defect in your Toshiba PC or optical drive. Please refer to your PC's product specification for listing of specific format compatibilities.

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Recording or viewing of certain optical media may be limited or prevented in accordance with applicable copy protection standards.

[8] **Display**. Small bright dots may appear on your screen display when you turn on your PC. Your display contains an extremely large number of thin-film transistors (TFT) and is manufactured using high-precision technology. Any small bright dots that may appear on your display are an intrinsic characteristic of the TFT manufacturing technology. Over a period of time, and depending on the usage of the computer, the brightness of the screen will deteriorate. This is also an intrinsic characteristic of the screen technology. When the computer is operated on battery power, the screen with dim and you may not be able to increase the brightness of the screen while on battery power.

[9] **Wireless-N**. The wireless adapter is based on a draft release version of the IEEE 802.11n specification, and may not be compatible with, or support all features (e.g., security) of, certain Wi-Fi® equipment.

[10] ***Intel® Wireless Display.*** Copy protection technology, if any, associated with the content may prevent or limit viewing of content.

[11] **USB 3.0.** 5Gbps is the maximum theoretical interface transfer rate per the specifications of the Universal Serial Bus 3.0. Actual transfer rate will vary depending on your system configuration and other factors.

[12] **USB Sleep & Charge**. The "USB Sleep & Charge function" may not work with certain external devices even if they are compliant with the USB specification. In those cases, turn the power of the computer ON to charge the device.

[13] **Weight**. Weight may vary depending on product configuration, vendor components, manufacturing variability and options selected.

[14] **Battery Life Rating**. Measured by MobileMark® 2007. MobileMark is a trademark of the Business Applications Performance Corporation. Rating based on either MobileMark Productivity 2007 modeling a user performing common mobile office activities or Reader 2007 modeling a user reading documents. See "Detailed Specifications" for test used.

Details of MobileMark 2007 testing are available at www.bapco.com

Rating is for comparison purposes only, and does not indicate the battery life that will be obtained by any individual user. Actual battery life may vary considerably from specifications depending on product model, configuration, applications, power management settings and features utilized, as well as the natural performance variations produced by the design of individual components. The battery life rating is only achieved on the select models and configurations tested by Toshiba under the specific test settings at the time of publication and is not an estimate of a system's battery life under any conditions other than the specific test settings.

After a period of time, the battery will lose its ability to perform at maximum capacity and will need to be replaced. This is normal for all batteries.

[15] **EasyGuard**. Toshiba EasyGuard™ technology comprises a number of features some of which may or may not be available on a particular Toshiba notebook depending on the model selected. See www.easyguard.toshiba.com for detailed information.

[16] **Software**. Some software may differ from its retail version (if available), and may not include user manuals or all program functionality.

Certain Microsoft® software products (including Microsoft Office Small Business Accounting if applicable) included with this computer may use technological measures for copy protection. IN SUCH EVENT, YOU WILL NOT BE ABLE TO USE THE PRODUCT IF YOU DO NOT FULLY COMPLY WITH THE PRODUCT ACTIVATION PROCEDURES. Product activation procedures and Microsoft's privacy policy will be detailed during initial launch of the product, or upon certain reinstallations of the software products or reconfigurations of the computer, and may be completed by Internet or telephone (toll charges may apply).

Internet access is required to enable certain functionality of certain Microsoft products(including Microsoft Office Small Business Accounting 2006) which may be included with this computer.

[17] **Upconverter/UpconversionTechnology (Resolution+® Technology).** Viewing enhancements may vary depending upon content quality and display device capability/functionality/settings. Depending on the quality of the content, some video noise may be visible.

[18] **Intel® Wireless Display. Copy protection technology, if any, associated with the content may prevent or limit viewing of content.**

[19] **Microsoft Office Starter 2010.** Office Starter consists of reduced-functionality versions of Word and Excel with advertising. PowerPoint, Outlook, OneNote, Access and Publisher are not included.

[20] **Warranty:** The terms and conditions of Toshiba's standard limited warranty are available at www.warranty.toshiba.com.

[21] **RoHS.** This notebook is compatible with European Union Directive 2002/95/EC, Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS), which restricts use of lead, cadmium, mercury, hexavalent chromium, PBB, and PBDE. Toshiba requires its notebook component suppliers to meet RoHS requirements and verifies its suppliers' commitment to meeting RoHS requirements by conducting component sampling inspections during the product design approval process.

[22] **Temperature (Environmental) Conditions**. All temperature references are approximate and the performance of your computer may vary from specifications even when operating within the recommended temperature range.

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D435

Use Environment	Indoor/Outdoor
Depth Technology	Active IR Stereo (Global Shutter)
Main Intel® RealSense™ component	Intel® RealSense™ Vision Processor D4 Intel® RealSense™ module D430
Depth Field of View (FOV)—(Horizontal × Vertical × Diagonal)	85.2° x 58° x 94° (+/- 3°)
Depth Stream Output Resolution	Up to 1280 x 720
Depth Stream Output Frame Rate	Up to 90 fps
Minimum Depth Distance (Min-Z)	0.2m
Sensor Shutter Type	Global shutter
Maximum Range	Approx.10 meters; Varies depending on calibration, scene, and lighting condition
RGB Sensor Resolution and Frame Rate	1920 x 1080 at 30 fps
RGB Sensor FOV (Horizontal x Vertical x Diagonal)	69.4° x 42.5° x 77° (+/- 3°)
Camera Dimension (Length x Depth x Height)	90 mm x 25 mm x 25 mm
Connectors	USB 3.0 Type - C
Mounting Mechanism	One 1/4-20 UNC thread mounting point Two M3 thread mounting points

APPENDIX F

SOURCE CODES

APPENDIX F

SOURE CODES

Weight computation codes:

```
import urllib.request
import json
import numpy as np
import cv2
import threading
from time import *
import pyrealsense2 as rs
import math
import tkinter as tk
import PIL
from PIL import Image, ImageTk
from scipy import ndimage

server = chr(102) + chr(105) + chr(114) + chr(101) + chr(97) + chr(108) + chr(97) + chr(114) + chr(109)

# 18000: 1400   18000:1200  947:600
# 42053: 1800   42053:1800  42053:1800



#cm = 400/24053
#cb = 26474200/24053

#cm = 600/24053
#cb = 18063600/24053
```

```
#cm = 200/9989
#cb = 5574000/9989



debug_color_mode = False
capture_mode = False
apply_distance_gradiant = False
force_name = True
capture_delay = 2
capture_video_start_count = 1
camera_size = 0 # 0 for small, 1 for large
main_window = None
list_monitor_id = ['827112071323', '819612070633', '827112071349']

#
=====================================================================
=====================================================================
=======================================


# Change to pick monitor Value
monitor_number = 1

debug_mode = False
send_to_server = True
show_method = True
force_name_rgb = "rgb_4"
force_name_depth = "depth_4ft_13"

#
=====================================================================
=====================================================================
=======================================
```

```
userID = "CHWT_{}".format(monitor_number)
img = np.arange(0, 256, 1, dtype = np.uint8)
temp_lut = cv2.applyColorMap(img, cv2.COLORMAP_JET)
lut = cv2.cvtColor(temp_lut, cv2.COLOR_BGR2GRAY)

cam_width = 640
cam_height = 480

cam_1 = None
cam_2 = None
frame_global_color = None
frame_global_depth = None

pipeline = None
device = None

cam_scale = cam_width/1280

image_frame_delay = 0.025

ch_press = None

still_living = True

save_loc = "CascadeTraining"
sample_loc = "ChickenSamples"

cascade_lbp_detector = cv2.CascadeClassifier('chicken_LBP_Detector.xml')
```

```
capture_video = "Sample {}"

capture_count = 0

capture_started = False

thressh_max_diff = 15
thressh_max_intensity = 120
thresh_size_min = 20000 * cam_scale * cam_scale
thresh_size_max = 50000 * cam_scale * cam_scale
thresh_pix_count = 800
thresh_red_advantage = 9
thresh_limit_diff = 8

rectangle_scale_val = 1.7

kernel = np.ones((2, 2), np.uint8)

string_to_send = ""
string_ready = False

#
==================================================================
==================================================================
=====================================



class MainWindow:
    def __init__(self, master=None, software_debug=None):
        software_debug = False if software_debug is None else software_debug
```

```
self.master = tk.Tk() if master is None else master
self.master.title("Chicken Weight")

self.panel_0 = None
self.panel_1 = None

if software_debug:
    self.master.geometry("660x850+0+0")
else:
    self.master.config(cursor="none")
    self.master.attributes('-fullscreen', True)
    self.master.geometry("{}x{}+0+0".format(self.master.winfo_screenwidth(),
self.master.winfo_screenheight()))

self.master.resizable(width=True, height=True)

self.master.configure(relief="ridge")
self.master.configure(background="#ffffff")

self.master.update()
self.Canvas_Main = tk.Canvas(self.master, highlightthickness=0)
self.Canvas_Main.configure(background="#ffffff")
self.Canvas_Main.place(x=0,
                y=0,
                height=self.master.winfo_height(),
                width=self.master.winfo_width())
self.master.update()

self.canvas_vid_0 = tk.Canvas(self.Canvas_Main, highlightthickness=0)
self.canvas_vid_0.configure(background="#000000")
```

```
self.canvas_vid_0.place(x=10,
                        y=0,
                        height=cam_height - 100,
                        width=cam_width)

self.canvas_vid_1 = tk.Canvas(self.Canvas_Main, highlightthickness=0)
self.canvas_vid_1.configure(background="#000000")
self.canvas_vid_1.place(x=10,
                        y=cam_height + 10 - 100,
                        height=cam_height - 100,
                        width=cam_width)

self.master.update()

self.L_Label_0 = tk.Label(self.Canvas_Main,
                               justify=tk.CENTER)
self.L_Label_0.configure(font=('Times New Roman', 12, 'bold'))
self.L_Label_0.configure(background="#FFFFFF")
self.L_Label_0.configure(foreground="#000000")
self.L_Label_0.configure(text='Chicken Count:')
self.L_Label_0.place(x=50,
                          y=780,
                          height=20,
                          width=200)

self.L_Label_1 = tk.Label(self.Canvas_Main,
                          justify=tk.CENTER)
self.L_Label_1.configure(font=('Times New Roman', 12, 'bold'))
self.L_Label_1.configure(background="#FFFFFF")
self.L_Label_1.configure(foreground="#000000")
```

```
self.L_Label_1.configure(text='Average Chicken Weight:')
self.L_Label_1.place(x=200,
                     y=780,
                     height=20,
                     width=400)

self.L_Chicken_Count = tk.Label(self.Canvas_Main,
                                justify=tk.CENTER)
self.L_Chicken_Count.configure(font=('Times New Roman', 20))
self.L_Chicken_Count.configure(background="#FFFFFF")
self.L_Chicken_Count.configure(foreground="#000000")
self.L_Chicken_Count.configure(text='0')
self.L_Chicken_Count.place(x=50,
                           y=800,
                           height=30,
                           width=200)

self.L_Average_Weight = tk.Label(self.Canvas_Main,
                                 justify=tk.CENTER)

self.L_Average_Weight.configure(font=('Times New Roman', 20))
self.L_Average_Weight.configure(background="#FFFFFF")
self.L_Average_Weight.configure(foreground="#000000")
self.L_Average_Weight.configure(text='0')
self.L_Average_Weight.place(x=200,
                            y=800,
                            height=30,
                            width=400)
self.master.update()
```

```
    def change_image(self, image, disp):
        if image is not None:
            _image = ImageTk.PhotoImage(Image.fromarray(image))
            if disp == 0:
                if self.panel_0 is None:
                    self.panel_0 = tk.Label(self.canvas_vid_0, image=_image)
                    self.panel_0.image = _image
                    self.panel_0.pack(side="left", padx=10, pady=10)
                else:
                    self.panel_0.configure(image=_image)
                    self.panel_0.image = _image
            else:
                if self.panel_1 is None:
                    self.panel_1 = tk.Label(self.canvas_vid_1, image=_image)
                    self.panel_1.image = _image
                    self.panel_1.pack(side="left", padx=10, pady=10)
                else:
                    self.panel_1.configure(image=_image)
                    self.panel_1.image = _image

    def change_label(self, count, mass):
        self.L_Chicken_Count.configure(text='{}'.format(count))
        self.L_Average_Weight.configure(text='{:.2f}'.format(mass))



def initialize_camera():
    global cam_1, cam_2,out,out1
    global pipeline, device
    global x
```

```
    if debug_mode:
        if force_name:
            cam_1 = cv2.VideoCapture("{}/{}.avi".format(sample_loc, force_name_rgb))
            cam_2 = cv2.VideoCapture("{}/{}.avi".format(sample_loc, force_name_depth))
        else:
            cam_1 = cv2.VideoCapture("{}/Sample {}.avi".format(sample_loc,
capture_video_start_count))
            cam_2 = cv2.VideoCapture("{}/Depth {}.avi".format(sample_loc,
capture_video_start_count))
    else:
        pipeline = rs.pipeline()
        config = rs.config()
        config.enable_stream(rs.stream.depth, cam_width, cam_height, rs.format.z16, 30)
        config.enable_stream(rs.stream.color, cam_width, cam_height, rs.format.bgr8, 30)
        #fourcc = cv2.VideoWriter_fourcc(*'XVID')
        #out1 = cv2.VideoWriter('Depth_4.avi',fourcc,5.0,(cam_width, cam_height))
        #out = cv2.VideoWriter('Rgb_4.avi',fourcc,5.0,(cam_width, cam_height))
        device = pipeline.start(config)


def camera_preview_loop():
    global ch_press, string_to_send, string_ready
    while still_living:
        if capture_mode:
            if frame_global_color is not None:
                frame_res_1 = frame_global_color.copy()
                cv2.imshow('Color', frame_res_1)
        else:
            if (frame_global_color is not None) and (frame_global_depth is not None):
                frame_color = frame_global_color.copy()
```

```
frame_depth = frame_global_depth.copy()
#out.write(frame_global_color)
#out1.write(frame_global_depth)
depth_mask = cv2.cvtColor(frame_global_color.copy(), cv2.COLOR_BGR2GRAY)
(thresh, depth_mask) = cv2.threshold(depth_mask, 255, 255, cv2.THRESH_BINARY)
chicken_count_lbp = cascade_lbp_detector.detectMultiScale(frame_color, 1.1, 7)

actual_chicken_count = 0
actual_chicken_area = 0

string_to_send = ""

ave_chicken_weight = 0
chicken_count = 0


for (x, y, w, h) in chicken_count_lbp:
  cropped_img_1 = frame_global_color[y:y + h,
                         x:x + w]

  gray_img_1 = cv2.cvtColor(cropped_img_1, cv2.COLOR_BGR2GRAY)
  (thresh, im_bw) = cv2.threshold(gray_img_1, 127, 255, cv2.THRESH_BINARY | cv2.THRESH_OTSU)

  param_mask = im_bw.copy()
  param_mask = cv2.erode(param_mask, kernel, iterations=10)
  param_mask = cv2.dilate(param_mask, kernel, iterations=12)
  param_mask = cv2.erode(param_mask, kernel, iterations=2)
```

```
param_pix_count = np.sum(param_mask > 0)

param_average = cv2.mean(cropped_img_1, param_mask)
param_diff = [abs(param_average[0] - param_average[1]),
              abs(param_average[1] - param_average[2]),
              abs(param_average[0] - param_average[2])]

if (w*h > thresh_size_min) and (w*h < thresh_size_max): # Size Limitation
    if debug_color_mode:
        cv2.rectangle(frame_color, (x, y), (x + w, y + h), (255, 0, 0), 5)
    if max(param_diff) < thressh_max_diff: # Color Limitation
        if debug_color_mode:
            cv2.rectangle(frame_color, (x, y), (x + w, y + h), (0, 0, 255), 5)
        if max(param_average) > thressh_max_intensity:
            if debug_color_mode:
                cv2.rectangle(frame_color, (x, y), (x + w, y + h), (255, 255, 0), 5)
            if param_pix_count > thresh_pix_count:
                if debug_color_mode:
                    cv2.rectangle(frame_color, (x, y), (x + w, y + h), (0, 255, 255), 5)
                if (max(param_diff) - min(param_diff)) < thresh_limit_diff:
                    if debug_color_mode:
                        cv2.rectangle(frame_color, (x, y), (x + w, y + h), (255, 255, 255), 5)
                    if ((param_average[0] + param_average[1])/2) - param_average[2] < thresh_red_advantage:
                        x2, y2, w2, h2 = widen_rectangle(x, y, w, h, rectangle_scale_val)
                        area_calculation_box = np.zeros((w2, h2, 1), np.uint8)
                        cropped_img_x = frame_color[y2:y2 + h2, x2:x2 + w2]
```

```
gray_cropped_img_x = cv2.cvtColor(cropped_img_x, cv2.COLOR_BGR2GRAY)
(thresh, bw_cropped_img_x) = cv2.threshold(gray_cropped_img_x, 127, 255,
        cv2.THRESH_BINARY | cv2.THRESH_OTSU)
bw_cropped_img_x2 = cv2.erode(bw_cropped_img_x.copy(), kernel, iterations=7)
bw_cropped_img_x2 = cv2.dilate(bw_cropped_img_x2, kernel, iterations=7)
bw_cropped_img_x3 = remove_garbage(bw_cropped_img_x2)

bw_cropped_img_x4 = cv2.bitwise_and(bw_cropped_img_x, bw_cropped_img_x, mask=bw_cropped_img_x3)
bw_cropped_img_x5 = cv2.bitwise_not(remove_garbage(cv2.bitwise_not(bw_cropped_img_x4)))
bw_cropped_img = remove_garbage(bw_cropped_img_x5)

cv2.rectangle(depth_mask,
    (x2, y2),
    (x2 + w2, y2 + h2),
    255,
    cv2.FILLED)
cv2.rectangle(frame_depth,
    (x2, y2),
    (x2 + w2, y2 + h2),
    (255, 255, 255),
    3)

contours, hierarchy = cv2.findContours(bw_cropped_img, cv2.RETR_EXTERNAL , cv2.CHAIN_APPROX_TC89_L1)
```

```
cnt = contours[0]
ellipse = cv2.fitEllipse(cnt)
center, meas, angle = cv2.fitEllipse(cnt)
ellipse_a = meas[1] / 2
ellipse_b = meas[0] / 2
ellipse_shifted = cv2.fitEllipse(cnt + (x2, y2))

cv2.ellipse(gray_cropped_img_x, ellipse, 255, 2)
cv2.ellipse(bw_cropped_img, ellipse, 255, 2)
cv2.ellipse(area_calculation_box, ellipse, 255, -1)

cv2.ellipse(frame_color, ellipse_shifted, (0, 255, 0), 2)


actual_chicken_area = actual_chicken_area + np.sum(bw_cropped_img > 0)
actual_chicken_area2 = np.sum(area_calculation_box > 0)
actual_chicken_count = actual_chicken_count + 1

chick_volume = int((4/3)*math.pi*ellipse_a*ellipse_b*((ellipse_a + ellipse_b)/2))
#chick_volume = -2e-7x^6+4e-5x^5-0.0037x^4+0.1238x^3-0.0768x^2+13.198x+30.
if show_method:       #features of chicken
    print("{}  :  {:10}    {:10}    {:10}".format(
            actual_chicken_count,
            actual_chicken_area,
            actual_chicken_area2,
            chick_volume) +
        "  -  {:10}    {:10}    {:10}".format(
```

```
int((actual_chicken_area / 100) * (actual_chicken_area2 / 1000)),
int((actual_chicken_area / 100) * (chick_volume / 1000)),
int((actual_chicken_area / 100) * (actual_chicken_area2 / 1000))) +
" - {:10} {:10} {:10} {:10}".format(
int((actual_chicken_area / 100) * (actual_chicken_area2 / 1000)* center[1]),
int((actual_chicken_area / 100) * (chick_volume / 1000)* center[1]),
int((actual_chicken_area / 100) * (actual_chicken_area2 / 1000)* center[1]),
int((chick_volume / 1000) * center[1])) +
" - {:10} {:10} {:10} {:10}".format(
int((actual_chicken_area) * (actual_chicken_area2 / 1000) / center[1]),
int((actual_chicken_area) * (chick_volume / 1000) / center[1]),
int((actual_chicken_area) * (actual_chicken_area2 / 1000) / center[1]),
int((chick_volume) / center[1])))

#cv2.imshow('0', gray_cropped_img_x)
#cv2.imshow('Chicken', bw_cropped_img)
#cv2.imshow('Binary', im_bw)
#cv2.imshow('BitwiseAnd', bw_cropped_img_x4)
#cv2.imshow('BitwiseNot', bw_cropped_img_x5)
#cv2.imshow('grayscale', gray_img_1)


# usable_value = int((chick_volume) / center[1])
```

```
                        calculated_mass = (int((63.323*(chick_volume)**0.2573)))
                        cv2.putText(frame_color,
                            "{:.2f}".format(calculated_mass),
                            (int(center[0] + x2 - 30), int(center[1] + y2 + 8)),
                            cv2.FONT_HERSHEY_SIMPLEX,
                            .8,
                            (255, 100, 100),
                            2,
                            cv2.LINE_AA)

                        ave_chicken_weight = ave_chicken_weight + calculated_mass
                        chicken_count = chicken_count + 1
            chicken_count
            if chicken_count == 0:
                ave_chicken_weight = 0;
            else:
                ave_chicken_weight = ave_chicken_weight/chicken_count
            string_to_send = "{}:{:.2f}".format(chicken_count, ave_chicken_weight)
            string_ready = True
            # cv2.imshow('Depth Masked', frame_depth_masked)
            #
            # cv2.imshow('Color', frame_color)
            # cv2.imshow('Depth', frame_depth)

            main_window.change_image(frame_color, 0)
            main_window.change_image(frame_depth, 1)
            main_window.change_label(chicken_count, ave_chicken_weight)
            # sleep(0.2)
        ch_press = cv2.waitKey(20)
```

```
def cam_capture_loop():
    global frame_global_color, frame_global_depth
    global capture_started, capture_video, capture_video_start_count
    global cam_1, cam_2

    while still_living:
        if debug_mode:
            ret1, frame1 = cam_1.read()
            ret2, frame2 = cam_2.read()
            if capture_mode:
                if capture_started:
                    if frame1 is None:
                        capture_started = False
                        print("Next Video")
                        capture_video_start_count = capture_video_start_count + 1
                        cam_1 = cv2.VideoCapture(
                            "{}/{}.avi".format(sample_loc,
capture_video.format(capture_video_start_count)))
                        cam_2 = cv2.VideoCapture(
                            "{}/{}.avi".format(sample_loc,
capture_video.format(capture_video_start_count)))

            if (frame1 is not None) and (frame2 is not None):
                capture_started = True
                frame_global_color = cv2.resize(frame1, (0,0), fx=cam_scale, fy=cam_scale)
                temp_frame_global_depth = cv2.resize(frame2, (0,0), fx=cam_scale,
fy=cam_scale)
                if apply_distance_gradiant:
```

```
                temp_frame_global_depth = cv2.cvtColor(temp_frame_global_depth,
cv2.COLOR_BGR2GRAY)
                frame_global_depth = cv2.LUT(temp_frame_global_depth, lut)
            else:
                frame_global_depth = temp_frame_global_depth
        sleep(image_frame_delay)
    else:
        frames = pipeline.wait_for_frames()
        depth_frame = frames.get_depth_frame()
        color_frame = frames.get_color_frame()
        if (color_frame is not None) and (depth_frame is not None):
            raw_frame_global_depth = np.asanyarray(depth_frame.get_data())
            frame_global_color = np.asanyarray(color_frame.get_data())
            temp_frame_global_depth =
cv2.applyColorMap(cv2.convertScaleAbs(raw_frame_global_depth,
                                                                alpha=0.155),
                                                                cv2.COLORMAP_JET)
            if apply_distance_gradiant:
                temp_frame_global_depth = cv2.cvtColor(temp_frame_global_depth,
cv2.COLOR_BGR2GRAY)
                frame_global_depth = cv2.LUT(temp_frame_global_depth, lut)
            else:
                frame_global_depth = temp_frame_global_depth


def save_image_loop():
    global capture_count
    while still_living:
        if (frame_global_color is not None) and capture_started:
            cv2.imwrite("{}/{} ({}).jpg".format(save_loc,
                                    capture_video.format(capture_video_start_count),
                                    capture_count),
```

```
                                frame_global_color);
        print("Save {} {}".format(capture_video.format(capture_video_start_count), capture_count))
        capture_count = capture_count + 1
        sleep(capture_delay)


def send_to_server():
    global string_ready


    while True:
        while not string_ready:
            sleep(0.1)


        if not string_to_send == "":
            new_body = {
                "userID": "{}".format(userID),
                "data": "{}".format(string_to_send)
            }
            json_post("http://" + server + "server.ddns.net/soap-client.php", new_body)
        string_ready = False
        sleep(2)



def json_post(endpoint, body):
    try:
        params = json.dumps(body).encode('utf8')
        req = urllib.request.Request(
            endpoint,
            data=params,
            headers={
```

```
                'Content-Type': 'application/json',
                'User-Agent': 'Chrome'
            }
        )
        response = urllib.request.urlopen(req)
    except:
        return False
    return response


def widen_rectangle(x_in, y_in, w_in, h_in, scaler):
    w_out = (int)(w_in * scaler)
    h_out = (int)(h_in * scaler)
    x_out = (int)(x_in - (abs(w_in - (w_out))/2))
    y_out = (int)(y_in - (abs(h_in - (h_out))/2))

    x_out = 0 if x_out < 0 else x_out
    y_out = 0 if y_out < 0 else y_out

    return x_out, y_out, w_out, h_out


def remove_garbage(im_in):
    im_out = im_in.copy()
    nb_components, output, stats, centroids = cv2.connectedComponentsWithStats(
        im_out, connectivity=8)
    sizes = stats[1:, -1]
    nb_components = nb_components - 1

    min_size = max(sizes) - 1
```

```
    for i in range(0, nb_components):
        if sizes[i] < min_size:
            im_out[output == i + 1] = 0

    return im_out

#
```

APPENDIX G

USER MANUAL

CHICKPIC System

User’s Manual

CONTENT	PAGE
SAFETY INSTRUCTION	3
PARTS DESCRIPTION	4
OPERATION INSTRUCTION	5
MAINTENANCE INSTRUCTION	7

CAUTION

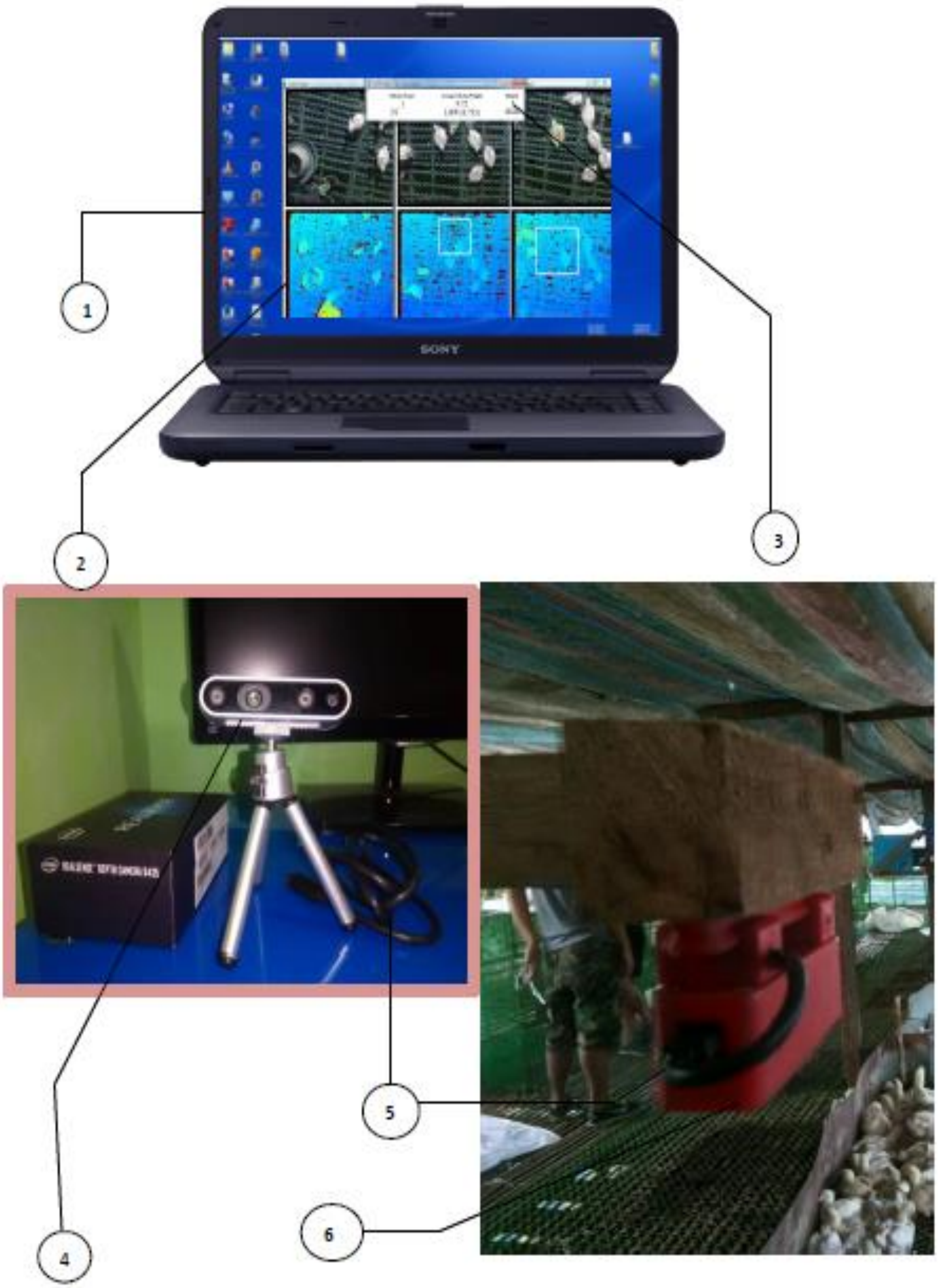
- Contact the authorized service technician for repair or maintenance of the laptop.
- The laptop is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the laptop by a person responsible for their safety.
- Children should be supervised to ensure that they do not play with the laptop.
- Please turn off and unplug the laptop before cleaning or maintenance

SAFETY INSTRUCTION

1. To avoid electric shock, fire or injury, please read the user manual carefully before using the laptop and keep it for future reference.
2. Never immerse the laptop used in the system in water or other liquids.
3. Please turn off the laptop when not in use otherwise it may result in danger.
4. Keep the laptop away from children.
5. The laptop is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the laptop by a person responsible for their safety.
6. With any indication of damage or malfunction, please stop using the laptop immediately to avoid hazards. Contact the ChickPic team for repair. Do not attempt to repair or change any parts by yourself.
7. Please turn off and unplug the laptop before cleaning or maintenance.
8. Clean the surface of the laptop with a dry cloth. Do not use corrosive detergent or solvent to clean. Do not wash the laptop with water.
9. Please turn off and unplug the laptop when not in use. Make sure the power is off before pulling out the plug and do not pull the cord.
10. When the laptop is not in use for a prolonged period, please turn it off, unplug it, pack it well, and store it in dry cool place.
11. Never install unnecessary programs that might slow down the laptop and make it prone to virus attack.
12. The laptop must be plugged into a specific socket for 220-240V and no less than 10A. Do not use any adapter or extension cord.
13. Always be aware of the camera position. Always tighten loose screws to prevent camera from falling.

PARTS DESCRIPTION

1.Laptop (Toshiba)	2. ChickPic Video capture and RGB
3.ChickPic weight GUI prediction	4. Intel RealSense Camera
5.USB 3.0 camera cable	6. Camera Holder


1
2
3
4
5
6
SONY

OPERATION INSTRUCTION

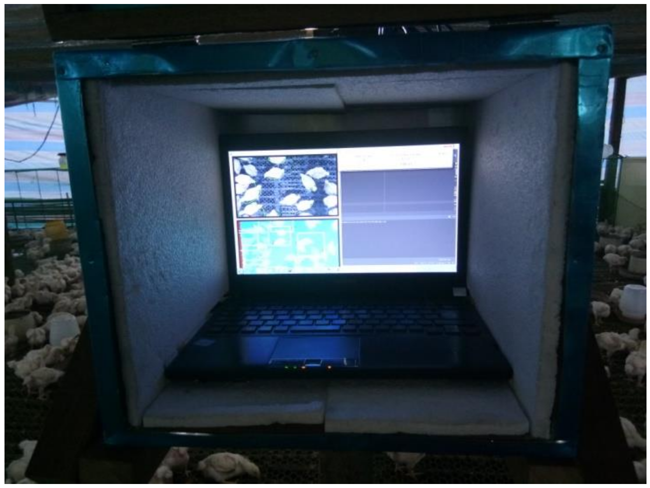
Setting up the Computer system

1. Plug in the computer system charger in a 220-240 V line.

2. Turn on the Toshiba laptop.

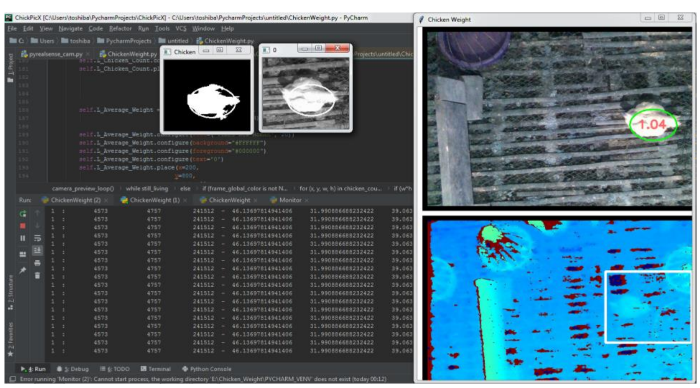
3. Check whether the laptop have sufficient battery charge to avoid interruption during the program execution.

3. Open the user's desktop.



Executing the program

1. In the desktop, open the Pycharm program.
2. Execute the chickpic.exe program at the upper right pane of the Pycharm environment by clicking the play button.
3.The program will then display the cameras real time video capturing.
4.To display the GUI for weight recommendations run the monitor.exe program still at the upper right pane. Just tab down the chickpic.exe program.
5. The program will then display the ChickPic GUI which includes the weight recommendation per day.
6.This will then be saved to the weight database to be accessed in any devices.



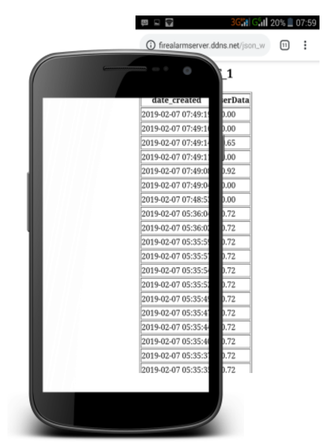
Checking the weight in the camera display

1. Using the Intel RealSense depth camera, the program displays the captured video and its equivalent RGB capture.
2. Wait for a chicken to stop at the view of the camera. It then detects the chicken.
3.The chicken will then be in an ellipse wherein weight prediction will be displayed next to the captured chicken.

Monitoring the weight online

User can access the ChickPic weight prediction in a computer, cellphone or any other internet connected devices using the database of the ChickPic program. Just go to systems website using the following link:

http://chickenweight.ddns.net



MAINTENANCE INSTRUCTION

Laptop

 Clean the laptop with dry cloth frequently. Never clean it with water directly.

 Don’t install unnecessary softwares to prevent memory corruption and virus attack.

 Always check the laptop chord for cut or looae wires

Real sense Camera

 The Realsense Camera is supported by a camera holder that is tightened by an allen screw and nut.

 Using the allen key included in the camera holder ,Loosen the screw until the camera fall out of the holder.

 Gently wipe the camera lens using a dry cloth or with an IPA.

 Reattach the camera in the holder using the allen key.

APPENDIX H

PROJECT DOCUMENTATION

APPENDIX H

PROJECT DOCUMENTATION

1. **Bureau of Fisheries and Aquatic Resources Personnel**

   a. **Dr. Maximo O. Cabilitazan**

   YCP Farms

   Production Manager-Broiler

   b. **Dr. Zenaida R. Rondilla**

   YCP Farms

   Technical Veterinarian

2. Documentation

Interview and consultation with Dr. Cabilitazan and Dr. Rondilla

Data Gathering

Manual Weighing Samples

Project Testing with Dr. Rondilla and Mang Lester

Proponents with their adviser

Engr. Nilo M. Arago

APPENDIX I

PROPONENTS' PROFILE

KYLA MARRY R. BARCO

#79-C Bayanan, Bacoor City, Cavite
Contact no.: 09434192056
barcokyla@gmail.com

OBJECTIVE

To obtain a position in a company and be flexible in a challenging environment that will utilize and enhance my abilities in the best possible way necessary for the electronics or communications industry.

EDUCATIONAL BACKGROUND

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
Ayala Blvd., Ermita, Manila
Bachelor of Science in Electronics Engineering
2013-present

IMUS INSTITUTE
Nueno Ave., Imus, Cavite
2009-2013

YOUNG SHEPHERD'S SCHOOL
San Nicolas, Bacoor, Cavite
2005-2009

ORGANIZATIONS | AFFILIATIONS

Organization of Electronics Engineering Students (OECES)
Technological University of the Philippines - Manila
Member, 2013-present
Membership Committee Senior Head, 2016-2017
Board of Directors Member, 2017-2018

Institute of Electronics Engineers of the Philippines
Manila Student Chapter (IECEP-MSC)
Member, 2015-present

SKILLS AND ABILITIES

- Sound knowledge of basic operating systems like Microsoft Excel, Word, PowerPoint, and Publisher
- Familiar with software tools like MATLAB, Python, NI Multisim, ExpressPCB, and DB Browser for SQLite
- Assembling consumer electronic product, soldering and troubleshooting

PERSONAL DATA

Last Name: Barco
First Name: Kyla Marry

Sex: Female
Birthdate: April 14, 1997
Age: 21
Citizenship: Filipino
Civil Status: Single

REFERENCES

Engr. Lean Karlo S. Tolentino
Department Head, College of Engineering, Technological University of the Philippines - Manila
09958925845

Ethel R. Kalinga
Production Operator, Analog Devices, Inc.
09193428039

I hereby attest that all the information I have rendered are true and correct to the best of my knowledge and belief.

Kyla Marry R. Barco
Applicant

LORIN C. BARNIDO JR.

L2 B7 Blueberry Extension Brgy. Rizal, Makati City
Contact no.: 09497936494
lorinbarnido24@gmail.com

OBJECTIVE

To obtain a position in a company and be flexible in a challenging environment that will utilize and enhance my abilities in the best possible way necessary for the electronics or communications industry.

EDUCATIONAL BACKGROUND

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
Ayala Blvd., Ermita, Manila
Bachelor of Science in Electronics Engineering
2014-present

BENIGNO "NINOY" S. AQUINO HIGH SCHOOL
Aguho St., Brgy. Comembo, Makati City
2010-2014

RIZAL ELEMENTARY SCHOOL
Milkweed St., Brgy. Rizal, Makati City
2004-2010

ORGANIZATIONS | AFFILIATIONS

Organization of Electronics Engineering Students (OECES)
Technological University of the Philippines - Manila
Member, 2014-present

Institute of Electronics Engineers of the Philippines
Manila Student Chapter (IECEP-MSC)
Member, 2016-present

DOST SCHOLARS' CLUB
Technological University of the Philippines – Manila
Member, 2014-present

BNAHS ROBOTICS CLUB
Benigno "Ninoy" S. Aquino High School
Member, 2012-2014

PHILIPPINE ROBOTICS NATIONAL TEAM
Philippine Team
Member, 2013-2014

SKILLS AND ABILITIES

- Basic knowledge in C#, Python, Java, Electronic workbenches, MATLAB, Lego Mindstorm EV3 Software
- Familiar in, Microsoft Office Applications, Adobe Photoshop
- Enthusiastic, optimistic, goal-oriented and focused

PERSONAL DATA

Last Name: Barnido
First Name: Lorin

Sex: Male
Birthdate: May 24, 1997
Age: 21
Citizenship: Filipino
Civil Status: Single

REFERENCES

Engr. Nilo M. Arago
College Secretary, College of Engineering, Technological University of the Philippines - Manila
09154688227

Engr. Lean Karlo S. Tolentino
Head, ECE Department, College of Engineering, Technological University of the Philippines - Manila
09958925845

I hereby certify that the following information are true and correct to the best of my knowledge.

Lorin C. Barnido Jr.
Applicant

ALEXANDER ANTHONY D.P. DOMINGO

1726 Abdon St. Otis Pandacan Manila
Contact no.: 09217655348
aadomingo1996@gmail.com

OBJECTIVE

To obtain a position in a company and be flexible in a challenging environment that will utilize and enhance my abilities in the best possible way necessary for the electronics or communications industry.

EDUCATIONAL BACKGROUND

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
Ayala Blvd., Ermita, Manila
Bachelor of Science in Electronics Engineering
2016-present

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
Ayala Blvd., Ermita, Manila
Electronics Engineering Technology
March 2016

ST. ANTHONY SCHOOL
Singalong, Manila
2009-2013

ST. ANTHONY SCHOOL
Singalong, Manila
2003-2009

ORGANIZATIONS | AFFILIATIONS

Organization of Electronics Engineering Students (OECES)
Technological University of the Philippines - Manila
Member, 2016-present

Institute of Electronics Engineers of the Philippines
Manila Student Chapter (IECEP-MSC)
Member, 2016-present

SKILLS AND ABILITIES

- Basic Electrical and Electronics
- Installation (CCTV system, FDAS, Intercom, etc.)
- Circuit design
- Wireless transmission
- Communications engineering

WORK EXPERIENCE	**Stelsen Corporation** Unit 41, Legaspi Suites, 178 Salcedo St., Legaspi Village, 1229 Intern, April 2015-October 2015
PERSONAL DATA	**Last Name:** Domingo **First Name:** Alexander Anthony **Sex:** Male **Birthdate:** November 21, 1996 **Age:** 22 **Citizenship:** Filipino **Civil Status:** Single
REFERENCES	**Engr. Nilo M. Arago** College Secretary, College of Engineering, Technological University of the Philippines - Manila 09154688227 **Engr. Lean Karlo S. Tolentino** Head, ECE Department, College of Engineering, Technological University of the Philippines - Manila 09958925845

I hereby certify that the following information are true and correct to the best of my knowledge.

Alexander Anthony D.P. Domingo
Applicant

ANTHONY JAM R. MERCADO

Blk. 81 Lot 3 Brgy. Ipil II, Silang, Cavite
Contact no.: 09218618669
manthonyjam@gmail.com

OBJECTIVE

To obtain a position in a company and be flexible in a challenging environment that will utilize and enhance my abilities in the best possible way necessary for the electronics or communications industry.

EDUCATIONAL BACKGROUND

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
Ayala Blvd., Ermita, Manila
Bachelor of Science in Electronics Engineering

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES - CAVITE
CQT Road Salawag, Dasmariñas, Cavite
March 2011

WORK EXPERIENCE

Line Maintenance Technician/Preventive Maintenance
Wafer Probe Department
Atmel/Microchip
August 2014-June 2015
102 Accuracy drive, Carmelray Industrial Park, Canlubang, Calamba City

OJT-Machine Operator
Final Test Department
ON Semiconductor Philippines Inc.
Governors Drive, Bo. Maduya, Carmona, Cavite

SKILLS AND ABILITIES

•Electronics Devices and Circuits Troubleshooting and Repair
•Computer Hardware Troubleshooting and Maintenance
•Computer Networking and OS Installation, Basic AutoCad
•Programming Skills -Java, Visual Basic, Assembly language, Turbo C, Pascal, Matlab, Android Application Development, HTML
•Machine Repair Skills-Magnum Tester, Personal Tester, Hard Dock/Soft Dock Tester,D 10), Grand tester; Electroglass Wafer Prober(4090,2001,TEL); Preventive Maintenance(Tester & Prober)

PERSONAL DATA

Last Name: Mercado
First Name: Anthony Jam

Sex: Male
Birthdate: October 10, 1991
Age: 27
Citizenship: Filipino
Civil Status: Single

REFERENCES

Joseph Palabrica
Line Supervisor, ON Semiconductor Phils., Inc.
808-38-01 loc 142

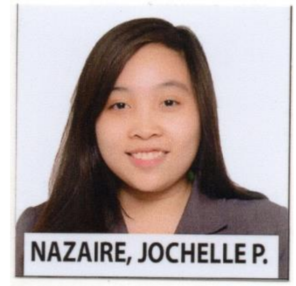
Jose Emelito Adato
Senior Equipment Technician, Microchip/ON Semiconductor Philippines
09393016813

Engr. Dennis Desacola
Wafer Probe Manager, Microchip Philippines
09177753497

I hereby certify that the following information are true and correct to the best of my knowledge.

Anthony Jam R. Mercado
Applicant

JOCHELLE P. NAZAIRE



Tabon 2, Kawit, Cavite
Contact no.: 09273627962
jochellenazaire@gmail.com

OBJECTIVE

To obtain a position in a company and be flexible in a challenging environment that will utilize and enhance my abilities in the best possible way necessary for the electronics or communications industry.

EDUCATIONAL BACKGROUND

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
Ayala Blvd., Ermita, Manila
Bachelor of Science in Electronics Engineering
2015-present

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
Ayala Blvd., Ermita, Manila
Electronics and Communications Engineering Technology
March 2015

EMILIANO TRIA TIRONA MEMORIAL NATIONAL HIGH SCHOOL
Gahak, Kawit, Cavite
2008-2012

AGUINALDO ELEMENTARY SCHOOL
Tabon, Kawit, Cavite
2002-2008

ORGANIZATIONS | AFFILIATIONS

Organization of Electronics Engineering Students (OECES)
Technological University of the Philippines - Manila
Member, 2015-present

Institute of Electronics Engineers of the Philippines
Manila Student Chapter (IECEP-MSC)
Member, 2015-present

SKILLS AND ABILITIES

- Basic knowledge in Python, Java, MatLab
- Familiar in MS Office
- Basic knowledge in troubleshooting laptop computers
- Enthusiastic, goal-oriented and hardworking

WORK EXPERIENCE

PHILKO UBINS LTD. CORP
3F D301, Tower D, Renaissance Tower, Pasig City
Intern, November 2018-February 2019

AFFILIATED ELECTRONICS SERVICE CORPORATION (ASERCO)
Walter Mart, Arnaiz Avenue, Makati
Intern, November 2014-March 2015

PERSONAL DATA

Last Name: Nazaire
First Name: Jochelle

Sex: Female
Birthdate: January 03, 1996
Age: 23
Citizenship: Filipino
Civil Status: Single

REFERENCES

Engr. Lean Karlo S. Tolentino
Head, ECE Department, College of Engineering, Technological University of the Philippines - Manila
09958925845

Engr. Nilo M. Arago
College Secretary, College of Engineering, Technological University of the Philippines - Manila
09154688227

I hereby certify that the following information are true and correct to the best of my knowledge.

Jochelle P. Nazaire
Applicant

JOHN CONRAD I. SANCHEZ

#36 Payna St. Billiones Cmpd. Veterans Vill. Proj. 7,
Quezon City
Contact no.: 09297584131
rhadsanchez@gmail.com

OBJECTIVE

To obtain a position in a company and be flexible in a challenging environment that will utilize and enhance my abilities in the best possible way necessary for the electronics or communications industry.

EDUCATIONAL BACKGROUND

TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES
Ayala Blvd., Ermita, Manila
Bachelor of Science in Electronics Engineering
2013-present

SAN FRANCISCO HIGH SCHOOL
C.P. Tinga Sports Complex, Hagonoy, Taguig City
2009-2013

ST. CATHERINE COLLEGE OF VALENZUELA
Valenzuela City
2003-2009

ORGANIZATIONS | AFFILIATIONS

Organization of Electronics Engineering Students (OECES)
Technological University of the Philippines - Manila
Vice President for Internal Affairs, 2017-2018
Documentation Senior Committee Head, 2016-2017
Member, 2013-2018

Institute of Electronics Engineers of the Philippines
Manila Student Chapter (IECEP-MSC)
Member of Board of Director, 2018-2019
Member, 2015-2018

SKILLS AND ABILITIES

- Basic knowledge in programming (MATLAB, Multisim, Eclipse)
- Familiar in Microsoft Office, Adobe Photoshop, Adobe After Effects, SketchUp, SolidWorks
- Good communications skills (oral and written)
- Work in team environment
- Enthusiastic, optimistic, goal-oriented and focused

PERSONAL DATA

Last Name: Sanchez
First Name: John Conrad

Sex: Male
Birthdate: March 12, 1997
Age: 21
Citizenship: Filipino
Civil Status: Single

REFERENCES

ENGR. LEAN KARLO S. TOLENTINO
Instructor 1, Department of Electronics Engineering
College of Engineering, TUP-Manila
(+63)995-892-5845
301-3001 local 503

ENGR. JOHN ROBERT H. MALIT
Design Engineer, Lattice Semiconductor
09974831630

I hereby certify that the following information are true and correct to the best of my knowledge.

John Conrad I. Sanchez
Applicant