BelcherReporter: Anti - Smoke Belching Cast Application

A Capstone Research Proposal
Presented to the Faculty of the
College of Computer Studies, University of Cebu – Banilad

In Partial Fulfillment of the Requirements
For the degree Bachelor of Science in Information Technology

By
Azucena Tupia
Aisa Arreglado
Dexel Mayad
Annelyn Cortes
Ivory Myrhh Villarin

Mr. Eric Ortega
Adviser

October 2017

ACKNOWLEDGEMENT

The completion of this study will not be possible without the presence and help of the following:

First of all, we would like to offer our utmost gratitude to Mr. Eric Ortega, our Capstone Project Adviser for his time in listening to our ideas and checking our works. Thank you for your presence, advice, patience, and for the inspirations.

To our Capstone Subject Adviser, Mrs. Moma Ortega, our warmest appreciation for sharing us your critical ideas and aspiring comments for the foundation of our study.

To our grammarian, Mrs. Miriam Flores, we are very thankful for your efforts in checking and improving our grammars and formats for the reliability of our study.

To our parents, and families, thank for believing that we can make this. We appreciate your supports such as care, time, and financial.

To those who are not mentioned, thank you for the support that you have bestowed to our studies. These will surely be appreciated as we mould ourselves to be better individuals and will reached success in the future.

To our Lord God, the Father in heaven, thank you for the life which you have given to us. Thank you for all the knowledge and wisdom to think and made this studies possible.

The Researchers

Azucena Tupia

Aisa Arreglado

Dexel Mayd

Annelyn Cortes

Ivory Myrrh Villarin

Dedication

To Faculty Instructors and Students

To University of Cebu Banilad

To Land Transportation Office

To Filipino Citizens

To Father in Heaven

To Our Family

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Air pollution is one of the major problems that long exist in our country. It is a contamination of the air that affects people's health in many ways. According to the latest records from the Department of Environment and Natural Resources showed that Metro Manila's air quality situation has worsened in terms of total suspended particulates from 106 µg/Ncm from July to December 2014 to 130 µg/Ncm from January to April this year (Uy, 2017).

It is likely for us people who suffer from certain environmental pollution to at least keep our precious lives away from harm. As a citizen, you would probably want to have a control with your surrounding especially to those irresponsible people who doesn't have concern with the health of the people around them. Individual is capable of taking care and saving mother earth. Since the world in has an outrageous counts of successful technology inventions and the power of technology is almost inevitable, it is time now to use it as a tool that will help individuals take control the violators by using the power of humanity. With this tool, saving mother earth is in each other's hand.

Rationale of the Study

As earth grows older, innovation is at its highest development too. One of the technologies that sync to the growth of innovation is the smart phone. A new research has found that people are obsessed with this portable handheld device. Some studies found out that the heaviest smartphone user's click, tap, or swipe on their phone 5,427 times a day and the rest still touch this device by 2,617 times a day on average (Nelson, 2017). Almost every person of this age uses smartphone on their daily basis and activities. According to report of app Annie, people launch an average of at least 9 apps per day and it's a habit already (Perez, 2017). Regardless of age, over 1.8 billion are using smart phone daily (William, 2014).

Several studies concluded that smartphones can be used to save lives and report violations. According to AMTA (Australian Mobile Telecommunication Association) report , the use of smartphones has the advantage of immediacy of access, in particular situations such as road traffic incidents , outdoor accidents, and injuries occurring at any areas especially in rural areas (2012). Accidents, violations and calamities are being reported or disseminated via social app like facebook , twitter and instagram.

The proposed system is called “BelcherReporter Application”, it is a smoke belchers reporting application. The system has feature design to address the common problem of the LTO, drivers, DENR, and public citizens for their daily transportation and activities.

For concerned citizen and health conscious, the system has a feature that could capture smoke belchers plate numbers and send it to LTO main office and road patrol. The system uses OCR (Optical Character Recognition) to analyze and recognize the characters from the captured images and it will automatically gather data from the LTO database then notify the smoke belcher’s complete information to LTO.

Upon opening the app the GPS automatically turn on to record the exact location where the violator is being captured. The application uses (Global Positioning System) for actual map. The purpose of GPS is for whenever a report has been made the LTO road patrol could immediately track the location of the violator or they could be aware if the violator is within their assigned areas.

To lessen the illegal activities regarding smoke belching, the system will provide the emission tester information of the violator including its complete address. The purpose of this feature is to identify the emission testing centers that violated the rules related to the qualification for passing the emission testing.

The application will suggest to users the nearest emission testing centers and the application has booking reservations for emission testing to provide more convenient services. It has also a search engine that could help user to search the location of the specified emission testing center. In addition, it also has a feature wherein it can save captured images whenever the user is offline and it will be automatically sent to LTO when online, it has send later button. The purpose of this feature is to prevent data loss.

The system restricts the users aside from LTO and road patrol from searching and viewing complete information of the smoke belchers. The only users allowed to search and view the complete information of smoke belchers are the authorized users such as the assigned personnel from the LTO and main office. The only feature that is enabled to non authorized user are capturing smoke belchers plate numbers, searching emission testing centers, reservations and view history.

In order to have an effective regulation, citizen’s goal must be in the same manner. The system aims to provide features that could help minimize air pollution. Apart from that, it could also solve the citizen’s attitudes towards implemented regulations and laws. Millions of eyes are the only solution to minimize air pollution and prevent violators from violating.

Objective of the study

This study aims to develop a smoke belching-reporting application.

To achieve this aim, the following specific objectives are as follows:

1. to gather data on the problems encountered by the citizens and LTO in smoke belching;
2. to determine appropriate methods and tools to convert image to text.
3. to identify techniques and tools on how to report violators; and
4. to define a notification scheme in tracking the violators.

Scope and Limitation of the Study

This study will develop a mobile application that will allow the public to report any type of vehicles that are running in the streets that emit black smoke to LTO. This application is called "Belch Reporter". The study is only limited to the anti-smoke belching violators. The application requires enabling of the Location or the Global Positioning Device (GPS) in order to provide accurate location where the picture or video is taken. Internet Connectivity is also necessary in sending information to the concerned agency. Moreover, the application will run on android mobile devices with Android API level 16 as the minimum SDK up to the latest.

The "BelcherReporter Application" consists of the following features: Optical Character Recognition (OCR), which converts violator's plate number image to text and will automatically search into LTO database and provide data, such as name of the person with whom the vehicle is registered, address and other important data. Another feature is the auto location detector of the reporter. To provide ease access and accurate location, GPS will automatically enable as soon as the app is open or access. Also the app has Use Offline or Send Later feature. User can still use the app without Internet connection but can't send the info gathered to the LTO yet. As soon as the user is connected to the Internet, the data will be sent to the LTO office. Lastly, the app suggests nearby emission testing centers around the area of the user with its corresponding location and allows user to book reservation for emission testing.

Significance of the Study

This study is a significant endeavor in minimizing the air pollution and solves the citizen's attitude regarding rules and regulations being implemented. Upon completion, this study will be beneficial to the following entities:

Citizen. The citizens will benefit most of this study because this will address the rampant problem which is the air pollution. This study aims to minimize the air pollution. As a result, everyone in the community will be able to enjoy a clean and healthy environment. The study will design an app that is easy to use and user friendly.

DENR (Department of Environment and Natural Resources). The department is responsible for the cleanliness of the environment for the assurance of the health of the citizen. The system is beneficial to the department for the reason that this could lessen the smoke belchers which is a high contributor of air pollution. This could help DENR in minimizing air pollution because most of the people nowadays are using smartphone which is very convenient and fast in reporting the violation.

LTO (Land Transportation Office). This study is also beneficial to the LTO since they are tasked to implement the anti-smoke belching law. This will help LTO to catch the violators easily with the cooperation of the reporter. In addition, instead of conducting random checking along the street and utilizing quite a number of personnel, LTO personnel will now have to wait for the reports to come from the user or reporter through the app.

Emission Testing Center. Emission testing centers plays a great factor in minimizing the air pollution. The study will help market the different services being offered by emission testing centers which is the online reservations and provides complete details of the location of the emission testing centers.

Researcher. This study will serve as a reference in the development of the project. It will be a great opportunity for the researchers to showcase the knowledge and skills gained in school and be able explores it. As the study progress, researchers learn new things and experiences that is beneficial to the completion of the study and even to the researcher's personal development.

Future Researcher. This study is beneficial to the future researchers who desire to study the system further. The study will serve as a guide and open for enhancement or development.

Flow of the Study

This section provides the process on developing our system. It is the step by step process on how the system is created. The inputs, designs, and other components that will be using for the task to be done on time.

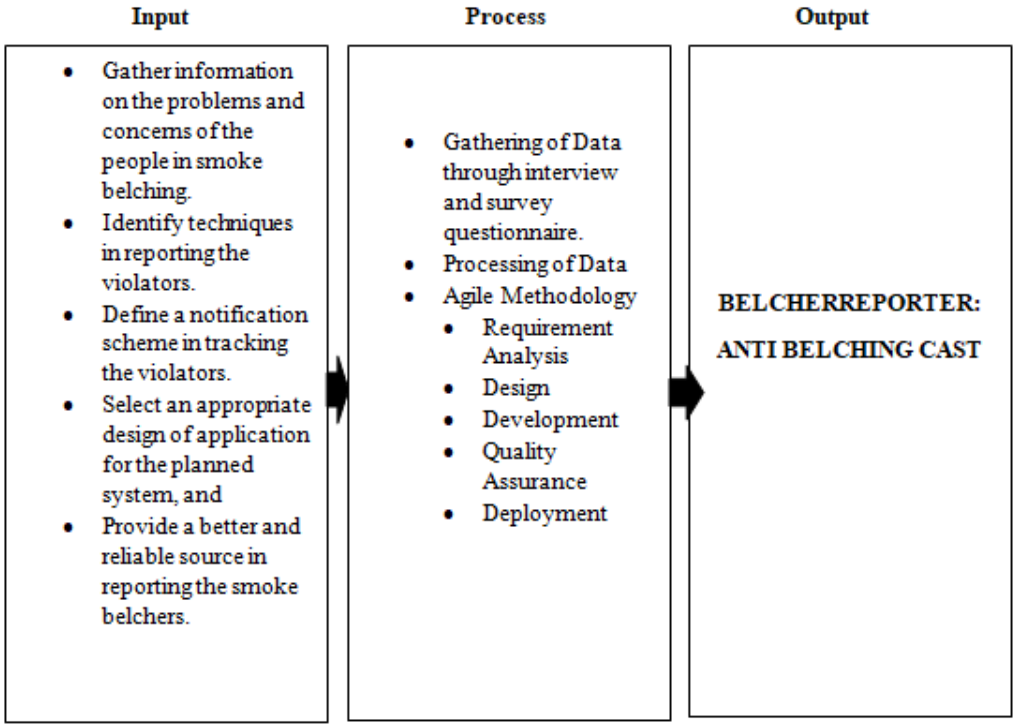

Figure 1: **Flow of the Study**

Figure 1 shows the flow on how the system will work and divided into three parts, the input, the process and the output. These are the phases that need to be followed for the project to be successfully completed.

The inputs are the data gathered by the researchers through interview from citizen. The problems encountered of the citizens in smoke belching on how smoke belching affects daily living. Determine the techniques and tools in tracking the violators in order for the concern citizen to have the power to report smoke belcher through the use of smartphone. And define a notification scheme on reporting violators directly to the Land Transportation Office (LTO).

For the process, the researchers choose agile development methodology in implementing the software development. Identifying requirements for the system, design phase, development of the system that could anticipate possible changes, quality assurance phase, and the deployment phase.

The output was created by analyzing and brainstorming of the information gathered from the citizens. And the researchers come up with the idea called “BelcherReporter: Anti Belching Cast” for the citizen to help them report smoke belchers through smartphones.

Definition of Terms

To avoid misunderstanding of terminologies that we used, here are the words that we defined operationally.

Methods and Tools to Minimize Smoke – Belcher – refers to the things that should be use and the systematic way of planning on how to prevent vehicles emit black smoke.

Notification Scheme in Tracking the Violators – notify and send picture to the nearest LTO (Land Transportation Office) who violates the smoke belching law.

Problem encountered by the citizens – problems on how smoke belching affect citizens to daily lives specifically when commuting.

Smoke Belcher – a vehicle who emit gas forcefully and the number one contributor to air pollution.

Smoke Belching Violators - refers to any public/private vehicle that violates the smoke belching law.

Techniques and Tools Reporting the Violators – refers to the other way of reporting smoke belchers, how to detect the vehicle’s plate number and also the vehicle’s location so that LTO can track violators.

CHAPTER II

REVIEW OF RELATED LITERATURE AND STUDIES

This section tackles a thorough discussion about the smoke belching ideas, generalizations or conclusions, methodologies, and others. To obtain a wide understanding on the objectives of the study. Those that were included in this chapter helps in familiarizing information that is relevant to the study.

Related Literatures

Smoke belching is the forceful expulsion of smoke from the vehicle's pipe. This is the number one major contributor to air pollution. Laws were passed to stop smoke belching and full force exerted to further protect the environment from air pollution (Mycee, 2012).

A look at how to access the location information or the geotag data attached to a photo and make use of this information to find where exactly the photos were taken. The cameras on almost all smartphones have GPS function built right into them. The moment you take a photo, your camera records the GPS Coordinates of the location at which the photo was taken and tags this information in the photo (Waseem Patwegar, 2017).

Automatic Number Plate Recognition (ANPR) is an image processing technology which uses number (license) plate to identify the vehicle. The objective is to design an efficient automatic authorized vehicle identification system by using the vehicle number plate. The system is implemented on the entrance for security control of a highly restricted area like military zones or area around top government offices e.g. Parliament, Supreme Court etc. The developed system first detects the vehicle and then captures the vehicle image. Vehicle number plate region is extracted using the image segmentation in an image. Optical character recognition technique is used for the character recognition. The resulting data is then used to compare with the records on a database so as to come up with the specific information like the vehicle's owner, place of registration, address, etc. The system is implemented and simulated in Matlab, and it performance is tested on real image. It is observed from the experiment that the developed system successfully detects and recognize the vehicle number plate on real images (Qadri et al, 2009).

Car cultures have social, material and, above all, affective dimensions that are overlooked in current strategies to influence car-driving decisions. Car consumption is never simply about rational economic choices, but is as much about aesthetic, emotional and sensory responses to driving, as well as patterns of kinship, sociability, habitation, and work. Through a close examination of the aesthetic and especially kinesthetic dimensions of automobility, this article locates car cultures (and their associated feelings) within a broader physical/material relational

setting that includes both human bodies and car bodies, and the relations between them and the spaces through which they move (or fail to move). Drawing on both the phenomenology of car use and new approaches in the sociology of emotions, it is argued that everyday car cultures are implicated in a deep context of affective and embodied relations between people, machines and spaces of mobility and dwelling in which emotions and the senses play a key part – the emotional geographies of car use. Feelings for, of and within cars ('automotive emotions') come to be socially and culturally generated across three scales involved in the circulations and displacements performed by cars, roads and drivers: embodied sensibilities and kinesthetic performances; familial and sociable practices of 'caring' through car use; and regional and national car cultures that form around particular systems of automobility. By showing how people feel about and in cars, and how the feel of different car cultures generates habitual forms of automobilized life and different dispositions towards driving, it is argued that we will be in a better position to re-evaluate the ethical dimensions of car consumption and the moral economies of car use (Mimi Sheller, 2004).

At a typical checkpoint, spotters identify smoke-belching vehicles visually, and relay their description to flaggers, who stop the vehicles for on-the-spot testing. A device called opacimeter is then used to analyze the vehicle's exhaust. After testing, vehicles found to be in violation have their license plates removed, and the operator is issued a citation and instructed to make necessary repairs (Legitipines, 2013).

The implementation of the city's anti-smoke belching ordinance is part of the overall efforts of the local government to significantly reduce the pollutants in the city's air due to emissions from motor vehicles plying the various roads in the city daily and that it is the local version on how to effectively and efficiently implement the provisions of the Clean Air Act. The proposal was referred to the City Council Committee on Ecology, Environmental Preservation and Health and Sanitation for the conduct of appropriate study and recommendation in future deliberations of the local legislative body (Dexter See, 2017).

This section presents how smoke belching contributed to air pollution, and how essential the devices, and emission testing center prevent or lessen the smoke belching from vehicles. This section also covers the implemented solutions aiding the growing concerns about smoke belching from vehicles, it also shows its advantages. Technology today is now used to create and improve solutions to problems. Through using previous studies it would help the researchers impound, and improve the existing solutions by making new ideas, concepts, and features that can be used in the future as a new and, helpful tool for everyone.

Related Studies

In the study entitled “Development of a Real-Time Smoke Belching Monitoring System for Public Utility Vehicles (PUV) via GSM” their system is designed in order to monitor smoke belchers or violators among public utility vehicles (PUV) that uses diesel such as jeepneys and buses. The concept of the project is to measure the opacity of the smoke being emitted by the PUV. The system then sends the data (Plate Number and K -value) for every one (1) hour to the Database System and to the operator with the aid of GSM Microcontroller that leads to a real time monitoring. The system is possible to implement and has a potential to be used for emission testing centers since it has the features of the commercial opacity meter which is common in emission centers to measure the smoke emitted by the diesel-fueled vehicles. This project serves as an innovation in emission testing because it monitors the smoke belchers in real-time and operators or owners of the vehicle are not required anymore to go to the emission testing center every year to renew their car registration (Rodelas et al, 2016).

In the study entitled “The Corrective Violation Ticket: A Realistic Approach to Smoke-Belching” have resorted to conducted random testing, through the use of checkpoints set up at temporary sites along Metro Manila roadways. At a typical checkpoint, spotters identify smoke-belching vehicles visually, and relay their description to flaggers, who stop the vehicles for on-the-spot testing. A device called an opacimeter is then used to analyze the vehicle’s exhaust. After testing, vehicles found to be in violation have their license plates removed, and the operator is issued a citation and instructed to make necessary repairs. Confiscated license plates are turned over to the Land Transportation Office (LTO). To reclaim his plates, a violator must obtain an Emissions Clearance certificate from an accredited emission-testing center. Then he must present the clearance certificate, and pay the fine, at the LTO. This is intended to ensure that non-compliant vehicles are repaired before being allowed to return to the road (Michael Brown, 2012).

In this study “Case Study: Task Force Tambutso” in its implementation, the community or general public must participate in the campaign to minimize air pollution by reporting the violators to the concerned government agency or report to civil society advocates or the media. Another move is to increase the number of days on roadside inspection. The Land Transportation Office (LTO) must strictly implement the rules and give the maximum penalty as provided by law (Cadiz et al, 2013).

In the study about “Smoke Belching” smoke belching vehicle owners shall be confronted, penalized, and their vehicle plate numbers withheld unless the offending vehicles would be tested, cleaned up and certified clean by the Roadside Inspection, Testing and Monitoring Team (RITM). The RITM, of the Clean Air Monitoring Unit, under the City Parks Management Office shall undertake said monitoring. Deputized police officers shall be with the team and assisted by the Department of Transportation and Communication. The teams shall flag down vehicles with visible dark emissions, test the said vehicles, and issue appropriate citations (Michael Bandiola, 2013).

A Fast Exhaust-Gas Analyzer for the ITER fusion Experiment Divertor is another study that presents first demonstration of a radio frequency excited optical gas analyser designed to quantitatively measure minority species inside the neutralization region of the ITER experiment divertor. The sensor head, which creates its own plasma excitation and plasma light emission, is designed to operate in a strong magnetic field, and the RF coupling leads to bright light emission. It also allows for operation at low voltages, avoiding the radiation-enhanced breakdowns expected when high voltages are present in the ITER environment. Furthermore, the preferred sensor head features full isolation of the metal RF electrodes from the induced plasma. It will permit long operation without frequent maintenance (Klepper et al, 2010).

The reservation tool works in combination with the grid engine queuing system so that users have all the conveniences of a queuing system, provided they have made a reservation on the Web to acquire nodes. Using the queuing system has several benefits, such as starting the job, or jobs, when the reservation starts, generating the machine file for MPI jobs, and providing accounting services. Development of the reservation system has been a learning process for all involved. The objective of this paper is to provide a technical overview of this HPC reservation system. In addition, there will also be a discussion on how the system may be used to meet the demands of various types of research. The development cycle of the reservation system will be discussed, specifically giving a timeline as to when and why various features were added. There will also be a discussion on the operational policies governing the system and the rationale for those policies. The data collected from the system, has been in production for a full year, will be analyzed to show various metrics related to utilization. This data will help to gauge the success of this program (Randy et al, 2007).

The Related Studies presents the existing application, their features and the benefits they contribute. The study shows the possible solution for smoke belching offered in order to address the concern growth of air pollution caused by smoke belching for this is the number one contributor to air pollution. Through reviewing the related studies, it would help the researchers in gaining new insights about smoke belching, and the possible improvements for the smoke belching.

TABLE 1

COMPARATIVE MATRIX

Related Studies	**Features**	**Limitations**
(1) Name: Reduce Black Smoke in Diesel Engine URL: https://www.bellperformance.com/bell-performs-blog/how-to-reduce-black-smoke-in-diesel-engines Year: 2015 Proponents: 1. Erik Bjornstad	● A multifunctional treatment like DeeZol will clean out the deposits; ● A detergent additive to your diesel fuel on a regular basis	● Performs all the treatment manually; ● Does not notify any LTO offices about smoke belching; ● Does not have real time- update

TABLE 1.1

COMPARATIVE MATRIX cont'd

Related Literatures	**Features**	**Limitations**
(2) Name: New Combustion Concept for Ultra-Clean and High-Efficiency Small DI Diesel Engines URL: http://papers.sae.org/1999-01-3681/ Year: 1999 Proponents: 1. Shuji Kimura 2. Osama Aoki 3. Hiroshi Ogawa 4. Shigeo Muranaka 5. Yoshitero Enomoto	● Developed a new combustion concept, called Modulated Kinetics (MK), that reduces NOx and smoke simultaneously due to low temperature, and premixed combustion characteristics ● Combustions photographs and transient heat flux measurements ● Measures smoke and determines how bad it is	● Does not update real time; ● Does not modify violators for smoke belching

TABLE 1.2

COMPARATIVE MATRIX cont'd

Related Studies	**Features**	**Limitations**
(3) Name: Measuring the Emissions of Passing Cars URL: http://pubs.acs.org/doi/abs/10.1021/ar950240x Year: 1996 Proponents: 1. G. A. Bishop 2. D. H. Stedman	● Measures hydrocarbons, carbon monoxide, nitric oxide, etc. ● Clean mixtures of smoke ● Records bad smoke	● Perform or cleans the mixture smoke one a year or every after 3 years ● Does not modify violators
(4) Name: The Correlative Violation Ticket: A Realistic Approach to Smoke Belching URL: http://www.investphilippines.info/arangkada/the-corrective-violation-ticket-a-realistic-approach-to-smoke-belching/ Year: 2012 Proponents: 1. Michael Brown	● Violations Ticketing System ● A device called an opacimeter is used to analyse the vehicles exhaust ● Checkpoint method for the smoke belching violators ● Obtain an Emissions Clearance certificate from an accredited emission-testing center	● Does not include real time update for the violators ● Manual ticketing process ● Automatic notifications for violators does not apply directly to the LTO database ● Does not set current locations for smoke belching violators ● Does not include nearest emission testing branches

TABLE 1.3

COMPARATIVE MATRIX cont'd

Related Literatures	**Features**	**Limitations**
(5) Name: Development of a Real-Time Smoke Belching Monitoring System for Public Utility Vehicles (PUV) via GSM URL: http://www.apjmr.com/wp-content/uploads/2016/04/APJMR-2016.4.2.01.pdf Year: 20126 Proponents: 1. Nelson C. Rodelas 2. Paraluman G. Sim 3. Angelita D. Guia	● Measure the opacity of the smoke being emitted by the PUV ● A predesigned sensor unit incorporated by Light Dependent Resistor Sensor this is to allow smoke to pass through ● Sends data for every one hour to the Database System and to the operator with the aid of GSM Microcontroller that leads to real-time monitoring	● Designed and monitors only public vehicles ● Sends data every after one hour on the database ● Option to search nearby emission testing center is not supported ● Option to Global Positioning System(GPS) to nearby emission testing is not supported

TABLE 1.4

COMPARATIVE MATRIX cont'd

Related Literatures	**Features**	**Limitations**
(6) Name: Empowering Publics to Report Smoke Belching URL: http://www.topgear.com.ph/news/mmda-empowers-public-to-report-smoke-belchers Year: 2010 Proponents: 1. Robert Nacianceno 2. Oscar Inocentes	● Using your mobile phones you can capture smoke belching vehicles ● Send the photo through the MMDA hotline ● Upon receiving the mms, they will scour their databank to identify the culprits and send them a summons	● Internet connection

Table 1 is about the multifunctional treatment of a Black Smoke in Diesel engine and its procedure is manual. Table 1.1 is about the combustion concept and how their device computes the mixture of chemicals in producing black smoke, measures and determines how bad it is. Table 1.2 studies about the measuring of smoke belching vehicles and mixture of chemicals that produce black smoke, it also studies and focuses on the violations of smoke belching vehicles and its ticketing process. Table 1.3 studies about the Development of a Real-Time Smoke belching from Public Utility Vehicles (PUV) which sends data every one hour to the Database System of the LTO. Table 1.4 studies about The Reporting of Smoke Belching Vehicles from MMDA which anyone would send a mms through the MMDA hotline that includes the plate number of the vehicle and all the other important information.

Table 1 focuses on reducing the black smoke in Diesel Engine. Table 1.1 and 1.2 focuses on measuring the mixture of chemicals that produces black smoke, and also the monitoring of violations through ticketing process. Table 1.3 focuses on the study of a Real-Time Monitoring System for PUV and sends data from the database, and also measures the opacity of the smoke being emitted by the PUV. Table 1.4 focuses on the reporting of smoke belching vehicles in which everyone has the privileged to send a photo from the MMDA hotline, upon sending the mms it

should contain the current place of the smoke belching vehicles, the plate number of the vehicle and all of the important information, this would be seen from the databank of the MMDA which would serve them as a guide to identify the culprits and summon them upon violating. The table shows the difference and how the tables are categorized focusing on issues needs to be familiarized by the researchers.

The related studies served as a reference or a guide in developing on the proposed study, served as a basis on how to improve the issues of smoke belching and how to develop the smoke belching violators, an application that provides real-time update of reporting violators that directs to the Database of violation's and option to search nearby emission testing center and also provides GPS. Creating a smart solution for the problem of smoke belching vehicle violators and responsiveness which leads on creating an application called "BelcherReporter" and make use of smart technologies.

CHAPTER III
RESEARCH METHODOLOGY

This section discusses the methodology to be used for the development of the project. It covers the steps, techniques in implementing the different system requirements. The diagrams, tables and figures explain on how the analyzing and understanding of the specifications and features are to be done. This discusses the relationships of the variables and the phases to be used in order to meet the objectives of the project.

Software Engineering Methodology

The study will apply the Agile Methodology. Agile is an iterative approach to software delivery that builds software incrementally from the start of the project, instead of trying to deliver it all at once near the end (Rasmusson, 2014). The team decided to use agile as the methodology for developing the project since all the updates and changes can be easily identified and monitored during the development. The advantages of agile methodology are it is more efficient, adaptable, and flexible which results to less errors, bugs, and system failure.

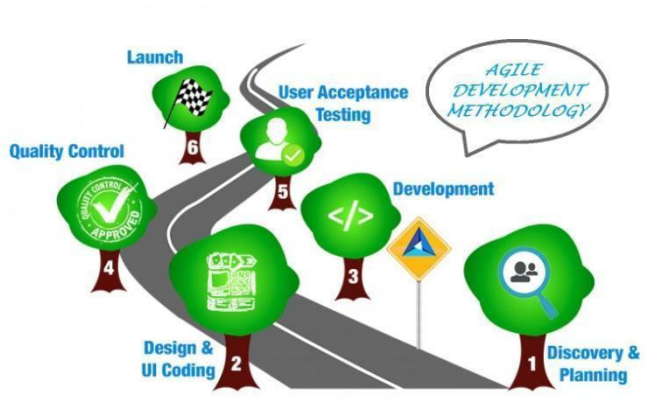

Figure 2: **Agile Development Methodology**

Figure 2 shows the specific functions to be used in different phases of agile methodology during the development of the project.

Requirement Analysis: The brainstorm phase. This phase will identify the system requirements. It involves the gathering of information and what method to be used in gathering the data. The proponents decided to use survey questionnaires in gathering data. Questionnaires will be distributed randomly to private drivers, public drivers, citizens, emission testing centers and LTO. The team will also conduct an interview to LTO and emission testing centers in order to

discuss the different processes to be followed related to the project. Moreover, during this phase the team will also be analyzing the flow of the project, discussing the tools to be used, measuring the compatibility of the software and how to overcome the loopholes and bugs that might be encountered during the development and gathering of information.

Design: This phase is refining of the identified system requirements and gathered information. Design phase tackles the mechanisms and algorithms on how to implement the system requirements and necessary deliverables such as the user interface designs, its back –ends and front – ends. The output of this phase will serve as the guide of the next phase.

Development: In this phase, the implementation of the required designs from the previous phase will be referred. It involves coding, debugging and unit testing of the specific functions and other system requirements. During this phase the project will be divided into modules and will be assigned to proponents following the procedures and timeline of the project to ensure the completion is on schedule. The team develops the system according to the system requirements.

Quality Assurance: This is also called the testing phase, this is the phase where the testing of the specifications and functions will be performed in order to measure if the project meets the system requirements. The team will perform several testing to insure the efficiency and accuracy of the system and other related requirements. Loopholes, errors, and bugs can be monitored and fixed during this phase. Thus, this is also a way of gaining the satisfaction and confidence of the customers. In addition, this could also give the percentage of the status of the project.

Deployment: In this phase, all the errors of the project are being fixed. Modules are being combined and tested. All the functions and specifications meet the system requirements. The project is ready to be released to the market.

Release to Market: This phase is all about marketing the project along with its agreement for technical support and maintenance to the clients. It also discusses the different methods or ways to be used in order to satisfy the client and for the system updates and maintenance.

Planning/Initiation Phase: The beginning of the study in which the different preparations is involved such as the feasibility study of the system requirements. This phase is presenting the timeline and different functionalities of the system.

Business Model Canvass

This section summarizes the entire business strategic management by presenting its activities and entities to exhibit its values.

Table 2

BUSINESS MODEL CANVASS

<table>
<tr><th>KEY PARTNERS</th><th>KEY ACTIVITIES</th><th>VALUE PROPOSITION</th><th>CUSTOMER RELATIONSHIP</th><th>CUSTOMER SEGMENTS</th></tr>
<tr><td rowspan="3">● Internet Providers
● Content Providers
● Carrier Providers
● Land Transportation Office</td><td>● Define and analyze the problem.
● Designing the platforms and architecture including its user interface design.
● Coding and testing the different specifications.
● Installation of the system to LTO.
● Downloading the application for mobile app.</td><td rowspan="3">● Minimize smoke belchers
● Provides search engine for emission testing centers.
● Sends warning to smoke belchers via text.
● Prevents the illegal activities during emission testing.
● Convenient and easy reservation process.</td><td>● System Updates & Maintenance</td><td rowspan="3">● Citizens
● LTO
● Private and Public Drivers
● Emission Testing Centers</td></tr>
<tr><td>KEY RESOURCES</td><td>CHANNELS</td></tr>
<tr><td>● Financial Resources
● Human Resources
● Intellectual Resources
● BelcherReporter Platform
● Internet or Data Connection
● Software and Tools Resources</td><td>● Google Play Store
● Land Transportation Office</td></tr>
<tr><td colspan="3">COST STRUCTURE</td><td colspan="2">REVENUE STREAM</td></tr>
<tr><td colspan="3">● Research and Development
● Advertisement</td><td colspan="2">● Updates and Maintenance Fee
● Sales</td></tr>
</table>

Table 2 explains the business canvass of BelcherReporter application. It shows the different activities and entities during the development. To clearly discuss the canvass, activities are categorized to make it easier to understand. The canvass is categorized to key partners, key activities, value proposition, customer relationship, customer segments, key resources, channels, cost structure, and revenue stream. These categories serve as an outline to the important activities and relationships in the system.

The key partner contains the essential stakeholder which provides the needed variables in order to complete the Belcher Reporter application. BelcherReporter application needs an internet for sending reports to lto, booking reservations to emission testing center and sending and receiving notifications. Carrier provider is one of the key partners for the system will send an sms to reported smoke belcher for the confirmation of the report and all necessary actions. Content provider is responsible for the development of the system, coding, debugging, and updates. And the Land Transportation Office is responsible for the strategies on how the system works. The important activities perform by the team during the development of the system is also presented in key activities from the first step to the end.

The value of proposition represents the objectives of the team in developing the system. It refers to the activities that could benefit the end users. The table also shows the customers and the relationship between the customers and the developers when the system is released to the market which is more on maintenance and technical support. Moreover, business canvass has key resources which state the resources to be use in developing the system; it involves costs, manpower, knowledge, internet and tools for the platform of BecherReporter application. The channel enumerates the store applications and the offices where it can be found. The table also shows cost of structure which shows the activities that involves cost such as the development of the system and advertisement. From the updates and maintenance is where the system could get revenues.

Program Workflow

This section illustrates the program workflow. The program workflow demonstrates how the system works, starting from registration to the actions to be performed by the LTO.

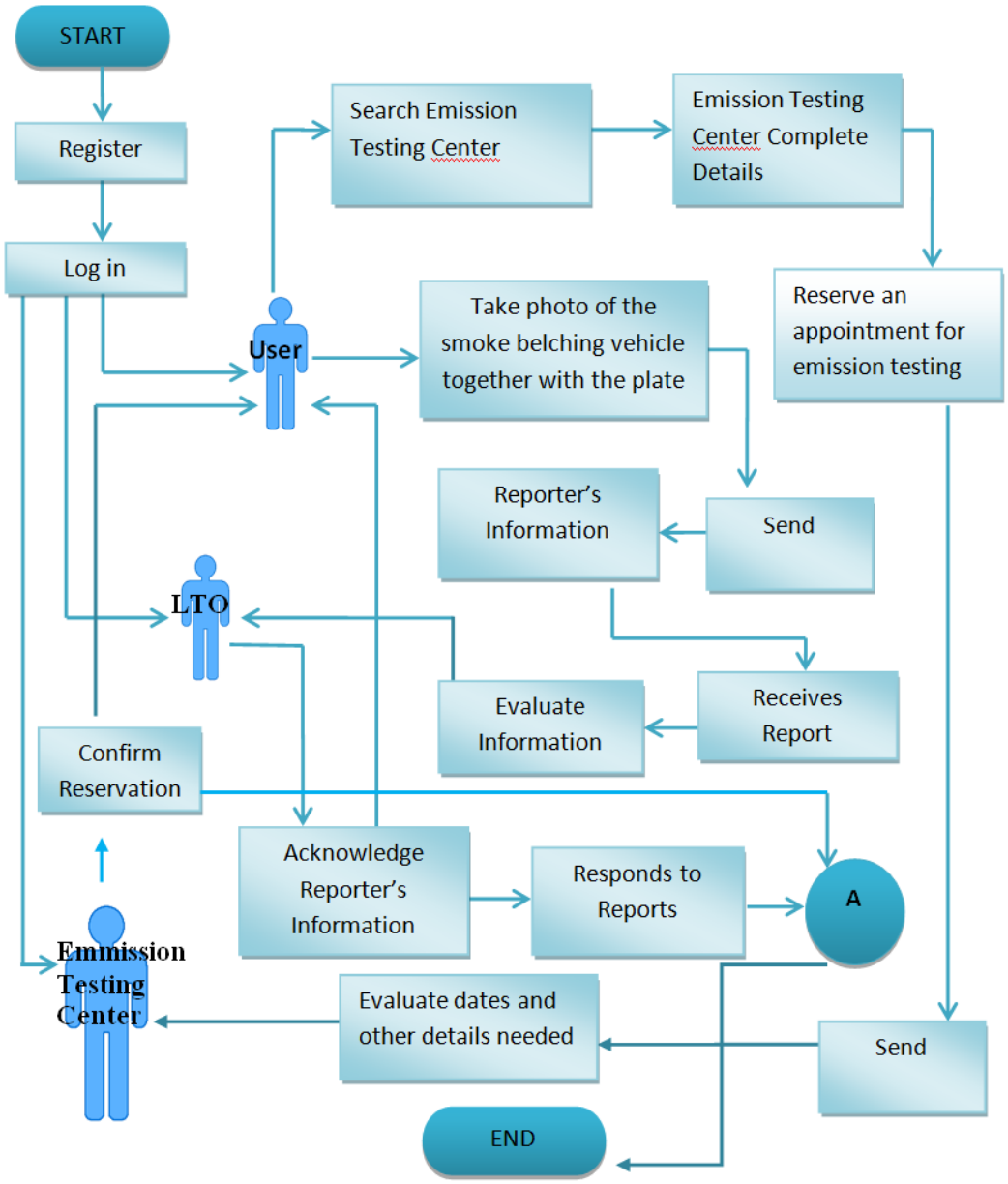

Figure 3: **Program Workflow**

Figure 3 shows the flow of the entire program. The user needs to register and provide the necessary information. Once registration is done, user can now log in to make use of the application. GPS will automatically enable every time the app is open. The user can now utilize the app as soon as initial requirements are met; taking photo of the smoke belching vehicle along with the plate

number is now possible. Using the application, the user will be able to send the captured images to the LTO database with the maximum numbers of three photos. LTO will then evaluate the reporter's reported information whether complaint made is valid or not. After the evaluation, LTO will then send out acknowledgement notice to the reporter and take necessary action when needed.

Aside from the functionalities mentioned above, the application has features that allow users to search the nearest emission testing centers or preferred centers for reservations. In addition, system will automatically send sms notification to reported violators for confirmation and for all necessary actions.

Gantt Chart

This section illustrates a project schedule of each researcher in developing the application.

Table 3

GANTT CHART

Task ID	Task Name	Task Lead	Start Date	End Date	July		August					Septeber				October		
					3	4	1	2	3	4	5	1	2	3	4	1	2	3
1	Acknowledgement	Aisa	9/23	10/13														
2	Dedication	Aisa	9/24	10/13														
3	Table of Contents	Aisa	9/25	10/13														
4	List of Tables	Aisa	9/26	10/13														
5	List of Figures	Aisa	9/27	10/13														
6	Rational of the Study	Aisa	7/30	8/28														
7	Objectives of the Study	Ivory	7/30	8/28														
8	Scope and Limitations of the Study	Cena	7/30	8/28														
9	Significance of the Study	Cena	7/30	8/28														
10	Flow of the Study	Dexel	7/30	8/28														
11	Definition of Terms	Dexel	7/30	8/28														
12	Related Literatures	Annelyn	7/30	8/28														
13	Related Studies	Annelyn	7/30	8/28														
14	Comparative Matrix	Annelyn	7/30	8/28														
15	Software Engineering Methodology	Aisa	9/23	10/6														
16	Business Model Canvas	Aisa	9/23	10/6														
17	Program Workflow	Cena	9/23	10/6														
18	Validation Board	Cena	9/23	10/6														
19	Gantt Chart	Cena	9/23															
20	Functional Decomposition Diagram	Ivory	9/23	10/6														
21	Use Case Diagrams	Cena	9/23	10/6														
22	User Interface Design	Ivory	9/23	10/6														
23	Story Board	Ivory	9/23															
24	Database Design	Dexel	9/23	10/6														
25	Entity-Relationship Diagram	Dexel	9/23	10/6														
26	Data Dictionary	Dexel	9/23	10/6														
27	Network Model	Annelyn	9/23	10/6														
28	Network Topology	Annelyn	9/23	10/6														
29	Software Specification	Annelyn	9/23	10/6														
30	Hardware Specification	Annelyn	9/23	10/6														
31	Proram Specification	Dexel	9/23	10/6														
32	List of Modules	Dexel	9/23	10/6														
33	References	Annelyn	9/11	10/6														
34	Curriculim Vitae	Aisa	9/23															
35	Appendices	Aisa	9/23															

Legend:

Incomplet/not started

On Going

Complete

Table 3 displays the researcher's activity and project timeline in accomplishing the assigned tasks of each member. All activities listed in the chart have a corresponding due date and each cell indicates a weekly basis. The chart displays progress of the researcher using color red for “Incomplete”, yellow for “On Going”, and green for “Complete” wherein the assigned tasks are done.

Functional Decomposition Diagram

This section serves as the synopsis of the different levels of the system. This shows the functionalities and specifications of the project.

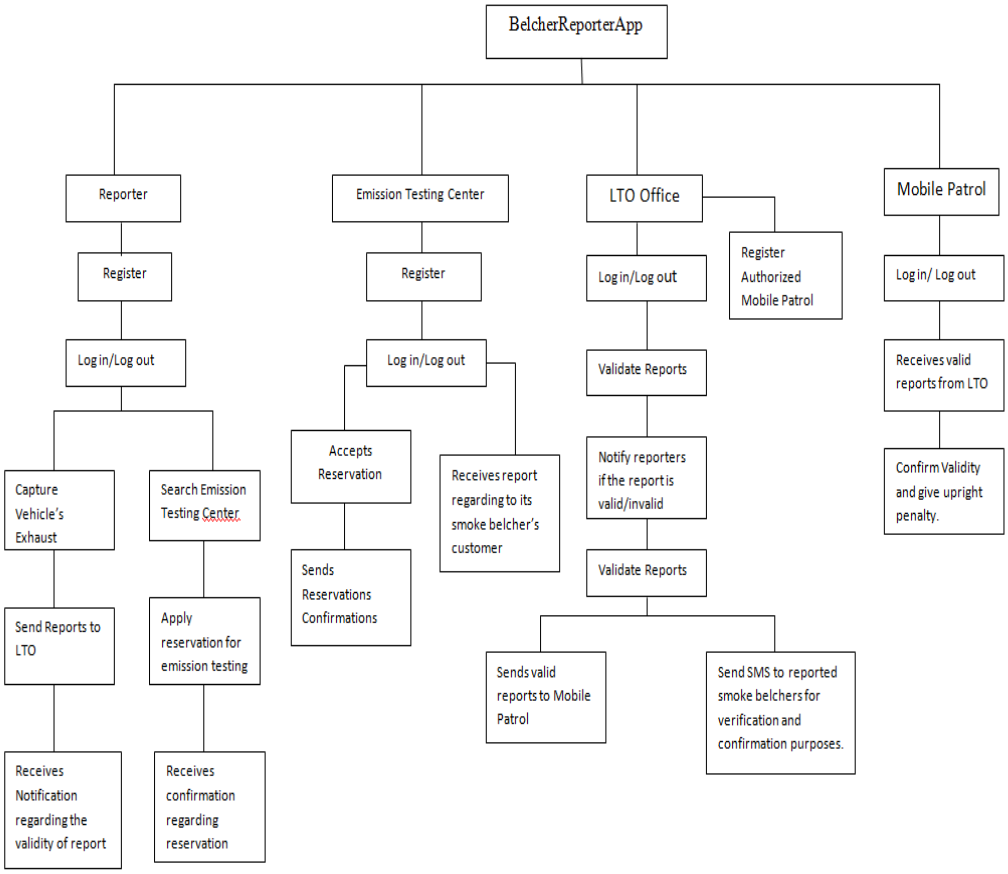

Figure 4: **Functional Decomposition Diagram**

This figure shows the function flow of the study. It began from the system itself going down to its fundamental processes, as to how the users make use of the proposed system. It illustrates what the proposed system specific functionalities. The application has feature that will

report violations in connection to the smoke belching law. To report a violator, the user must login to the Belcher Reporter App. Whenever the user logged in, the GPS will automatically enable.

The user will capture the smoke from the exhaust using the application with a given maximum number of three photos. The captured images will be sent to the LTO Office for validations. The LTO office will validate the report based on the images sent by the reporter. After the validation, LTO Office will notify the USER to confirm the validity of the received images. For valid reports, LTO will send the violators complete details or information to the on duty Mobile Patrol Officer for the verification of the validity of report. The patrol officer will make used of the violator's information to locate the vehicle. If the violation is confirmed, the Patrol officer will notify the LTO Office and the violator the status of the report and the upright penalty for the committed violation. The violation report will be tagged as "Resolved", otherwise "Unresolved.

Use Case Diagram

This section illustrates the graphical representation between the actors and the set of tasks involve in the business process application.

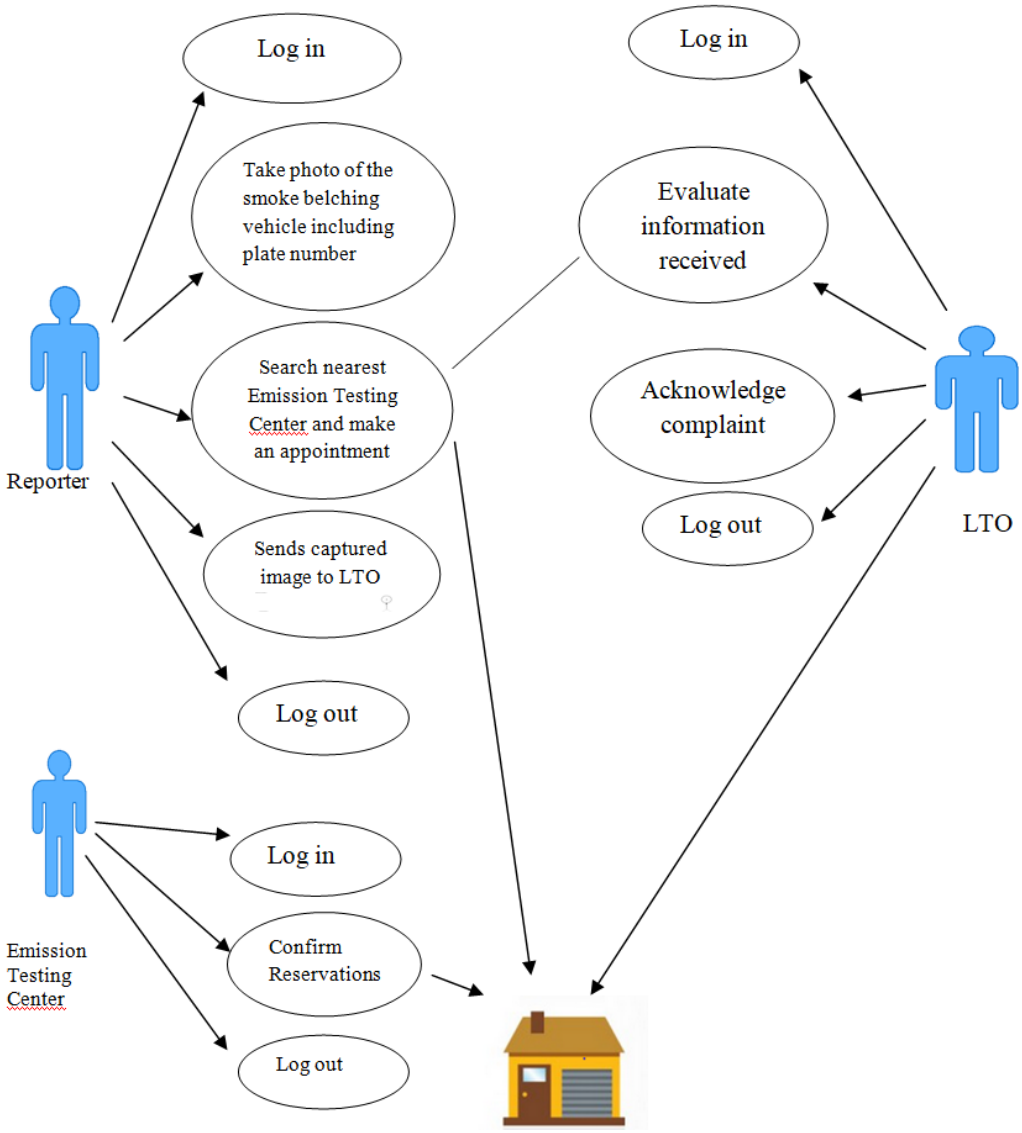

Figure 5: **Emission Testing Center**

Figure 5 comprises of the actors and set of tasks performed. The actor is a person who carries out the set of action accordingly while a set of task is the role played by the actor in the process. The actors in this study are the citizen, LTO, and Emission Testing Center.

Every concerned citizen in the community who wants to make use of the application needs to create an account first. Once registration is done, the user can now log in and may start using the application. User can take photo of the smoke belching vehicles together with the vehicle's plate number and send the captured image to the LTO anytime. In addition, GPS enables automatically every time the user will open the app.

The LTO has to log in as well to use the functionality of the application. LTO will then view the photo received and sends acknowledgement notice to the reporter. The LTO will evaluate the data and take necessary actions when needed.

User Interface

This section shows the different processes and flows of the system including the needed data in order to use the application.

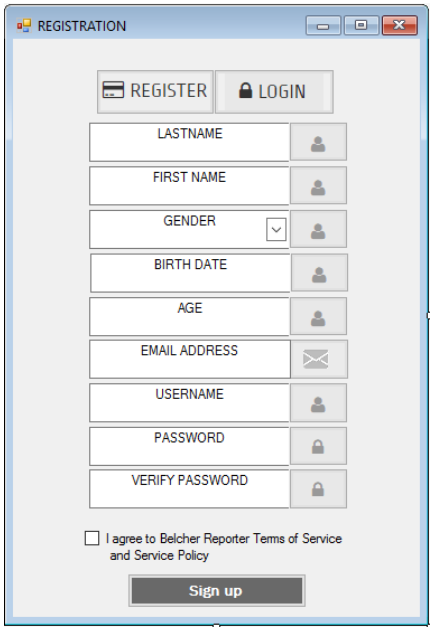

Figure 6: **User Registration**

Figure 6 exhibits the User Registration page. To register, the user must need to fill out all the necessary information such as lastname, firstname, birthdate, age, email address, username and password which will be used to log in, and drop down for the choices of gender.

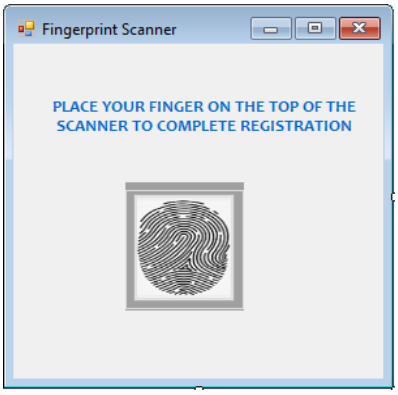

Figure 7: **Scan Fingerprint**

Figure 7 shows the dialog box for Scan Fingerprint. Scanning the fingerprint is one of the requirements of the registration process, this is to ensure the security and for unique identity. Fingerprint will be used in retrieving user password.

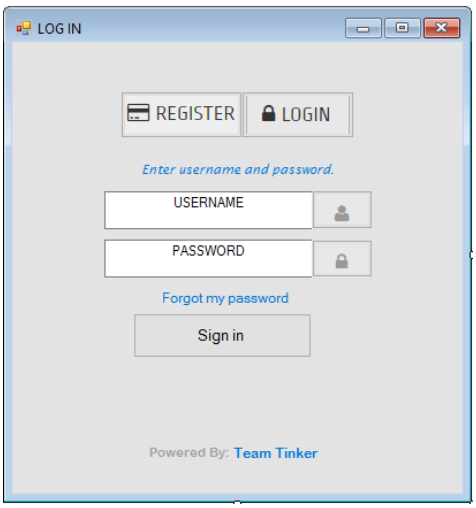

Figure 8: **BelcherReporter Login**

Figure 8 shows the login page for the user. The user must provide the correct username and password to log in. If the user forgets the password, the user can reset the password by clicking the "Forgot my password" and reset password link will be sent to the specified email address provided during the registration.

Figure 9: **Forgot Password**

Figure 9 shows the dialog box for "Forgot my password". The user will be directed to forget password interface which will ask user to provide new password and scan fingerprint, the fingerprint must match the registered fingerprint used by the user.

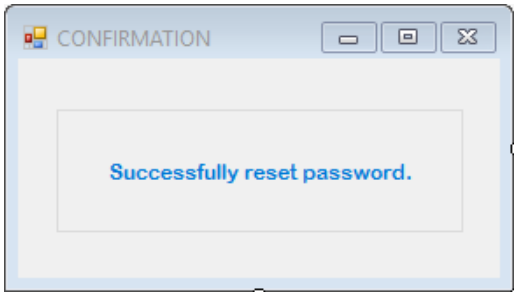

Figure 10: **Confirmation Dialog Box**

Figure 10 shows the Confirmation notification box. This dialog will appear if the fingerprint scanned is successful.

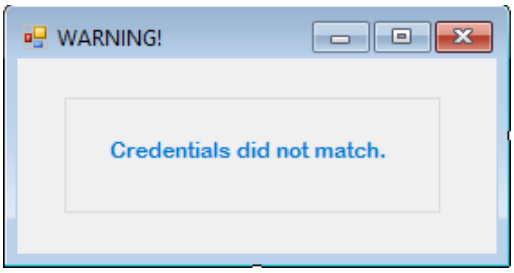

Figure 11: **Warning Dialog Box**

Figure 11 shows the Warning notification box. This will appear if the fingerprint did not match to the user's credentials.

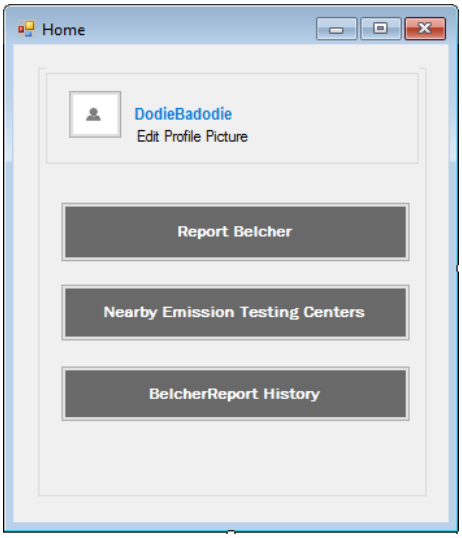

Figure 12: **User Home**

Figure 12 shows the user Home page which contains the name, profile picture, edit profile photo. The interface has the three important features of the application which allows the user to capture and report, search emission testing centers and view history of the confirmed smoke belcher.

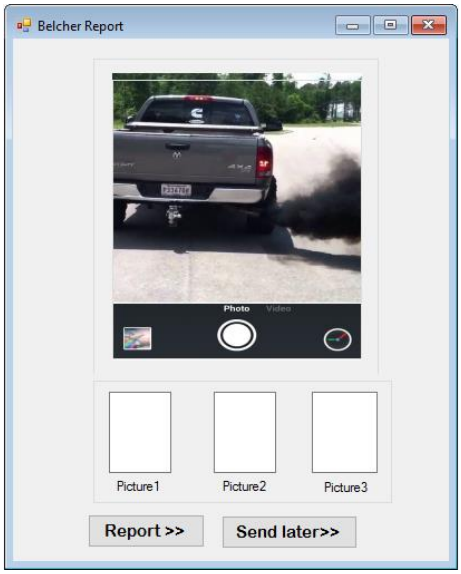

Figure 13: **Report Belcher**

Figure 13 shows the user's report belcher page. To report a violator, the user must capture the smoke coming from the exhaust most importantly the plate number. The app can store a maximum of 3 photos. By clicking the "Report" button, captured image/s will be sent to LTO office and will undergo validation and verification while "Send later" button is for offline reporters which will be sent automatically when internet or data is available.

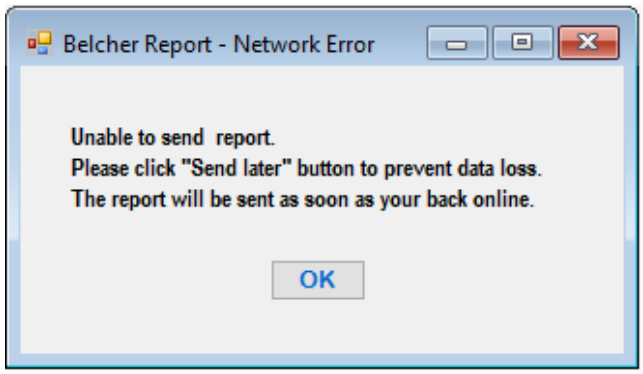

Figure 14: **Belcher Report – Network Error**

Figure 14 shows the dialog box which will notify the user on what to do if the internet connection is not available or the user is offline.

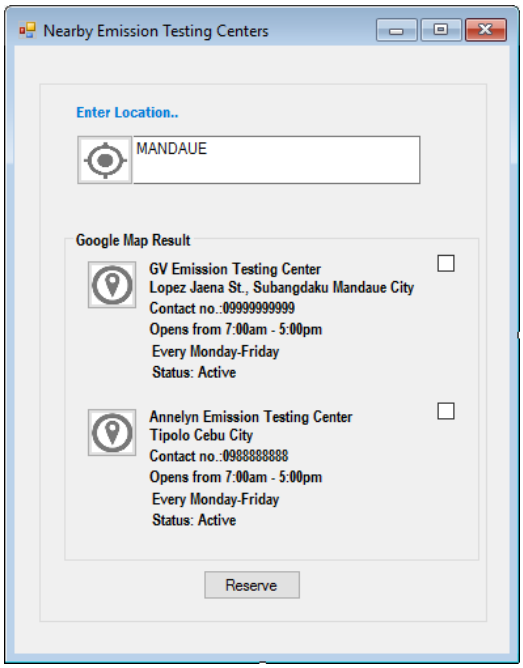

Figure 15: **Nearby Centers**

Figure 15 the user will search for a nearby smoke emission testing center and it would give the user a choice where they want to run for a smoke test for their vehicles through reservation.

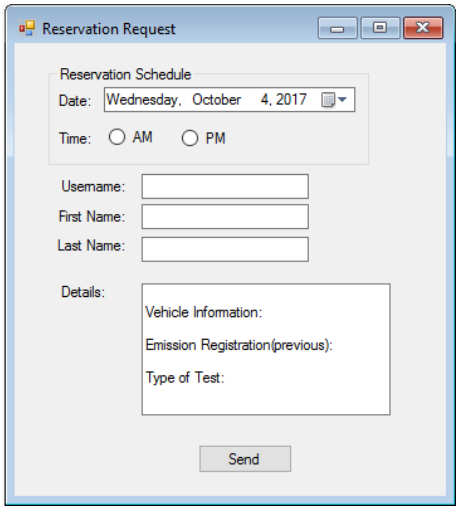

Figure 16**:** **User Reservation Request**

Figure 16 shows the reservation schedule of the user, the date and time when the user wanted to run for a smoke test, and the rest of the information is already provided from the database.

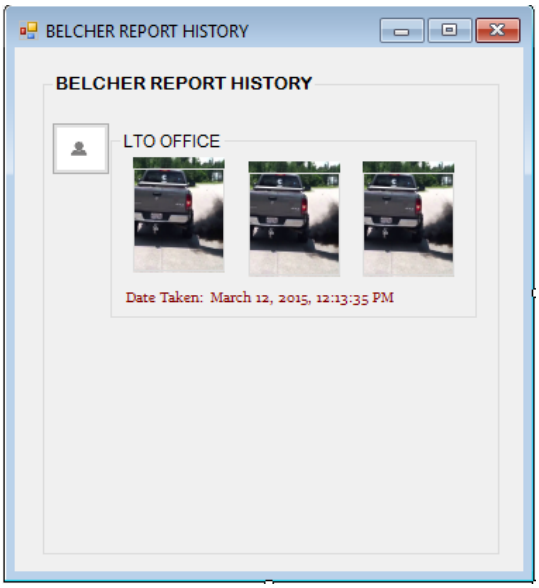

Figure 17: **BelcherReporter History**

Figure 17 shows the history of reports made by the user that was sent to LTO.

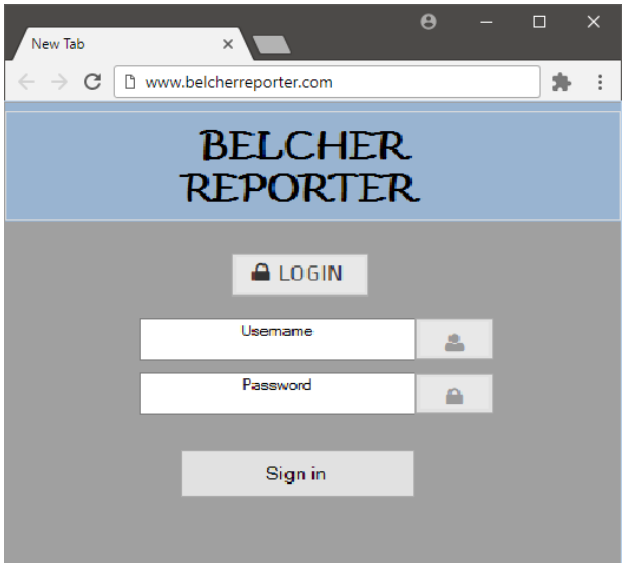

Figure 18: **LTO Web Log in**

Figure 18 shows the web page for LTO Login. To login, the LTO must enter the username and password. Only authorized personnel are allowed to login.

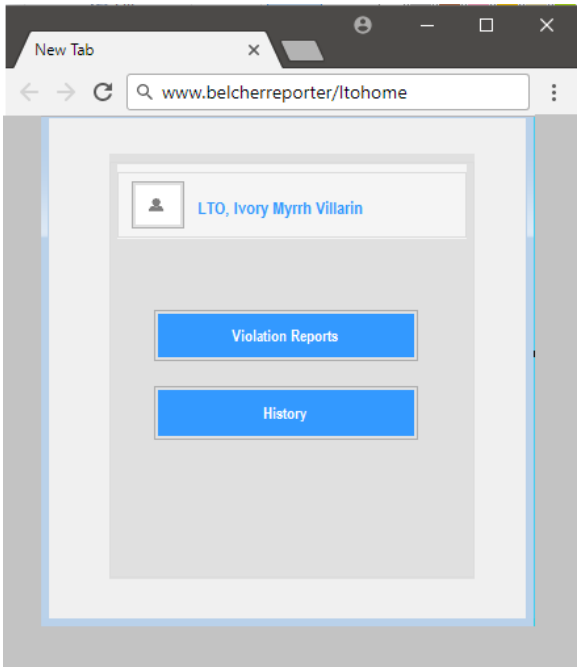

Figure 19: **LTO Home**

Figure 19 shows the home page for LTO wherein it contains the name, profile picture, violation reports, and History. By clicking either of the buttons will direct the LTO to the corresponding user interfaces.

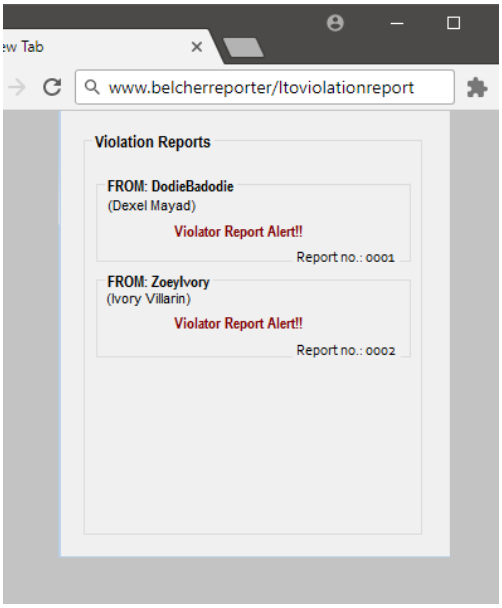

Figure 20: **LTO Violation Report**

Figure 20 shows the violation reports from the reporters. To check, the LTO must click either of the following reports and will be directed to report content interface.

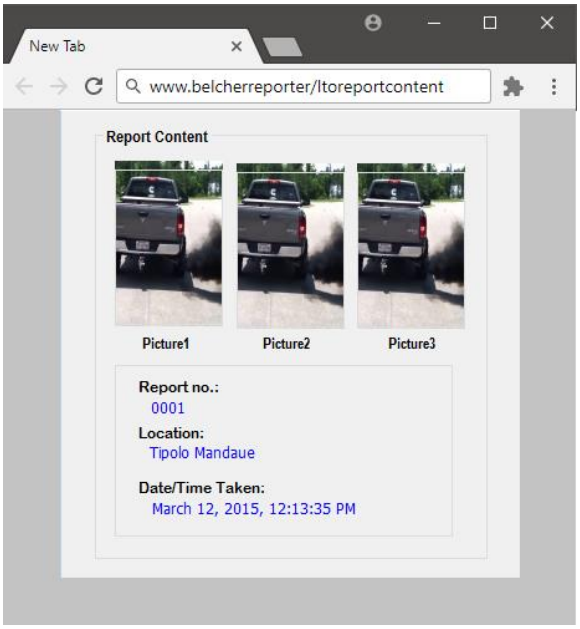

Figure 21: **Report Content**

Figure 21 exhibits the content of the report. LTO will evaluate the report's content and will responds to the reporter after thorough evaluation.

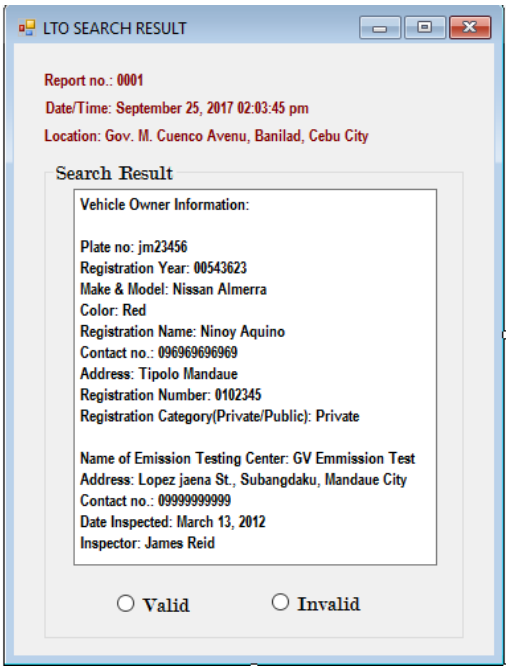

Figure 22: **LTO Search Result**

Figure 22 shows query result dialog box of the violator's information. The plate number will serve as a primary key in retrieving the violator's details. Upon viewing the report, the system will automatically perform query using OCR technology. Once assessment is done regardless of the evaluation result, LTO will send out notification to the reporter regarding to validity of the report. LTO mobile patrol will be notified once valid button is tick.

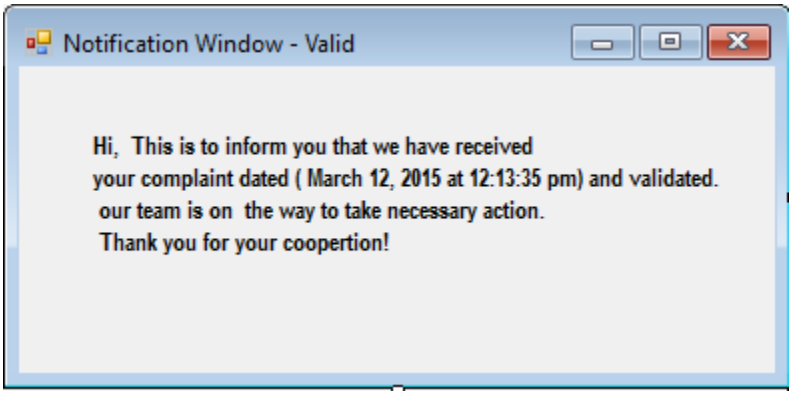

Figure 23: **Notification Window –Valid**

Figure 23 displays the notification message sent by LTO office to reporter for valid reports.

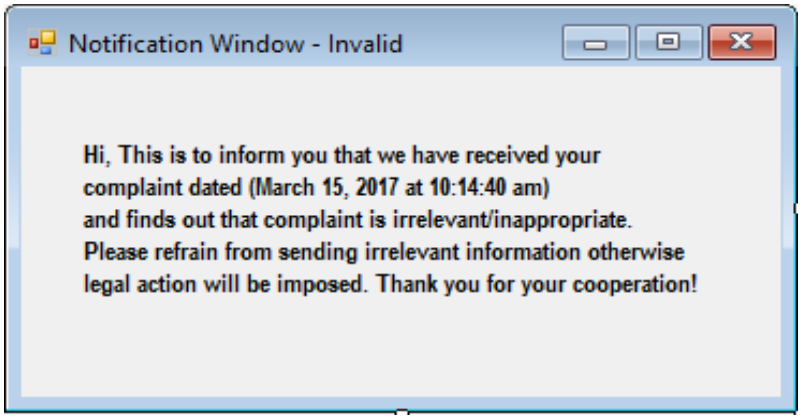

Figure 24: **Notification Window – Invalid**

Figure 24 displays notification message sent by LTO office to reporter for invalid reports.

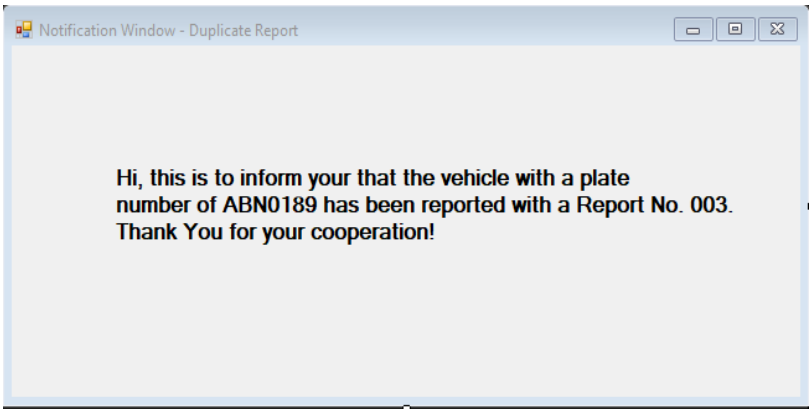

Figure 25: **Notification Window – Duplicate Report**

Figure 25 displays the notification for duplicate reports which will be sent to reporter. This is to ensure that there is no duplication of reports and to avoid duplicate processes and actions of the LTO.

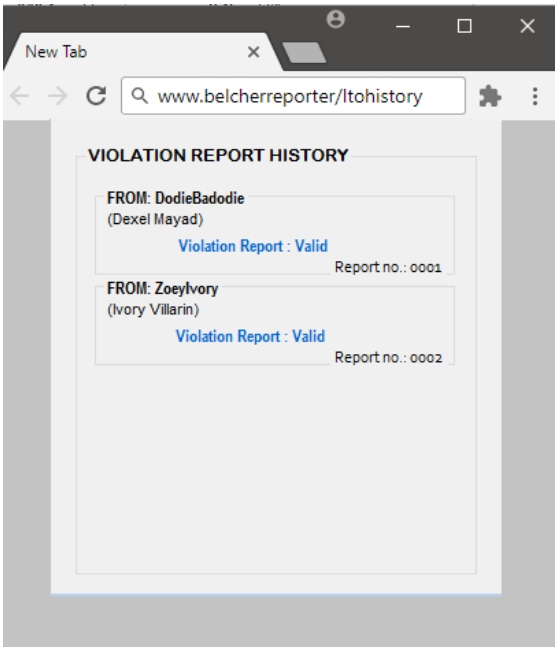

Figure 26: **LTO History**

Figure 26 shows the violation report history of LTO which records valid reports only.

Figure 27: **Mobile Patrol Log in**

Figure 27 shows the login page of the Mobile Patrol Police. Only authorized registered mobile patrol officer can log in the application. The authority will be given by the LTO main office.

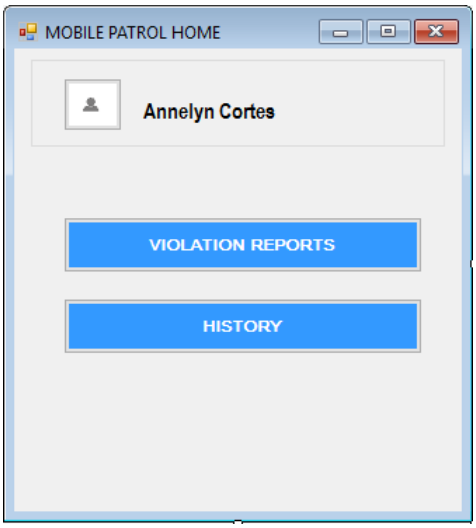

Figure 28: **Mobile Patrol Home**

Figure 28 shows the home page for Mobile Patrol Police wherein it contains the name, profile picture; violation reports button which contains all the verified reports coming from LTO main office and history button which contains all confirmed/unconfirmed reports. By clicking either of the buttons, the Mobile Patrol Police will be directed to the corresponding user interfaces.

Figure 29: **Mobile Patrol Violation Report**

Figure 29 shows the violation reports received from the LTO. To check, the Mobile Patrol Police must click either of the following reports and will be directed to the report content interface.

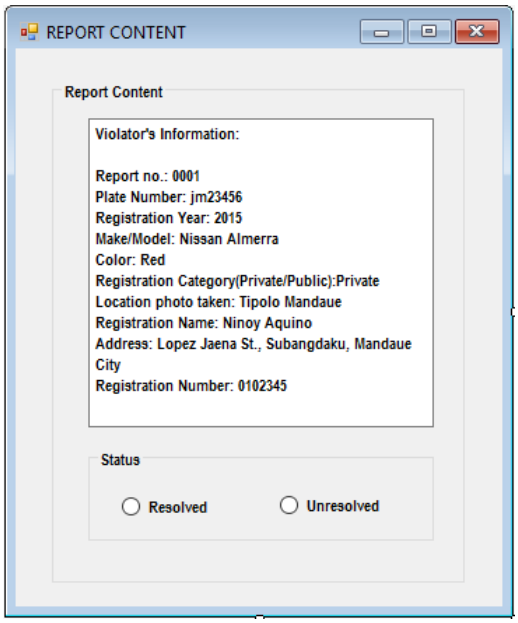

Figure 30: **Report Content**

Figure 31 shows the contents of the report received by Mobile Patrol. It contains the complete information of the violator. The Mobile Patrol Officer will make used of the information. Once caught, the Mobile Officer will check the smoke from the vehicle's exhaust to confirm the report and give immediate action. The officer will tick resolved button after the penalty is served otherwise unresolved. There are two purposes of resolved button, for confirmed smoke belchers and unconfirmed smoke belcher. The resolved button is an indication that action has been taken.

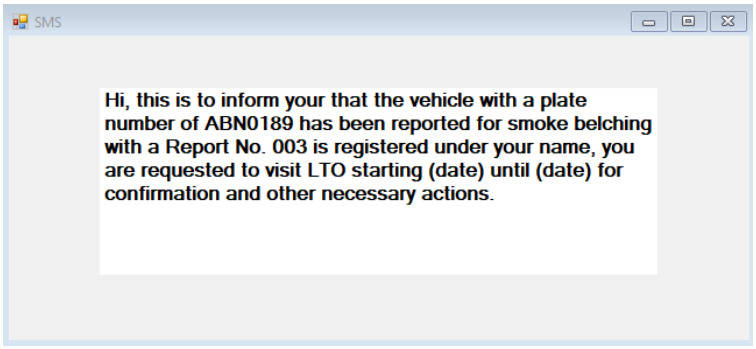

Figure 31: **SMS Message**

Figure 31 shows the sms notification that will be received by the reported smoke belcher including the necessary actions in order to verify and confirm the report. The purpose of the sms is for the awareness of the vehicle owner regarding to the report that will be received by the LTO.

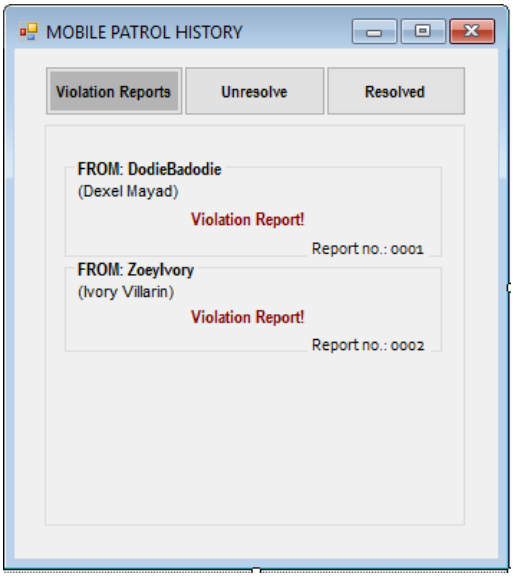

Figure 32: **Mobile Patrol History**

Figure 32 shows the violation report history. This will serve as a record of the resolved and unresolved cases. Once resolved button is ticked, resolved violation complaints will disappear on the violation report tab and automatically transferred to resolved tab.

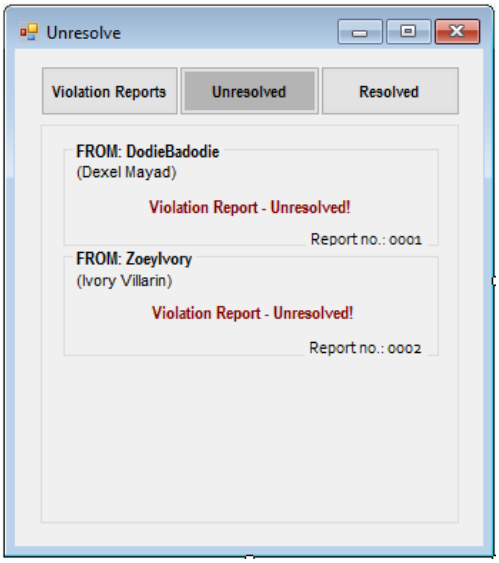

Figure 33: **Unresolved Reports**

Figure 33 displays the lists of all unresolved complaints. This means that actions were not taken to this report numbers.

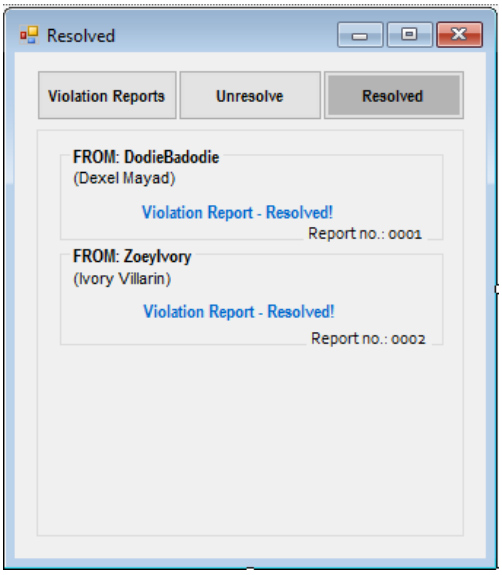

Figure 34: **Resolved Reports**

Figure 34 exhibits the list of resolved complaints.

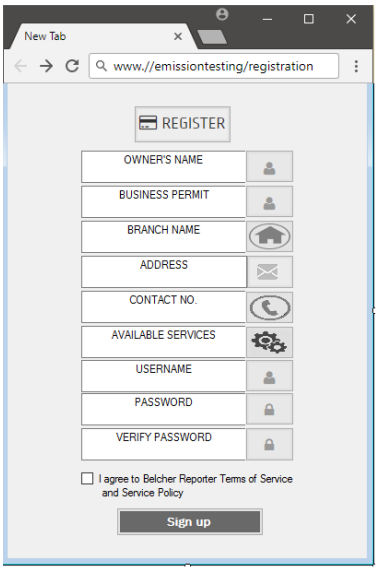

Figure 35: **Emission Testing Centers Registration**

This figure shows the registration page for emission testing centers. In order to register the owner must complete all the data needed during registration and must agree the BelcherReporter Terms of Service and Service Policy. The site of emission testing center is connected to LTO with different controls of both parties.

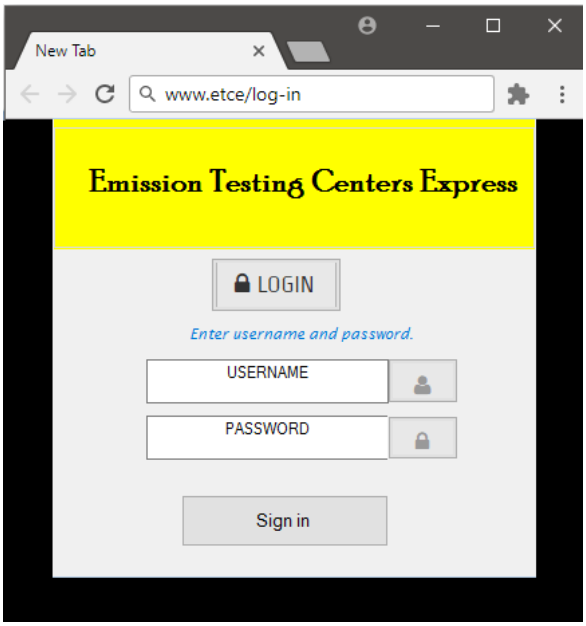

Figure 36: **Emission Testing Center Express Login**

Figure 36 shows the login site for the registered emission testing center after the completion of all the requirements during the registration. Each emission testing center has only one username and password.

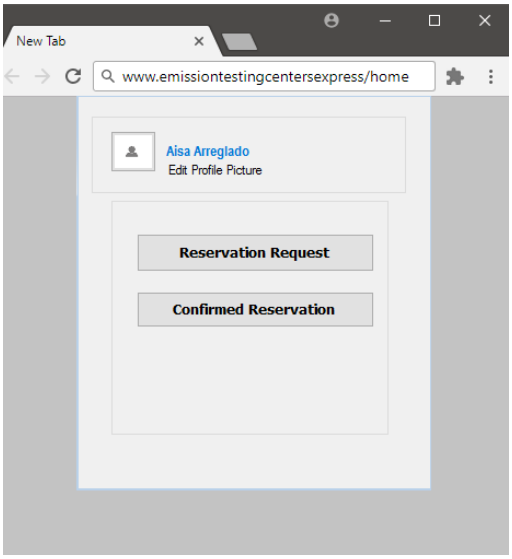

Figure 37: **Emission Testing Centers Express Home**

Figure 37 Home page of the Smoke Emission Testing Centers authorized personnel who logged in from the site.

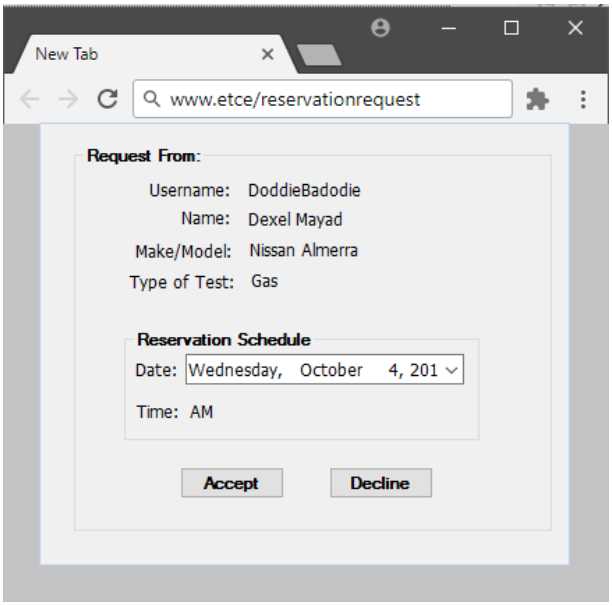

Figure 38: **ETCE Reservation Request**

Figure 38 shows the request for reservation from the requestor including the dates, name, username, and vehicle model. Interface provides two buttons to response the request.

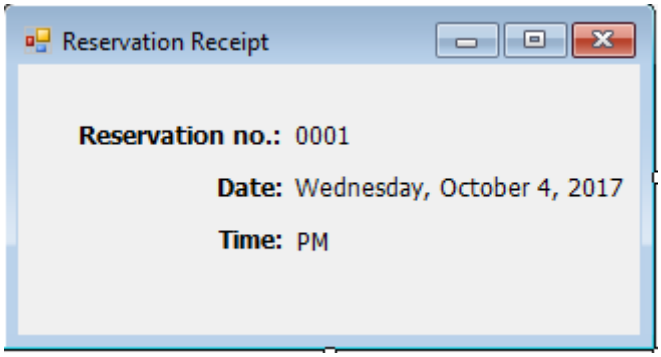

Figure 39: **Reservation Receipt**

Figure 39 displays the confirmed reservation request received by the requestor. Reservation number is the confirmation of the reservation and the schedule is booked under the requestor's name.

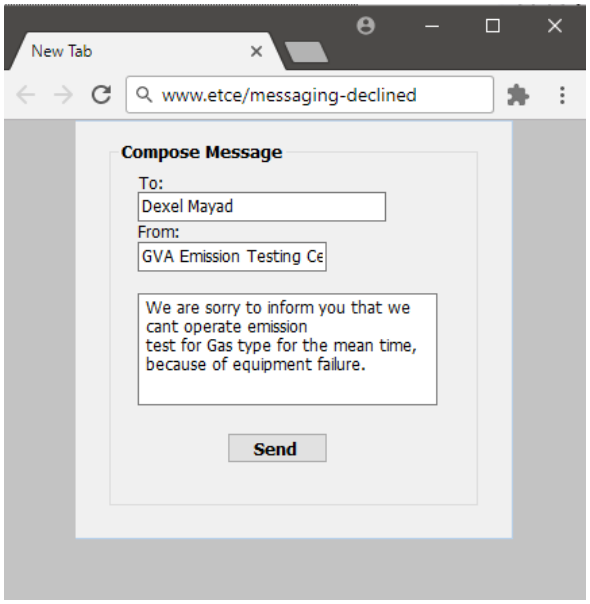

Figure 40: **Declined Message Dialog**

Figure 40 shows the Declined Message Dialog from to be sent to requestor as a response to the request for reservation including the possible reasons for the declined request.

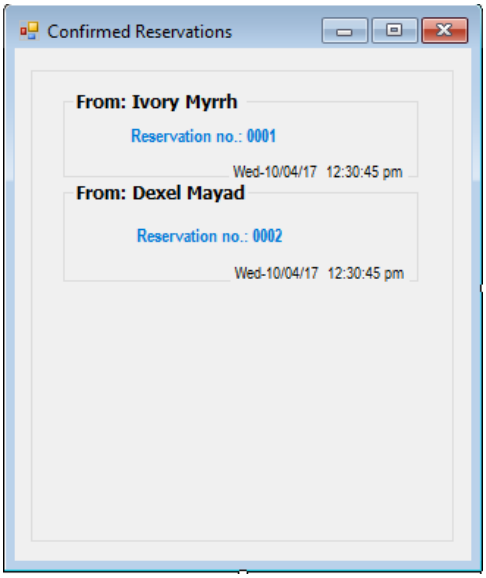

Figure 41: **Confirmed Request**

Figure 41 shows the LTO interface of the confirmed reservations including the name of reserved requestor and the date.

Storyboard

This section illustrates how the corresponding sections of the application work and interact with each other.

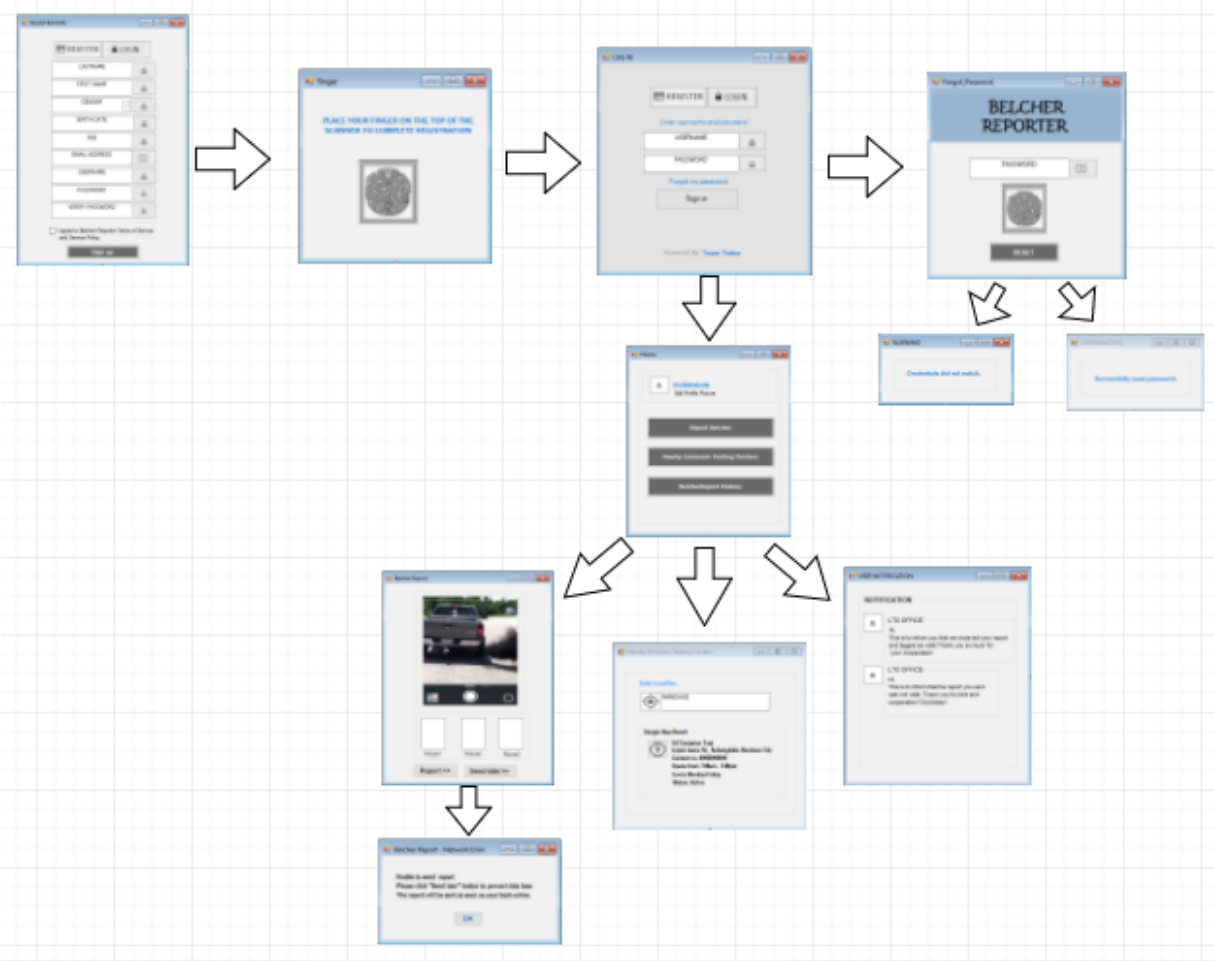

Figure 42: **User Interface Story Board**

Figure 42 shows a series of user interface (UI) showing the connectivity and flow in the BelcherReporter Application to the user. Upon using the application the log-in user interface appears. To use the application, the user must fill out all the necessary information to sign-in. In the login interface the user must input the username and password that was provided during the registration. If the user already have an account and forgets the password, the "Forgot my password" is to be tick. It directs the user to another interface that will help him/her to reset the password. To report a violator, the user needs to capture the vehicle's plate no and the smoke coming from the exhaust. The capture image will be used to validate and retrieve the information of the reported violator. The user can also search for nearby emission testing centers base on the preferred location.

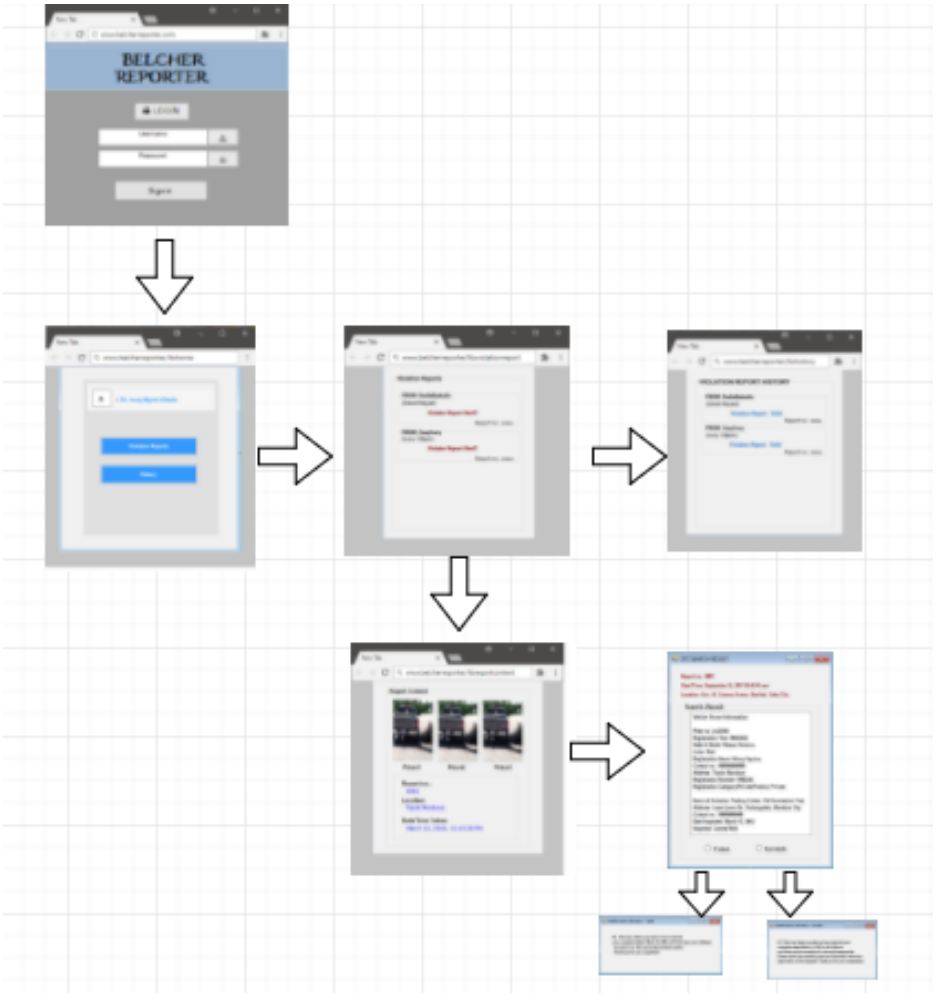

Fig 43: **LTO User Interface Storyboard**

Figure 43 shows the LTO Account story board. This page is for the authorized personnel only. The admin is responsible for registering the user for the account needs to be authenticated if happened that the LTO forgets the password, and only the owner of the account can retrieve the password. To start, LTO police must enter a valid username and password to log in. Once done, the officer will be directed to the home page containing its name and profile picture. By clicking the violation reports button directs the LTO police to its corresponding page that contains the reports from the received. LTO police will check the report to validate. Once validated regardless of the evaluation result, LTO will send out notification to the reporter and the mobile patrol will be notified once valid button is tick.

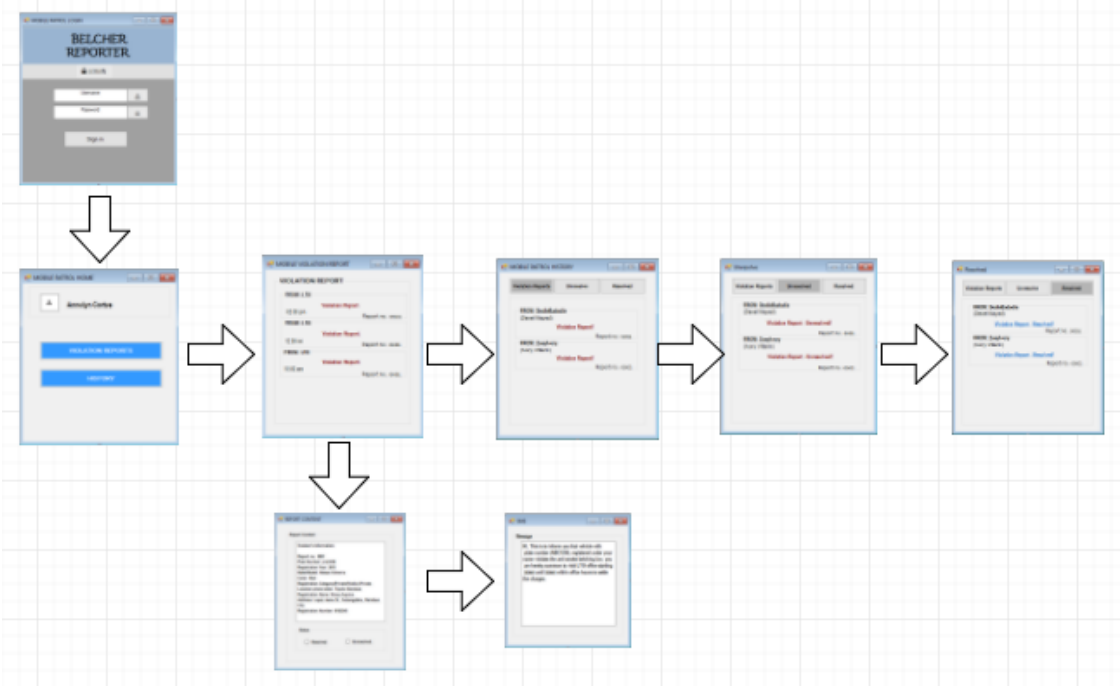

Figure 44**: Mobile Patrol User Interface Storyboard**

Figure 44 shows the Mobile Patrol Account story board. Only the authorized persons are allowed to log in using the account. To login, Mobile Patrol police must enter a valid username and password. When done logging in, the Mobile Police can start checking the reports by clicking the violation reports button. It has the corresponding interface that contains the validated reports from the LTO Police that holds the violator's complete information. The Mobile patrol will make used of the report to locate the vehicle. Once caught, the Mobile Police will check the smoke from the exhaust to confirm the committed violation. If confirmed, the violator will receive an upright penalty and mobile patrol will send out notification to the LTO Office.

Database Design

This section shows full information of all database design and has its corresponding keys to retrieve contents from the table. Table name and column name with its corresponding primary key and foreign key correspond with the entered data and save to its assign section. Each table has its primary key which is a unique identifier, and cannot contain a null value while the foreign key is also a primary key from another table and also cannot contain a null value.

Table 4

USER INFO

	Users
PK	userName
	userPass
	firstName
	lastName
	Gender
	BirthDate
	Age
	Email
	FingerPrintIMG

Table 4 shows the main information of the user which includes username which is the unique identifier of the user, firstName, userPass is the password of the user,lastName, Gender, Birthdate of the user, Age, Email, and FingerPrintIMGto avoid dummy accounts.

Table 5

LTO REPORTS

	LtoReports
P	ReportNo
K	ReportDate
	RebortAbout
	PlateNum
	Location
	Status

Table 5 shows the report information of the violator which will be verify to the Land Transportation Office (LTO) database. The information includes, ReportNo is the unique code identifier of the user's report, ReportDate date it was reported, PlateNum is the violator's vehicle plate number, Location of the vehicle when caught belching smoke, and Status is the update notification for the user from the Land Transportation Office (LTO) if the report was valid or invalid.

Table 6

EMISSION INFO

	EmissionInfo
P	TesterBranchCode
K	BranchName
	Address
	PhoneNum
	Status

Table 6 shows the information of the emission testing center to help user find nearby emission testing. The information includes TesterBranchCode a unique code identifier of the emission testing center provided by the researchers, BranchName, Address, PhoneNum is the phone number of the emission testing center, and Status is to verify if the emission testing center is still active or inactive.

Table 7

USER REPORTS

	UserReports
P	userName
K	firstName
	lastName
	Image
	Date
	Time
	Location
	Status

Table 7 shows the information of the report that will be send to the Land Transportation Office (LTO) website from the user's report. The information includes userName unique identifier of the reporter/user, firstName, lastName, Image is the picture taken by the user, Date& Timereported, Location of the vehicle when caught belching smoke, and Status if the user still active or inactive.

Table 8

LTO INFO

	LTOInfo
PK	LTOBranchCode
	Address
	Status

Table 8 shows the information of the Land Transportation Office (LTO) where the report was sent. The information includes LTOBranchCode a unique code identifier for Land Transportation Office (LTO), Address of the Land Transportation Office (LTO), and Status is to verify Land Transportation Office (LTO) if it is still active or inactive.

Table 9

VEHICLE INFO

	VehicleInfo
PK	PlateNum
	OwnerName
	Color
	Model
	Make
	Category
	RegistrationNo

Table 9 shows the information of the violator's vehicle.The information includes are PlateNum is the vehicle's plate number and the unique code identifier of the vehicle, OwnerName, Color of the vehicle, Model of the vehicle, Make is the maker of the vehicle, Category identifies if the vehicle is public or private, and RegistrationNo is the registered number of the vehicle from Land Transportation Office's (LTO) website.

Table 10

EMISSION RESERVATION

	EmissionReservation
PK	ReservationNum
	ReservationType
	userName
	FirstName
	LastName
	Date
	Time
	EmissionTestingName

Table 10 shows user's reservation information for emission testing center. The information includes are ReservationNum is the user's reservation number and unique code identifier, ReservationType identifies the user's vehicle engine type if it is gas or diesel, userName of the user, FirstName, LastName, Date of the reservation, Time of the reservation, and EmissionTestingName.

Entity Relationship Diagram

This section illustrates the relationship of the table entities and their cardinalities. Every table entities have its cardinalities connected to different table. The system's data would not work to its specific database connection if the table entities and cardinalities are not connected properly.

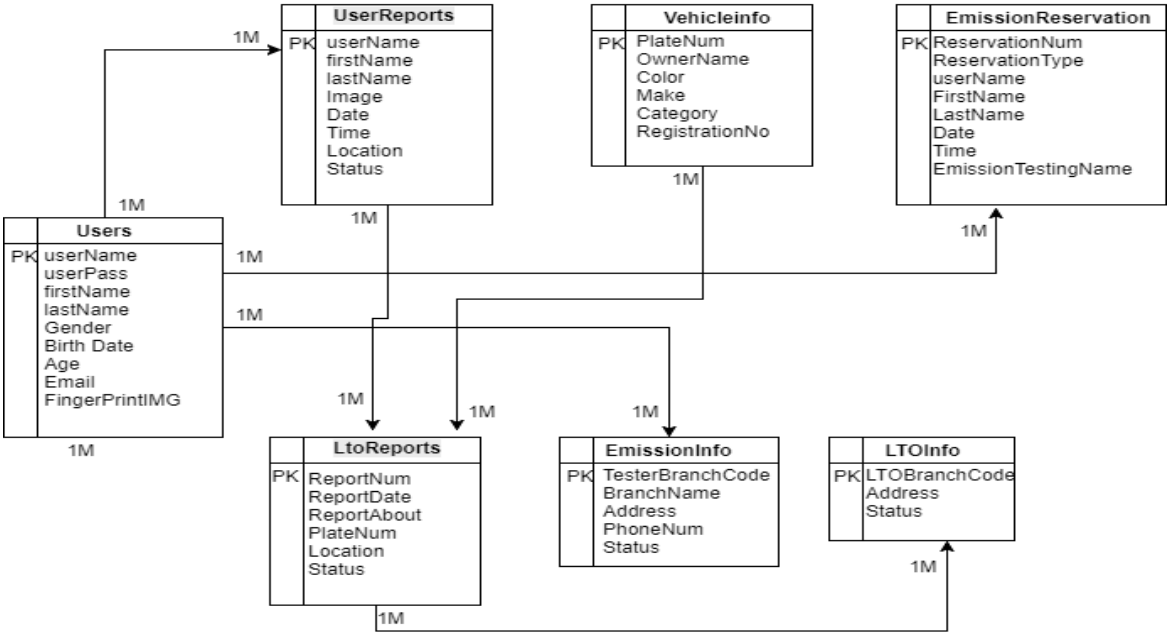

Figure 45**: <u>Entity Relationship Diagram</u>**

Figure 45 illustrates how the entities and cardinalities work with data connections. The users table will save all user's information after the registration and can access the other table. The user can now send a report and the UserReportstable will save all the information send by the user. After the report, the table LTOReports will get information from UserReports table to verify the following data from the Land Transportation Office (LTO) and also the information of the Land Transportation Office (LTO) where the user send the report will be save to LTOInfo table. Also, the information of the user's reservation from system's feature where the user can book reservations to the emission testing centers will be save to the table EmissionReservation. The data that will be save to the table LTOReports will be base from the UserReports data. VehicleInfo table will save the vehicle's information so that LtoReports can retrieve the information of the violator's vehicle.The EmissionInfo table will save the all the information of the nearby Emission testing centers and also it can retrieve information of the vehicle's emission testing centers where it was tested.

Data Dictionary

This section provides a wide understanding and organizes each datum in different tables. Demonstrates the description of the data, table name, column name, null, and the data types which identify what data will be inputted.

Table 11

USER INFO

TABLE NAME	COLUMN NAME	DATA TYPE	NULL	DESCRIPTION
user	userName	String	No	User's unique username and Primary Key of the Table
	userPass	String	No	User's Password
	firstName	String	No	User's First Name
	lastName	String	No	User's Last Name
	Gender	String	No	User's Gender
	Birthdate	Date	No	User's Birth Date
	Age	Number	No	User's Age
	Email	String	No	User's Email Address
	FingerPrintIMG	Blob	No	Fingerprint of the User

Table 11 displays the intended information the user will input. The data to be inputted are userName which is the unique code identifier for the user, userPass is the user password, firstName, lastName, Gender, BirthDate of the user, Age, Email, and for the FingerPrintIMG is the user's fingerprint which is to be converted into image file format.

Table 12

LTO REPORTS

TABLE NAME	COLUMN NAME	DATA TYPE	NULL	DESCRIPTION
ltoReports	ReportNo	String	No	Vehicle's Report Number and the Primary Key of the Table
	ReportDate	Date	No	Date the Vehicle Caught Emit Belching Smoke
	ReportAbout	String	No	Brief Description of the Report
	PlateNum	String	No	Vehicle's Plate Number
	Location	String	No	Location of the Vehicle Caught Emit Belching Smoke
	Status	Boolean	No	Valid or Invalid

Table 12 displays the user's report information of the violator which will be verified to the Land Transportation Office (LTO) database. The data to be inputted includes, ReportNo report number of the report and its unique code identifier, ReportDate, PlateNum is a unique plate number of the violator's vehicle, Location of the vehicle when caught belching smoke, andStatus is the update notification for the user if the report was valid or invalid.

Table 13

EMISSION INFO

TABLE NAME	COLUMN NAME	DATA TYPE	NULL	DESCRIPTION
emissionInfo	TesterBranchCode	String	No	Unique Code Identifier of the Branch and the Primary Key of the Table
	BranchName	String	No	Name of the Branch
	Address	String	No	Address of the Branch
	PhoneNum	Number	No	Phone Number of the Branch
	Status	Boolean	No	Active o Inactive

Table 13 displays the information of the nearby emission testing centers for the user. The data to be inputted are TesterBranchCode a unique code identifier of the branch, BranchName, Address, PhoneNum is the contact number of the branch, and Status is to verify if the emission testing center is active or inactive.

Table 14

USER REPORTS

TABLE NAME	COLUMN NAME	DATA TYPE	NULL	DESCRIPTION
userReports	userName	String	No	The Username of the User Who Send the Report and Primary Key of the Table
	firstName	String	No	First Name of the User Who Send the Report
	lastName	String	No	Last Name of the User Who Send the Report
	PlateNum	String	No	Vehicle's Plate Number
	Date	Date	No	Date when the Vehicle Caught Emit Smoke Belching
	Time	Time	No	Time when the Vehicle Caught Emit Smoke Belching
	Location	String	No	Location of the Vehicle Caught Emit Smoke Belching
	Status	Boolean	No	Active or Inactive

Table 14 displays full information of the user's report of the violator. The data to be inputted are uersName is the unique code identifier of the user, firstName of the user, lastName of the user, PlateNum is the Vehicle's Plate Number owned by the violator, Date when the vehicle caught emit smoke belching, Time when the vehicle caught emit smoke belching, Location of the vehicle where the smoke belching happened, and Status is to verify if the user is still active or inactive.

Table 15

LTO INFO

TABLE NAME	COLUMN NAME	DATA TYPE	NULL	DESCRIPTION
ltoInfo	LTOBranchCode	String	No	Land Transportation Office's (LTO) Unique Code Identifier and Primary Key of the Table
	Address	String	No	Land Transportation Office's (LTO) Address
	Status	Boolean	No	Active or Inactive

Table 15 shows the information of the Land Transportation Office (LTO) where the user send the report. The information is LTOBranchCode which is the unique code identifier of the branch, Address of the branch, and Status is to verify Land Transportation Office (LTO) if it is still active or inactive.

Table 16

VEHICLE INFO

TABLE NAME	COLUMN NAME	DATA TYPE	NULL	DESCRIPTION
VehicleInfo	PlateNum	String	No	Plate Number of the Vehicle and the Primary Key of the Table
	OwnerName	String	No	Vehicle's Owner Name
	Model	String	No	Model of the Vehicle
	Color	String	No	Color of the Vehicle
	Make	String	No	Maker of the Vehicle
	Category	Boolean	No	Public or Private
	RegistrationNum	Number	No	Registered Number of the Vehicle

Table 16 displays the information of the violator's vehicle. The data to be save includes PlateNum is the plate number and unique code identifier of the vehicle, OwnerName, Model of the vehicle, Color is the actual color of the vehicle, Make identifies the vehicle's maker, Category if the vehicle is public or private, and RegistrationNum is the registered number of the vehicle.

Table 17

EMISSION RESERVATION

TABLE NAME	COLUMN NAME	DATA TYPE	NULL	DESCRIPTION
EmissionReservation	ReservationNum	Number	No	User's Reservation Number and the Primary Key of the Table
	ReservationType	Boolean	No	Gas or Diesel
	userName	String	No	User's Username
	FirstName	String	No	User's First Name
	LastName	String	No	User's Last Name
	Date	Boolean	No	Date of the Reservation
	Time	Number	No	Time of the Reservation
	EmissionTestingNAme	String	No	Name of the Emission Testing Center

Table 17 displays the user's reservation information to the emission testing center. The data to be saved includes ReservationNum user's reservation number, ReservationType identifies the user's vehicle engine type, userName of the user, FirstName, LastName, Date of the reservation, Time of the reservation, and EmissionTestingName.

Network Topology

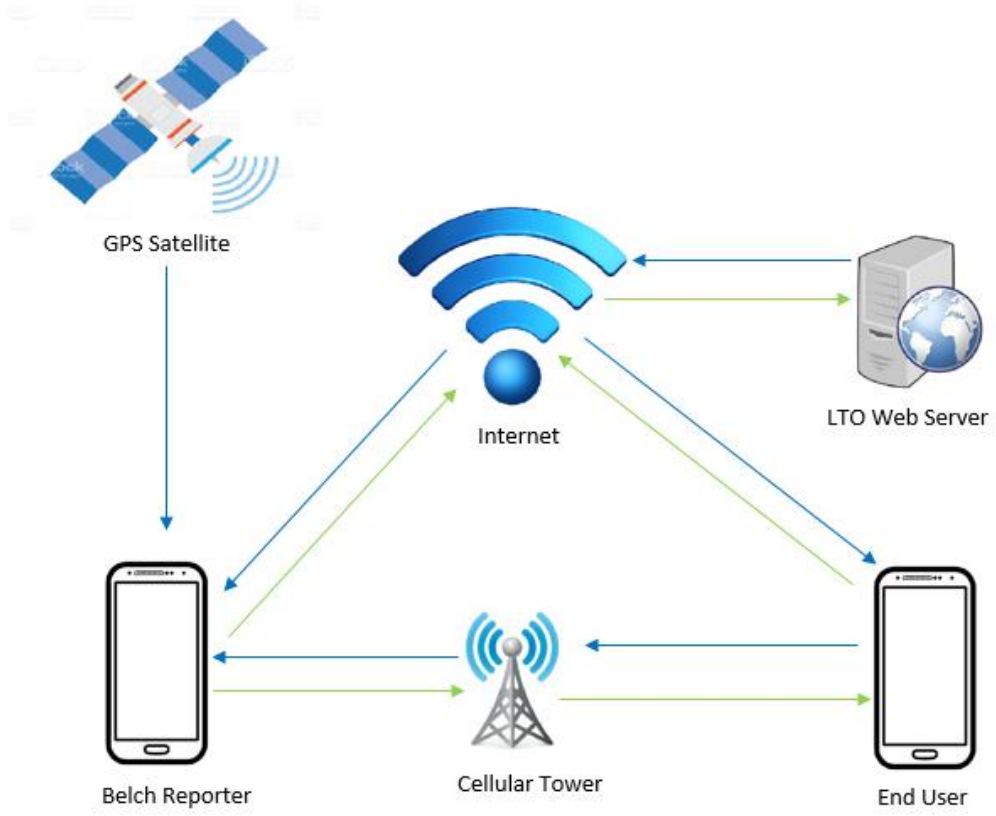

Figure 46: **Network Topology**

Figure 46 shows the bidirectional flow of the system. The GPS or Global Positioning System generates the geographical location of the nearest emission testing center, and the current location where the photo was taken by the belch reporter. Information is then sends or transferred in the LTO Web Browser through the power of internet and cellular connections.

Development/Construction/Build Phase

In the development phase, the team begins the development phase by verifying that all task identified during the envisioning and planning phases have been completed. Also, the team does a final verification of the concepts from the designs within an environment that mirrors production as closely as possible.

Software Specifications

This section presents the software specifications of the study which includes the programming languages used, the database, and the platform.

The application is intended for everyone, specifically the vehicle owners from public to private vehicle, to most concerned citizen, and the LTO. Both must have a smartphones that supports GPS with Google Maps integration and a Web Server in order to work, and function properly. A Web Server is a computer system that processes request via HTTP, the term can refer to the entire system or the software that accepts and supervises the HTTP request. GPS can be found on newer versions of smartphones.

BelcherReporter will operate within the condition of the specified requirements. BelcherReporter is made use of Java Programming Language which will be implemented in Android Studio IDE (Integrated Development Environment), and C# .NET for User Interface and designs, and Google Maps API and Interface. For the Database it will utilize the Firebase Database. Also it will run in variety of android smartphones device ranging from Version 4.1 API 16 (JellyBean) up to the latest version for easy and friendly-user interface.

Hardware Specifications

This section represents the hardware specifications of the study. This includes the RAM, the memory, the Processor, the Operating System, and the storage requirements that were used in the implementation stage.

For development, BelcherReporter used a Microsoft based computer or laptop with an i5 core, and above processor running on Windows 7/Vista, Windows 8 and Windows 10 (32-64 bit) Operating System with a minimum of 4GB of RAM for faster processing and allows computer to work with more information at the same time. The hard disk must have at least a free space of 250-500 MB for the Integrated Development Environment (IDE) installation for a bigger data storage, and a 2GB or more for the Android SDK, JDK, emulator system images, caches, and other necessary tools needed.

For deployment, BelcherReporter used an Android Device running on Android OS API 16 Version 4.1 (JellyBean) up to the latest version. Along with the smartphone it must have a built-in GPS Maps integration that can be used as precise a location that can be useful for the study. The android device must have at least 250GB free space in RAM, and 200MB free space in Internal Storage.

Program Specifications

This section shows the task and algorithms of the different modules in the system. The tables show programmer of each modules which is responsible for the development of the assigned module, module names, and the assigned person who will perform each task.

Table 18

LIST OF MODULES FOR USER

Programmer	Modules	Admin	User
Mayad, Dexel C.	Registration		
	Create		*
	Retrieve		*
	Delete	*	
	No. of Points (1 point per module)	1	1
Mayad, Dexel C.	Login/Logout		
	Login		*
	Logout		*
	No. of Points (1 point per module)	1	1
	System Notification		
	Retrieve		*
	View		*
	No. of Points (1 point per module)	0	1

Table 18.1

LIST OF MODULES FOR USER cont'd

Programmer	Modules	Admin	User
Villarin, Ivory Myrrh C.	Send Report		
	Create		*
	No. of Points (1 point per module)	0	1
Villarin, Ivory Myrrh C.	Search Emission Testing Centers		
	Search		*
	View		*
	No. of Points (1 point per module)	0	1

Table 18 demonstrates the respective task of the user. In each module, there are query listed below and the intended admin/user will perform the task. The modules for user and admin are system notification for user's report status from Land Transportation Office (LTO), send report for the user's task to report a person who violates the smoke belching law, and search emission testing centers for user's task to search for nearby emission testing.

Table 19

LIST OF MODULES FOR AUTHORITIES

Programmer	Modules	LTO Officer	Emission Testing Center	Mobile Patrol
Villarin, Ivory Myrrh C.	View Report			
	Retrieve	*	0	*
	View	*	0	*
	No. of Points (1 point per module)	1	0	1
Cortes, Annelyn T.	Report Status			
	Update	*		*
	Retrieve	*		*
	No. of Points (1 point per module)	1		1

Table 19.1

LIST OF MODULES FOR AUTHORITIES cont'd

Programmer	Modules	LTO Officer	Emission Testing Center	Mobile Patrol
Cortes, Annelyn T.	Mobile Patrol Login			
	Retrieve	0	0	*
	View	0	0	*
	No. of Points (1 point per module)	0	0	1
	Emission Testing Center Login			
	View	0	*	0
	Retrieve	0	*	0
	No. of Points (1 point per module)	0	1	0
Cortes, Annelyn T.	Accept Report			
	Update	*		*
	View	*		*
	No. of Points (1 point per module)	1		1
Arreglado, Aisa A.	Send Report			
	Create	*		*
	No. of Points (1 point per module)	1		1

Table 19.2

LIST OF MODULES FOR AUTHORITIES cont'd

Programmer	Modules	LTO Officer	Emission Testing Center	Mobile Patrol
Tupia, Azucena E.	SMS/System Notification			
	Retrieve	*		*
	View	*		*
	No. of Points (1 point per module)	1		1
	Accept Reservation			
	Update	0	*	0
	View	0	*	0
	No. of Points (1 point per module)	0	1	0

Table 19 demonstrates the task that the authorities will perform. There are three users in this table which is the LTO officer, emission testing center, and mobile patrol. In every modules LTO officer, emission testing center, and mobile patrol will perform each query that is assigned to them. Modules for authorities includes sms/system notification for the update of the sent report to mobile patrol, send report, view report for LTO officer, emission testing center, mobile patrol, report status, mobile patrol login is the mobile patrol's account, accept report, and send report is from the user's report.

References

Asif, M., & Qadri, M.T. (2009). *Automatic Number Plate Recognition System for Vehicle Identification Using Optical Character Recognition.* Paper Presented at the IEEE Sponsored Educational Technology and Computer. doi: 10.1109/ICETC.2009.54

Bandiola, M. *Smoke Belching.* Prezi. Retrieved February 25, 2013, from https://prezi.com/l7olkrmjdpxe/smoke-belching/

Braganza, A.M., Liwanag, A.G., & Palines, C.R. (2007). *Comparison of Local Jeepney Specifications and Selected Philippine National Standards for Road Vehicles.* Retrieved October 29, 2007, from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.458.7983&rep=rep1&type=pdf

Brown, M. (2013). *Smoke Belching is more than harmful.* Retrieved October 24, 2013, from http://legitipines.com/blog/smoke-belching-is-dangerous-health/

Brown, M. (2012). *The Corrective Violation Ticket: A Realistic Approach to Smoke Belching.* Retrieved May 08, 2012, from http://www.investphilippines.info/arangkada/the-corrective-violation-ticket-a-realistic-approach-to-smoke-belching/

Carlson, E.P., & Klepper, C.C. (2010). *A Fast Exhaust Gas-Analyser for the ITER Fusion Experiment Diversion.* Paper Presented at the IEEE Sponsored IEEE Nuclear and Plasma Sciences Society. doi: 10.1109/TPS.2009.2037742

De Cadiz, B.G., & Sonon, H.A. (2013). *Case Analysis: Task Force "Tambutso".* Paper Presented at the Eastern Visayas State University. doi: 10.13140/2.1.4189.6324

Guia, A.D., Rodelas, N.C., & Sim, P.G. (2016). *Development of a Real-Time Smoke Belching Monitoring System for Public Utility Vehicles (PUV) via GSM.* Retrieved April 3, 2016, from http://www.apjmr.com/wp-content/uploads/2016/04/APJMR-2016.4.2.01.pdf

Maycee (2012). *Smoke Belching and the Environment*. Retrieved January 13, 2013, from https://hubpages.com/politics/Smoke-Belching-and-the-Environment

Mimi, S. (2004). *Automotive Emotions: Feeling the Car.* Paper Presented at the Senior Lecturer, Dept of Sociology, Lancaster University. doi: 10.1177/0263276404046068

Patwegar, W. (2017). *How to Find the Location where a Photo was taken.* Retrieved August 08, 2017, from http://www.techbout.com/find-location-where-photo-was-taken-17094/

Randy, N, & Thompson S.R, (2007). *An Interactive Web-Based HPC Reservation System.* Paper Presented at Denver, CO, USA. doi 10.1109/HPCMP-UGC.2006.3

See, D.E., (2017). *Violations of Smoke Belching Vehicles No Longer Accumulated.* Retrieved March 14, 2017, from http://baguioheraldexpressonline.com/violations-of-smoke-belching-vehicles-no-longer-accumulate.

Appendix A – 1

Transmittal Letter

October 17, 2017

Engr. Trinidad Etulle
Chief Admin Division
DENR Central Visayas
Greenplains Subdivision,
Banilad, Mandaue City

Dear Engr. Etulle,

Good day! We, the 4th year Bachelor of Science in Information Technology students of University of Cebu – Banilad Campus, are currently making the Capstone project entitled "BelcherReporter: Anti – smoke belching cast application". The aforementioned activity will be the requirement for our research study.

To further understand our study, we humbly ask your permission to conduct a personal interview with you about the processes and activities related to air pollution. Rest assured that the gathered information will be keep with utmost confidentiality.

Respectfully Yours,

Azucena Tupia
Project Manager

Mr. Eric Ortega
Adviser

Recommended by:

Ms. Moma Ortega
Dean, College of Computer Studies

Appendix A - 2

Transmittal Letter

October 17, 2017

Ms. Alita C. Pulgas,
OIC, Regional Director
LTO Region VII
N. Bacalso St., Cebu City

Dear Ms. Pulga,

Good day! We, the 4th year Bachelor of Science in Information Technology students of University of Cebu – Banilad Campus, are currently making the Capstone project entitled "BelcherReporter: Anti – smoke belching cast application". The aforementioned activity will be the requirement for our research study.

To further understand our study, we humbly ask your permission to conduct a personal interview with you about the processes and activities related to smoke belching. Rest assured that the gathered information will be keep with utmost confidentiality.

Respectfully Yours,

Azucena Tupia
Project Manager

Mr. Eric Ortega
Adviser

Recommended by:

Ms. Moma Ortega
Dean, College of Computer Studies

Appendix B

Survey Questionnaire for Citizen

Name: _____ Date: _____

Age: _____

We are the 4th year Bachelor of Science in Information Technology of University of Cebu – Banilad student, we are currently proposing "BelcherReporter Application: anti – smoke belching cast" for our Capstone. We are conducting a survey to gather data from your thoughts and feedbacks.

Thank you and Have a blessed day!

Direction: Check your preferred answer.

1.) What is your daily transportation?

☐ Commute ☐ Own car

2.) In your daily transportation have you observed any smoke belcher?

☐ Yes ☐ No

3.) If the answer is yes in number 2, how does it affect you?

☐ It makes me think of the dangerous effect to my health.
☐ It makes me uncomfortable.
☐ Nothing.

4.) Have you tried reporting smoke belcher? If the answer is yes, in what way?

☐ Capture plate number and post to facebook.
☐ Call the nearest LTO or road patrol.
☐ Capture plate number and report to nearest LTO.

5.) If you were given a chance to create something that could help minimize smoke belchers what would it be and why?

_____

_____

Appendix C

Survey Questionnaire for LTO

BelcherReporter Survey for LTO

Good Day! We are the 4th year Bachelor of Science in Information of Technology student of University of Cebu – Banilad. We are currently proposing our project entitled "BelcherReporter: Anti – Smoke Beching Cast". We will be conducting surveys and interviews in order to fill all the needed data for our project. We humbly ask for your time, patience, thoughts and knowledge. This would take 3-5 minutes only. We are very thankful for your cooperation. Rest assured that all your answers will be kept with high confidentiality.

I.) Land Transportation Office

1.) Have you received any complaint/report from the citizen regarding the smoke belching? If the answer is yes, please proceed to number 2, if the answer is no, please proceed to no 4.
2.) In what way does the complainant send their report?
3.) How many reports/complaints you received every month?
4.) How are you going to identify if the vehicle violates the smoke belching law?
5.) How often do you conduct random checking on the vehicles that are running on the street?
6.) What are the actions and processes taken for the smoke belchers?
7.) What do you think is the best way in minimizing smoke belchers?

_____

Signature over Printed Name

Appendix D

Survey Questionnaire for DENR

BelcherReporter Survey for DENR

Good Day! We are the 4th year Bachelor of Science in Information of Technology student of University of Cebu – Banilad. We are currently proposing our project entitled "BelcherReporter: Anti – Smoke Beching Cast". We will be conducting surveys and interviews in order to fill all the needed data for our project. We humbly ask for your time, patience, thoughts and knowledge. This would take 3-5 minutes only. We are very thankful for your cooperation. Rest assured that all your answers will be kept with high confidentiality.

I.) Department of Environment and Natural Resources

1.) How does smoke belching affect the cleanliness of the environment?
2.) If you were given a range of 1 – 10, in what range does smoke belching affect air pollution? Why?
3.) What are the effects of smoke belching to our health?
4.) Have you taken an action that could help minimize smoke belching? If the answer is yes, how?
5.) If you were given a chance to create something that could help minimizes smoke belching, what would it be?

_____

Signature over Printed Name

Appendix E

Censor's Certificate

University of Cebu
College of Computer Studies

Date: October 09, 2017

C E N S O R 'SCERTIFICATE

This is to certify that the undersigned has reviewed and went through all the pages of the proposed project study/research manuscript titled:

BecherReporter: an Anti - Smoke Becher Cast application

as against the set of structural rules that govern the composition of sentences, phrases, and words in the English language as well as the technical terms, syntax (format, etc) and semantics appropriate for the Information Technology and Computing fields.

Signed:
Ms. Miriam Flores
Grammarian

Conforme:
Azucena Tupia
Project Manager

Noted:
Mr. Eric Ortega
Adviser

CURRICULUM VITAE

PERSONAL DATA

NAME: Azucena E. Tupia
DATE OF BIRTH: April 22, 1984
ADDRESS: Brgy Suba, Cebu City
GENDER: Female
CIVIL STATUS: Single
RELIGION: Roman Catholic
CONTACT NUMBER: 09335659590

EDUCATIONAL BACKGROUND

Tertiary:	Bachelor of Science in Information Technology University of Cebu – Banilad Banilad, Cebu City School Year 2012 – Present
	Associate in Computer Science North Negros College Villena St., Cadiz City School Year 2002 – 2003
Secondary:	Holy Infant Academy Sto. Niño St., Cadiz City School Year 2000 – 2001
Primary:	Tiglawigan Elementary School Brgy. Tiglawigan, Cadiz City School Year 1996 – 1997

PERSONAL DATA

NAME: Aisa A. Arreglado

DATE OF BIRTH: April 10, 1990

ADDRESS: Brgy. Pit os, Cebu City

GENDER: Female

RELIGION: Roman Catholic

CONTACT NUMBER: 09951223358

EDUCATIONAL BACKGROUND

Tertiary:	Bachelor of Science in Information Technology University of Cebu – Banilad Banilad, Cebu City School Year 2014 – Present
Secondary:	Madridejos National High School Madridejos, Cebu City School Year 2005 – 2006
Primary:	Bunakan Polytechnic School Brgy. Bunakan, Cebu City School Year 2001 - 2002

PERSONAL DATA

NAME: Annelyn T. Cortes

DATE OF BIRTH: May 24, 1997

ADDRESS: Brgy. Guadalupe, Bogo City

GENDER: Female

RELIGION: Roman Catholic

CONTACT NUMBER: 09354885249

EDUCATIONAL BACKGROUND

Tertiary:	Bachelor of Science in Information Technology University of Cebu – Banilad Banilad, Cebu City School Year: 2013 – Present
Secondary:	Saint Louise de Marillac College of Bogo Bogo City School Year: 2012 – 2013
Primary:	Guadalupe Elementary School Guadalupe, Bogo City School Year: 2008 - 2009

PERSONAL DATA

NAME: Ivory Myrhh Villarin

BIRTH DATE: March 16, 1996

ADDRESS: Mandaue City

GENDER: Female

RELIGION: Roman Catholic

CONTACT: 09362329635

EDUCATIONAL BACKGROUND

Tertiary: Bachelor of Science in Information Technology
University of Cebu-Banilad
Gov. Cuenco Ave., Banilad, Cebu
S.Y. 2010 – Present

Secondary: San Sebastian National High School
San Sebastian, Bato, Samboan Cebu
S.Y. 2009 – 2010

Primary: San Sebastian Elementary School
San Sebastian, Bato, Samboan Cebu
S.Y. 2005 – 2006

PERSONAL DATA

NAME: Dexel C. Mayad

DATE OF BIRTH: December 29, 1996

ADDRESS: Brgy San Jose, Cebu City

GENDER: Male

RELIGION: Roman Catholic

CONTACT NUMBER: 09950995434

EDUCATIONAL BACKGROUND

Tertiary:	Bachelor of Science in Information Technology University of Cebu – Banilad Banilad, Cebu City School Year 2013 – Present
Secondary:	Colegio de San Francisco Javier Rizal, Zamboanga del Norte School Year 2012 – 2013
Primary:	Sapang Dalaga Central Elementary School Sapang Dalaga, Misamis Occidental School Year 2008 – 2009