

INTERNET – BASED CAR COLLISION VERIFICATION SYSTEM FOR CAR INSURANCE COMPANIES

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ABSTRACT

The study has focused in the development of a product that could help the insurance company to verify if their policyholder has encountered an accident or collision. When the car owner encounters an accident or collision it will notify the insurance company via web by sending the pictures of collision and the details of the vehicle, this serves a supporting tool for the insurance policy holder whenever they encountered an accident or collision. The method used for the development of the project is the agile development method. Agile development method attempts to develop a system incrementally, it emphasizes continuous feedback. The hardware materials that were used in this project are the single board which is the raspberry pi, collision sensors that detects the collision, cameras that captures the images when there is an impact detected. The raspberry pi will send the information such as the location of the accident or collision using the GPS, vehicle's plate number and the owner's name via web. A text message will be received by the policyholder when the information is received in the insurance company's web site. And the insurance company can manage the status of the policyholder's claim.

Keywords: Insurance, Raspberry Pi, Sensors

INTRODUCTION

The internet-based car collision verification system for car insurance companies is a project that strives to create an application that could speed up the process of verifying accidents involving an insured vehicle.

In the past, cars were listed as a luxury, and only the rich can afford to buy one. However, with the proliferation of specialty dealerships and the importation of the pre-owned vehicle, many Filipinos can acquire a car. And with the changing needs of the time, cars are no longer a luxury but a necessity. All motor vehicles and other vehicles here in the Philippines must be registered in the Land Transportation Office (LTO). This provision is stipulated in section 5 of article 1 of R.A. 4136. Registration or renewal of registration of a car requires among others an Appropriate Insurance Certificate of Cover (COC). Motor Vehicle and vehicle owners in the Philippines are required by law to secure a Compulsory Third-Party Liability (CTPL) insurance as a requirement to the registration of a motor vehicle with the Land Transportation Office (LTO). CTPL is mandatory insurance for a possible liability to a third party. Here in the Philippines we only have two types of car insurance. CTPL and Comprehensive Car Insurance. CTPL has limited coverage compared to the other type. CTPL

can cover only injuries and damages caused to a third-party vehicle and its passengers up to a certain amount.

When an insured car gets into an accident, the policyholder will request to claim insurance from the insurer. Insurance companies would include a lineup of requirements as part of the procedure to secure the validity of any claim. These requirements imposed by insurance companies include Police Report with attached affidavit of the driver, a picture of the damaged portion of the vehicle, medical certificate (if applicable), death certificate (if applicable), among others. A driver's affidavit as reflected in the police report which does not coincide with the picture of the damaged or broken portion of the car will cause the disapproval of an insurance claim. More often than not, processing the approval of car insurance claim in the Philippines takes at least two weeks. Only after notice of approval has been released can repairs be made to the damages on the car. It contributes to a prolonged inconvenience on the part of the car owner or the policyholder.

To ease up the inconvenience brought about by long wait the internet-based car collision verification system for car insurance companies is a project that aims to develop a system that be a supporting tool that provides information or document from the policyholder for the car insurance company to be used as a proof that the

policyholder encountered an accident or a collision.

Accidents can happen at any time to anyone even to a car. Getting a car insured frees the owner from the hefty costs in case an accident is met. It also frees the owner from potential liabilities to the government. For this reason, car owners would get their cars insured.

The significance of the proposed project is the help it can give both to the insurer and the policyholder. In this proposed project the car will be equipped with a collision sensor and cameras both inside and outside the car's body. When a car collides with another object be it another car, a post, or the like, the collision sensor will be able to detect it with the help of a Raspberry Pi. The moment of collision will be captured by the cameras installed in and outside the car's body. Information will be generated, and the car insurance company will be notified through its website.

The purpose of the application is to:

- To create an internet-based car collision application that will notify the car Insurance company with the vehicle details including the collision photo as a supporting tool for the insurance policyholder whenever they encountered an accident or car collision.
- To take a snapshot regardless of the location of the damaged part of the vehicle.
- To generate a report in the insurance company side about the details of the collision or accident.

The internet-based car collision application has a feature that will notify the insurance company if the car had an accident, it will take pictures from the camera installed in the car inside and outside both front and back and beside the car. The application could not help the driver to avoid accident or collision; it will not help them to call the police for their police report requirements but at least to let the car insurance company notify that anytime that car owner will go to their company to claim their car insurance. It will make an easy way to claim their insurance because the car insurance company is already notified. The only collision can detect by this application acts of nature such as fire, flood, and loss of the vehicle is not included in the scope of this project.

Raspberry Pi board supports the application and collision sensor by the help of the programming language used by Raspberry Pi which is Python and C Programming Language it will send information in a web-based monitoring system for the car insurance company. The website that is intended for the car insurance company has a dashboard that displays a

report about the incident of the policyholder it has the location where it happened, but the location is not exact because as per writing the GPS has a margin of error of 5 meters. For the insurers, web view it has information from the collision sensors and transmitted by the Raspberry Pi; however, the display is limited to a sedan type of car. Another limitation is since the researcher doesn't have enough fund for using a real car or vehicle to test the project the researcher will be using a toy car to use for testing the project.

New cars these days had also innovated their technologies, one of their new technology is the sensing application that that notifies the driver if they hit someone or something. Unfortunately, this application or technology is not included when purchasing a new car. If the owner of the car wants to have this application, he or she must pay another fee for this which is very expensive to the part of the car users, but this application will not notify the car insurance company if the car got hit.

Bowers and Deane (2015) explain that a collision detection system may use the acquired sensor data to detect potential collisions. Detecting potential collisions may comprise accessing a collision detection model generated. Collision detection systems may be configured to acquire sensor data from one or more sources, including, but not limited to: a sensing system of the collision detection system, sensing systems of other vehicles, and/or other external sources.

McClellan (2015) invented a system and method for communicating between an insurer and an insured. The system detects operating characteristics of an entity, and a cost of ensuring the unit, as decided by the insurer in consideration of the detected operating characteristics. The entity may be a driver or a vehicle. The system provides an interface system for communicating the operating characteristics and the cost of insuring the entity between the insurer and the insured. The system provides a vehicle monitoring system for monitoring the operating characteristics and for providing mentoring feedback to a driver and a storage system for storing the operating characteristics. The system includes a processing system for deciding the cost of insuring the entity based upon the monitored operating characteristics.

Mills (2015) invented a collision detection system for a vehicle that includes a sensor and the camera. The sensor measures a first data set of an object relative to the vehicle. The camera measures a second data set of the object relative to the vehicle and separately measures an image-based time – to – collision with the object based on scalable differences of captures images. A fusion module matches data from the sensor and the camera and estimates a collision threat

based on the matched data. A plausibility module generates a signal if the measured image-based time-to-collision is less than a calculated steering-based time-to-collision and a braking-based time-to-collision with the object. A countermeasure module actuates a countermeasure device, such as an autonomous braking system, if the collision threat exceeds an actuation threshold and the signal from the plausibility module is received, thereby statistically reducing the rate of false actuations of the countermeasure device.

Salvagio (2013) presented a method, computer-readable medium, and apparatus by which a user can access information about one or more details may be used by an insurance provider or claims administrator to provide an information portal to its clients. User's feedback in recognizing one or more foreclosed properties may be expected to receive. Then, property data may be saved from a property database, and the property data may include property damage information and insurance claim information for each of the recognized properties. Then, based on the saved property data, it may be determined whether an identified property is damaged and whether an insurance claim is filed. Subsequently, information to the identified property may be displayed, and this information may include a damage indicator and an insurance claim status indicator.

Hagelstein and Hagen (2012) invented a system and methods for insurance based upon monitored characteristics of collision detection. A property of an insurance policy may be determined, at least in part, upon characteristics of a vehicle collision detection system. The characteristics may pertain to any capability, configuration, and/or operating state of the collision detection system. For example, a property of the insurance policy may be based upon whether the collision detection system is configured to take automatic collision avoidance actions in response to detecting a potential collision and/or whether the automatic collision avoidance actions can be overridden by the operator of the vehicle. The property of the insurance policy may be dynamic, may be updated in response to changes to the collision detection system and/or the real-time operating state thereof. The coverage of particular events may be based upon characteristics of the collision detection system and/or vehicle at the time the event occurred.

Bartulis, Sokolovskij, and Prentkovskis (2010) discussed that a collision of vehicles might be head-on collisions and collisions of motor vehicles running in a similar direction. Collisions of two or more vehicles, called chain collisions. Chain collisions occur when drivers maintain a very short distance between there and the other motor vehicle ahead. The most dangerous vehicle collision is the head-on collision; excessive energy which the vehicles were running towards

each other at high speed possess rapidly turns into the energy to destroy both human beings and goods or materials. Head-on collisions of motor vehicles are often caused by the drivers violating traffic rules.

Herman (2016) wrote in his blog the 5 top most common types of auto accidents first is the vehicle rollover it reflects the interaction of the driver, road, vehicle, and environmental factors; it occurs when the road is wet or if the tires of the vehicle are already shrill. A single car accident a type of road traffic accident that consists of only one vehicle; example when a vehicle collides with an electric pole and alike. Rear-end collision an accident where vehicle crashes into the back of another vehicle; these cause when the driver is distracted, tailgating, panic stops, and reduced grip due to irregular road conditions caused by weather. The side-impact collision also known as broadside or T-bone collisions where the side of one or more vehicles crushed. Head-on collision a type of accident where the front ends of two vehicles hit each other in opposite directions.

Gaar Law Firm (2019) explained that Sideswipe and multiple vehicle collisions are also one of the types of the car collision. Sideswipe collision occurs when two cars that are parallel touch. The damage is only minimal, as the cars have just "swiped" each other. Multiple vehicle collision is sometimes referred to as "pile-ups" and often occur on busy roads such as highways and parkways it involves many vehicles, and it can be dangerous. Vehicles can be impacted multiple times, and it may be difficult to escape. It is also difficult to determine fault in these cases.

Denham (2018) answered the question about which side of a car, is less likely to be t-boned in an accident; he explains that the driver is more likely seeing a vehicle on a collision course coming from the passenger side because, the driver's view to the passenger side is blocked by pillars supporting the car's roof, by a front seat passenger.

There are studies about this project but so far only sensing and capturing events while driving was applied. Communication between driver and its car insurance company were taken for granted. In cases where the driver is killed in a car collision accident, it would take long for the bereaved family to receive an insurance claim. It is due to the delay in the verification process where several requirements have to be met. The researcher believes that this kind of project will help not only car insurance companies but also the drivers.

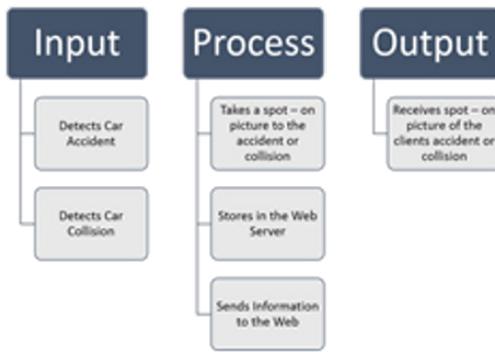


Figure 1. Input Process Output

METHODS

Requirements Specifications

Software

The researcher used the Python programming language for the development of the application. This is the programming language used for the Raspberry Pi board. HTML, CSS, PHP, JavaScript will be used for the Web-based monitoring system of the car insurance company.

Hardware

The Raspberry Pi board is the main hardware that the researcher will use. In this board China made (no brand from China) collision sensor and Computer web cameras installed in the vehicle are connected to the Raspberry board. The researcher prefers to used Raspberry Pi because it can run multiple programs compared to Arduino; it can run one program at a time. Since the project needs multitasking processes like capturing an image, sends information in the web site, sends an auto-generated text message to the policyholder. All these processes were completed at one time by the Raspberry Pi board.

Analysis of Data Gathering on the Application

The researcher gathers data and interview with the Country Bankers Life Insurance Corporation. Some of the needed information was also searched via the internet.

Design Application Features

The following are the features of the application:

- Detects when there is a collision or accident
 - Takes a picture of the scene and sends the information to the website of the insurance company
 - Notifies the car insurance company when their client had an accident through their web-based monitoring system
- The information will not be sent if the location has no signal. The captured image during the collision will be sent if the car will be transported and there is an available signal.
- The Raspberry Pi board were placed inside the car to prevent overheating of the board.
- The sensors were placed in the front left and right side, back left and right side, and both right and left side of the car. It will be covered with a foam so that it will prevent detecting false collisions.

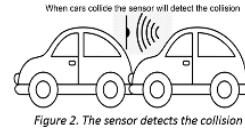


Figure 2. The sensor detects the collision

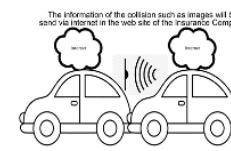


Figure 3. The taken images from the camera that is attached to the sensors will be sent to the web site of the Insurance Company

www.insurancecompany.com			
Client Name	Vehicle Details	Information or Images Received	Status and Date
Mars Garcia	Avanza 9.0 Plate #: 1234	image1.jpg image2.jpg	Pending 08.22.2018

Figure 4. The Insurance Company Website will be notified



Figure 5. The Policyholder will receive an auto-generated text that the information was already sent to the Car Insurance Company Web Site

DEVELOPMENT

In the development, the researcher uses a Toy car for the development and testing of the project.

TESTING

A test case was used for the tester to determine whether the system under test satisfies requirements or tasks correctly. This process of developing test cases can find problems in the requirement or design of an application.

Figure 1. Input Process Output

Test Case	Expected Output
Car Accident or Car Collision Scenario	
Check if a collision at the front left side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Front Left side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the front right side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Front right side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the back right side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Back right side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the <u>back left</u> side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Back left side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the right side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Right side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the left side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Front right side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the front of the car will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Front of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the back of the car will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Back of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Checks if a correct text generated message will be sent to the policyholder Insurance Company Web Site	The policyholder receives an auto-generated text message
Checks if it ends correct information in the car insurance company website	Information such as vehicle owner name, plate number, date, time and location should be correctly displayed in the web site
Check <u>admin</u> (car insurance company side) login with valid data	Admin is successfully log in
Check if the edited status for the insurance claim is updated correctly	Claim status should be updated
Check user's(policyholder) login with valid data	The policyholder is successfully logged in

WORK PLAN

ID	Task Name	Start	Finish	Duration	M	J	J	A	S	O	N	D	J	F	M
					u	a	y	n	e	c	t	r	e	c	a
1	Initiation	5/30/20 18	6/23/20 18	4 months 1 day											
2	Planning	6/2/20 8	6/29/20 18	3 weeks 24 days											
3	Analysis	6/15/20 18	7/15/20 19	10 months 19											
4	Design	7/15/20 18	12/7/20 20	6 months 15 days											
5	Implementation	9/30/18 09	01/30/20 09	5 months 09											

The researcher used the agile method in the development of the project. Agile methods attempts to develop a system incrementally. The researcher chooses this development method because the agile approach emphasizes continuous feedback, and each

incremental step is affected by what was learned in the prior steps. So this means that unlike the waterfall approach the researcher can go back to the previous phase as the project continuous to develop.

RESULTS AND DISCUSSION

Results

For the testing of the project the researcher uses the functionality test. Functionality test is a type of black box testing also known as behavioral testing for software testing method; it executes to confirm that the functionality of the application or system is performing as expected. The table below is the following test cases that were being tested to make sure that it is performing as expected:

Table 2. Gantt Chart

Test Case	Expected Output
Car Accident or Car Collision Scenario	
Check if a collision at the front left side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Front Left side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the front right side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Front right side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the back right side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Back right side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the <u>back left</u> side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Back left side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the right side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Right side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the left side will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Front right side of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the front of the car will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Front of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the back of the car will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Back of the car Date: Date of <u>Collision Time</u> : Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Checks if a correct text generated message will be sent to the policyholder Insurance Company Web Site	The policyholder receives an auto-generated text message
Checks if it ends correct information in the car insurance company website	Information such as vehicle owner name, plate number, date, time and location should be correctly displayed in the web site
Check <u>admin</u> (car insurance company side) login with valid data	Admin is successfully log in
Check if the edited status for the insurance claim is updated correctly	Claim status should be updated
Check user's(policyholder) login with valid data	The policyholder is successfully logged in

Check if a collision at the front of the car will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Front of the car Date: Date of Collision Time: Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Check if a collision at the back of the car will cause the system to display a notification in the insurance company web site	The insurance company web site will display the following notification: "Collision detected: Back of the car Date: Date of Collision Time: Time of Collision Location: Collision Location base in Longitude and Latitude with Map." A photo of the collision is included in the notification
Checks if a correct text generated message will be sent to the policyholder	The policyholder receives an auto-generated text message
Insurance Company Web Site	
Checks if it ends correct information in the car insurance company website	Information such as vehicle owner name, plate number, date, time and location should be correctly displayed in the web site
Check admin's car insurance company side) login with valid data	Admin is successfully log in
Check if the edited status for the insurance claim is updated correctly	Claim status should be updated
Check user's(policyholder) login with valid data	The policyholder is successfully logged in

For test cases numbers 1 to 8 the problem there is the accuracy of the location because the location is not exact because as per writing the GPS has a margin of error of 5 meters. Other test cases were performing as expected.

Discussion and Recommendation

The researcher prefers to used Raspberry Pi because it can run multiple programs compared to Arduino; it can run one program at a time. Since the project needs multitasking processes like capturing an image, sends information in the web site, sends an auto-generated text message to the policyholder. All these processes were completed at one time by the Raspberry Pi board. The researcher just used china made products due to the lacking source of funds, but in the end, the projects proof its concept that it can perform the objectives stated by the researcher.

For the recommendation for the future developers, it is better to test this concept in a real car if you have enough budget for these. Adding new functions such as it will produce a police report may do.

CONCLUSION

Internet of things nowadays is very popular and useful. This kind of projects has its future, but it needs to be tested in a real car. New models of vehicles at present has an installed camera in their side mirror not just in the back and front they even have vehicles that are mobility intelligent that has a feature to alert the driver from advance safety features, like blind spot, etc. but some collisions happens accidentally without us knowing if this concept is included it will be a good help for the policyholder to have a supporting

document for him or her to claim their car insurance.

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