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Swine Buddy: Development of Messenger Chatbot for Monitoring Swine

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Abstract:- Due to the widespread disease's impact on the swine industry, this study aims to develop a messenger chatbot to ease the collaboration between farmers and the municipal veterinarian of Capalonga, Camarines Norte. The chatbot acts as the virtual veterinarian monitoring the swine's health via the farmers' response. The veterinarian takes action based on the chatbot report. The chatbot was developed with the motivation and principles of the Rapid Application Development Model. The selected respondents are composed of swine farmers and the municipal veterinarian of Capalonga, Camarines Norte that evaluated the chatbot using the USE Questionnaire. Features include farmer registration, monitoring, management, and report generation. Another beneficial feature of the Swine Buddy is the scheduling of veterinarian visits. Swine Buddy received an overall average weighted mean of 6.28 rating from the respondents which is equivalent to Very Satisfactory. Using Swine Buddy indeed provided ease for both swine farmers and veterinarians. Using this collaboration tool helps maximize the minimum resource that we have. This also opens new opportunities for other agriculture sectors in monitoring and record-keeping.

Keywords*:* Chatbot; Monitoring; Veterinarian; Agriculture; Swine.

1. Introduction

Pig farming is the opportunity to access healthcare and education for the majority of farmers in many countries. It is also often the mainstay of people's livelihoods but is now under threat because of widespread swine diseases [1]. A study about the farmers' insight into African Swine Fever (ASF) reveals that the majority of the swine farmers are willing to cooperate with the reporting of swine's health. Furthermore, veterinarians are still the go-to person during pig sickness instead of farmers treating the sickness themselves. The study also suggested that monitoring will go a long way to stop the spread of the disease [2]. Apart from the need for more veterinarians, it is suggested to have a data-gathering tool, monitoring, and database for decision-making will be helpful in times of pandemic [3]. With the advent of low-cost and easily implemented technology, a tool can be developed to address the scenario, one candidate is the implementation of a chatbot. Chatbot provides new and personalized experiences to the user through a conversational interface. This tool can be used for monitoring swine's health which can help mitigate the spread of these diseases as well in decision-making. Personalized experience and targeted responses are other advantages of chatbots. Chatbots indeed provide a good user experience to the user. Social media which is the subject of chatbot creation is popular and can be leveraged for audience reach [4]. The creation of a chatbot can be done using modern programming languages and supported by tools to ease the development. It is also easy to launch and can be used with mobile devices and software the end user is currently using. Using a chatbot reduces waste and improves efficiency in the process [5]. Chatbots are efficient in providing timely information that leads to better decision-making compared to manual channels of Frequently Asked Questions or brochures as proven by the study targeting child vaccination during the COVID-19 pandemic [6]. With the viability of the implementation of chatbots, few studies have been conducted in the context of monitoring tools and exploring its interface other than human-like two-way communication. Monitoring of swine's health is necessary to prevent the spread of disease as well as a decision-making tool for veterinarians. Based on the interview, the veterinary office of Capalonga, Camarines Norte is implementing paper-based record keeping. This study aims to develop real-time monitoring using the Messenger service chatbot for recording responses and

generating reports. The chatbot was made available to the swine farmers and the report was made available to the veterinarian.

2. Methodology

The Rapid Application Development (RAD) Method was employed to develop the chatbot as its focus was on building a prototype to be evaluated by the users and provide value. To achieve fast project turnaround, RAD focus on minimizing the planning stage and maximizing prototype development [7]. Another benefit of RAD in this study is its flexible nature given there will be considerable revision as there are new rules and feature that is exclusive to chatbot development as compared to web or mobile development. RAD follows four main phases illustrated in Fig. 1.

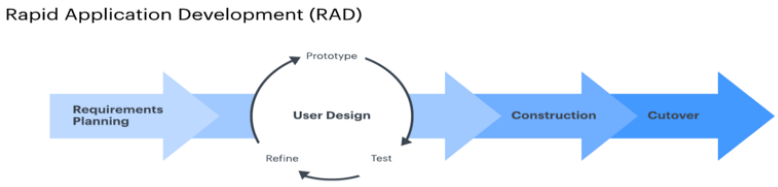

Fig. 1. Rapid Application Development (RAD) Methodology

2.1 Requirements planning

The first step of RAD is scoping the current problem and providing clear goals and expectations for the project [7]. The author initiated a series of conversations with the municipal veterinarian of Capalonga, Camarines Norte until the requirement of the project is clearly stated and agreed upon. The result of this phase is the understanding of the current status and practice being implemented to address the monitoring of swine health and identify the data needed to generate the report. It was acknowledged that the system generate the ASF Negative Monitoring Report shown in Fig. 15, one of the reports mandated to the office [8].

2.2 User design

With the requirement finalized and approved, a continuous discussion was conducted to formulate the design of the system. In this step, the specification is formulated using prototypes. RAD sets itself apart from other development models as the conversation with the user was segmented to refine the specific requirements of the project in an iterative manner [9]. Paper-based prototyping was utilized to create the prototypes. Chatbots don't require rigorous design compared to a web app or mobile app, which is why paper-based prototyping is suitable. Other advantages of paper-based prototyping include quick iteration which fits with RAD principles; it is cheap and universal [10]. In this phase, the structure of the conversation between the chatbot and the farmer was formulated. Though the Messenger platform supports unstructured or structured message types [11], the structured message exchange was designed since the purpose of the chatbot is to gather data. It was also decided that the chatbot will use the local dialect during the conversation.

2.3 Rapid Development

Phase 3 formulates a working model based on the prototypes from the design phase. RAD gives way to rapid development as the majority of uncertainty was already addressed during the iterative design phase. For developing the backend logic of the chatbot, python with Django framework was chosen. Django enables RAD because the majority of the requirement to build the backend logic are included outside the box. The pre-built Admin Interface of Django will be used to generate reports and the user interface for veterinarians. Coding is done in Visual Studio Code, the author takes advantage of the code editor's feature and extension for successful development. pytest, a fully functional testing framework, was used for unit and integration testing. Git was used for local version control and GitHub was used to host the code repository. GitHub Actions was also used to initiate the CI/CD pipeline and deploy the code to production. SQLite was used as a data source for both development and production. Ngrok was used to deploy the local development server over the internet and provided the SSL

certificate required by Messenger Platform Webhook. To deploy the system in production the code was hosted in PythonAnywhere. All the technologies used in the development up to production are open-source.

2.4 Cutover

In this final phase, the developed chatbot and its admin interface were introduced to the municipal veterinarian and 15 selected swine farmers with profiles provided by the Municipal Veterinary Office of Capalonga, Camarines Norte. The 15 farmers were identified to be the most active farmers that avail of the services offered by the office. The farmer respondents were asked to use the chatbot and the municipal veterinarian was asked to use the admin interface. USE questionnaire was given to validate the experience of the respondent upon using the chatbot and the admin interface [12].

3. Result and Discussion

The development of a chatbot is set apart from the usual web app or mobile app, this is due to the rules that need to conform to and features exclusive to the platform. The following are the summarized steps that were taken by the author to implement the chatbot. (a) Creation of the Facebook Developer Account, Facebook App, and Facebook Page. Facebook Developer Account enables the creation of a Facebook App to extend the platform capabilities and access the other resource. The particular services that were set up on Facebook App are Messaging and Webhook. The Facebook App then subscribed to the Facebook Page to listen to the message it receives. (b) Creation of a backend service connected to the Facebook App that will receive the message and respond as well as store the data in the database and generate the report. Fig. 2 illustrates the operation of the Swine Buddy using the UML Sequence Diagram.

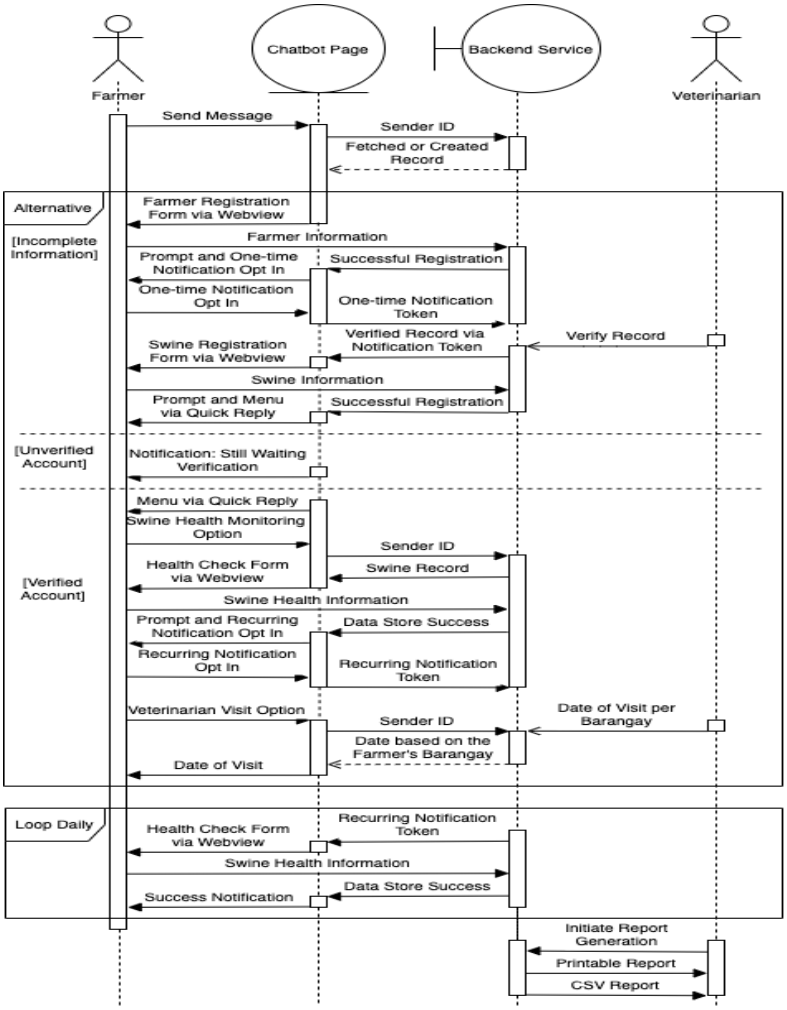

Fig. 2. UML Sequence Diagram of Swine Buddy

The sequence diagram introduced the primary actors of the system which are the Farmer and the Veterinarian. The Farmer mainly interacts with the Chatbot Page and relies on the Backend Service to formulate the logic and trigger response. The veterinarian is the one that interacts with the Admin Interface of the backend service. This allows the veterinarian to do the management and operation work on the data gathered.

3.1 Features

The main goal of the Swine Buddy is to ease the interaction between the farmer and the veterinarian. The response of the farmer is valuable for the veterinarian's decision-making while the farmer needs a platform to seamlessly respond. This goal was expected to be achieved by the following feature of Swine Buddy. *Registration*: Farmers are registered by initiating a conversation with the chatbot. The rule of the Messenger Platform dictates that the user should always start the conversation with the chatbot. Fig. 3 shows the initial interaction with the unregistered sender.

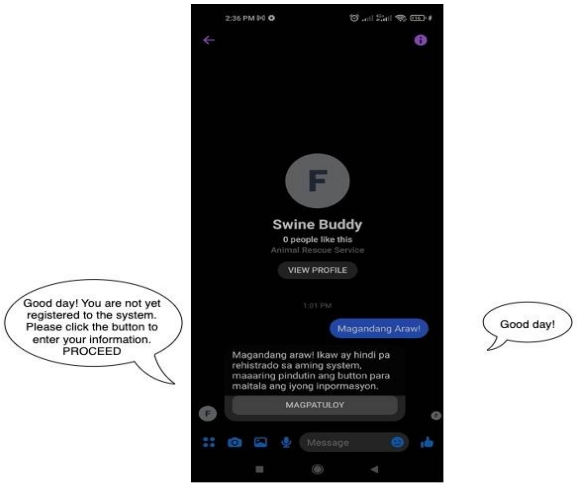

Fig. 3. Initial conversation of the farmer with the chatbot

The Backed Service verifies if the sender (farmer) is already saved in the database, if not, the farmer is advised to complete the required information using the Webwiew feature of the Messenger Platform shown in Fig 4.

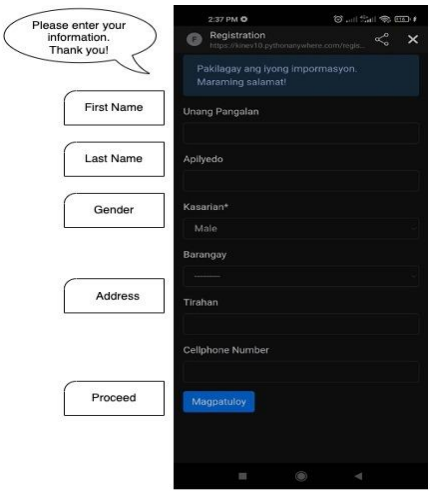

Fig. 4. Webview to allow the farmer to input personal information

Webview allows the display of external HTML to Messenger Platform, this reduces the complexity of entering data. With webview, the user is now accessing a direct form from the backend service enabling direct saving of data. The backend service then prompts the success of the registration and returns the control to the chatbot once the registration is finished. The notification includes the One-time Notification opt-in request shown in Fig 5.

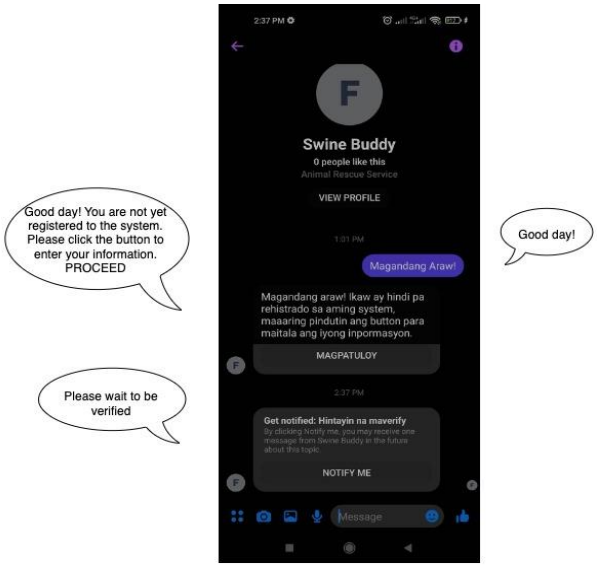

Fig. 5. One-time Notification request

One-time Notification allows the chatbot to send a notification after the veterinarian verified the farmer's information. A chatbot is only allowed to respond within the 24-hour window when the user initiates a conversation [11].

One-time notification is one of the ways that allows the chatbot to send messages outside the 24-hour window as the veterinarian may take more than 24 hours to verify the registration. Once the information of the farmer has been verified, the farmer will be directed again to a webview to input the information about the swine shown in Fig. 6.

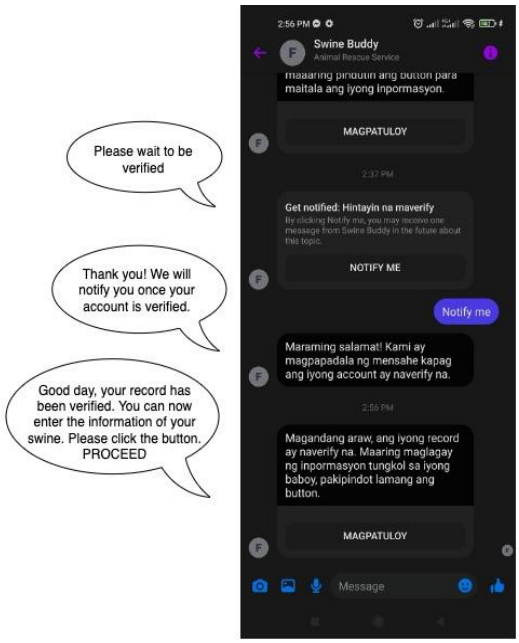

Fig. 6. Notification from the chatbot that the information was verified

The message of the chatbot used the notification token that was saved in the database during the opted-in for the one-time notification. The token can only be used once and is sufficient as the veterinarian will only verify the farmer's information once. A prompt to input the detail of the swine is sent to the farmer in the webview is shown in Fig 7.

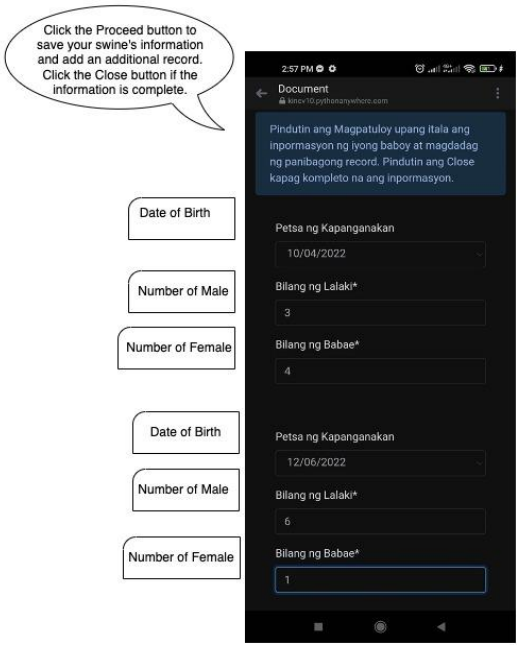

Fig. 7. Webview to input the swine detail.

The farmer is asked to input the date of birth of the swine to determine its age. The swine age is used as the distinction of the swing amongst other swine on the farm. The gender of the swine is also recorded as it is relevant for decision-making. Once all the information about the swine is complete, the chatbot will prompt the chatbot's options menu to the farmer shown in Fig. 8.

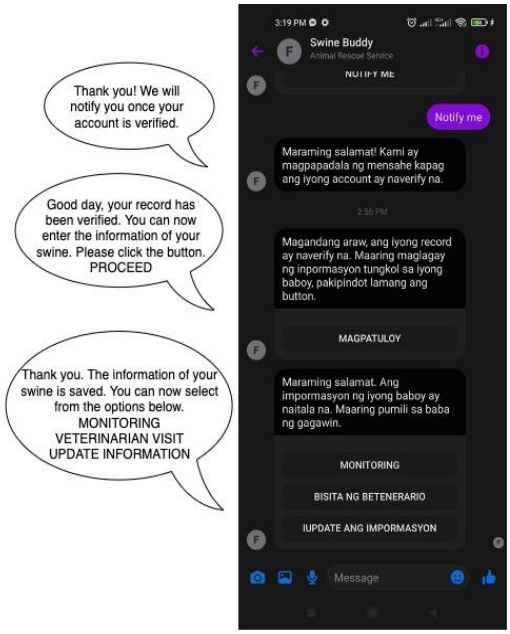

Fig. 8. Options Menu

Registered and verified farmer is allowed to report and continuously send responses using the chatbot for the veterinarian to monitor the status of the swine. The visit of the veterinarian is also available by mapping the farmer's barangay to the schedule of the veterinarian's visit entered in the admin interface.

Monitoring: One of the advantages of Swine Buddy is to allow farmers to easily report swine sicknesses and monitor them. Fig. 9 shows the interface on how to report sickness coming from the Options Menu.

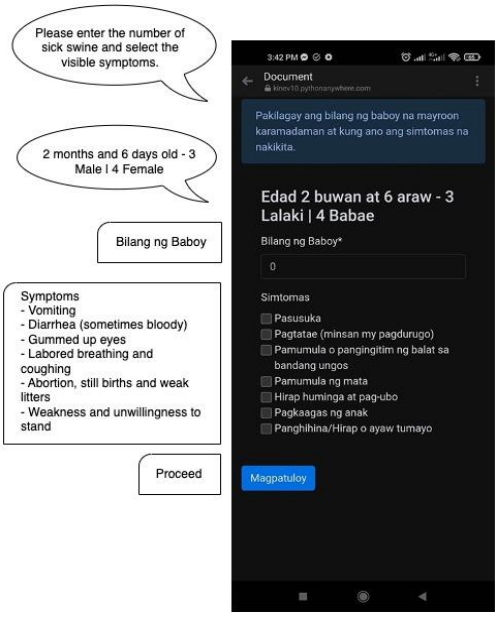

Fig. 9. Webview to report the sickness of the swine

The webview displays all the registered swine of the farmer and asks for the number of sick swine. The common symptoms of ASF are also presented for the farmer to select which symptom the swine is showing. The report will be saved along with the current date and can be edited as the situation progress. A Recurring Notification opt-in is requested to allow the chatbot to send messages and track the status of the swine daily as shown in Fig. 10.

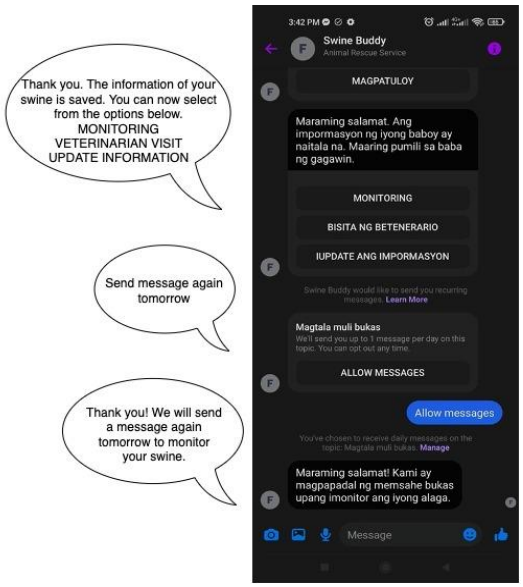

Fig. 10. Recurring Notification request

Another way to send messages outside the 24-hour window is using Recurring Notifications, the sender only needs to agree to receive a notification only once and the chatbot can send a message daily. Recurring Notification makes monitoring possible but requires that the Backend Service is already deployed in the production environment. Sending messages using the Recurring Notification token requires a scheduled task that is hard to implement in the local development environment.

Management: The veterinarian can manage the overall behavior of Swine Buddy via the Admin Interface. The admin interface is accessible to the veterinarian using a valid username and password upon login. The main dashboard of the admin interface is shown in Fig. 11.

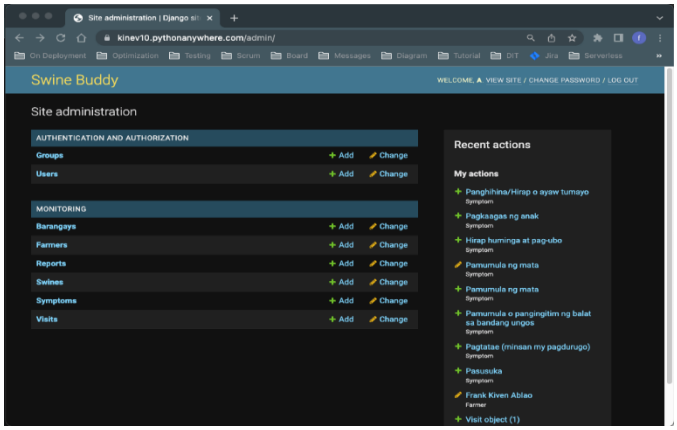

Fig. 11. Main dashboard of the Admin Interface

From the main dashboard, the veterinarian can mark the farmer as verified following the action shown in Fig. 12. The veterinarian can also schedule the visit to barangays as shown in Fig. 13.

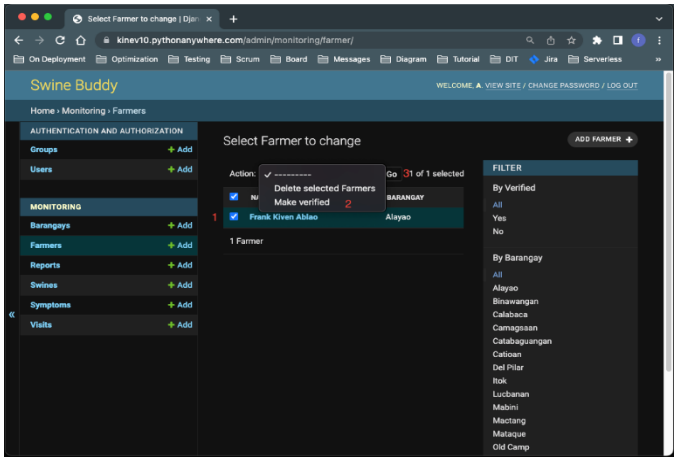

Fig. 12. Actions to verify the information of the farmer

The veterinarian can select multiple farmers to verify and will initiate the chatbot to send a notification to selected farmers. The action of the veterinarian is asynchronous which is why a One-time Notification is requested to the user.

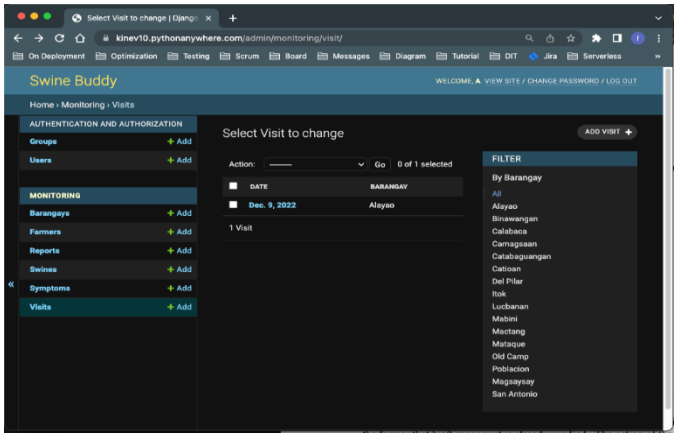

Fig. 13. Schedule of visits to barangay

The veterinarian can input the date of the visits to the barangay. The dates are available to the farmer using the chatbot's Options Menu. The dates can also be easily filtered by the barangay for easy viewing by the veterinarian.

Reports: Swine Buddy is capable of generating the ASF Negative Monitoring Report required by the Municipal Veterinary Office. The report is composed of consolidated data entered by the farmer via the chatbot. The report is accessible using the veterinarian account in the Admin Interface. The action to generate the report is shown in Fig. 14.

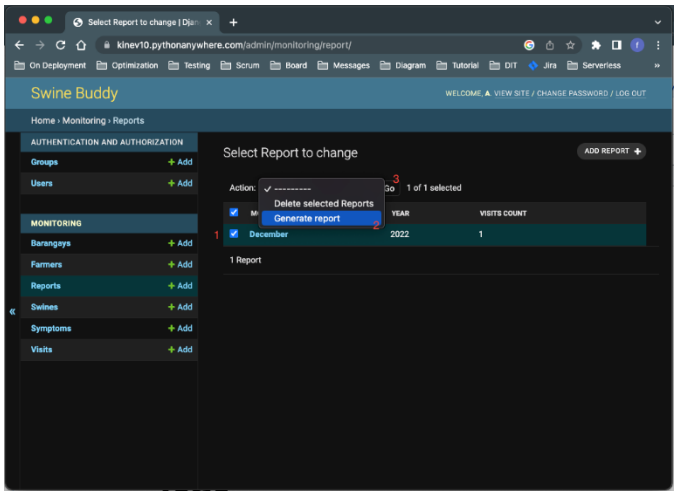

Fig. 14. Action to generate ASF Negative Monitoring Report

The veterinarian only needs to select the corresponding row that contains the month and the year the report will be generated. Unlike the verification of the farmer, the report is only generated one record at a time. The generated ASF Negative Monitoring Report is shown in Fig. 15.

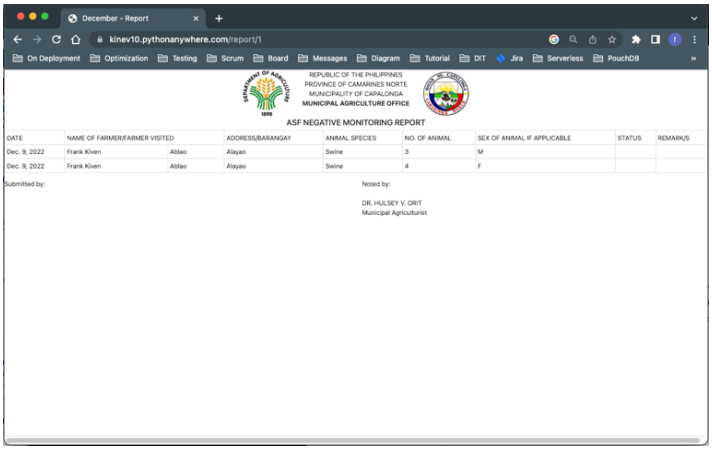

Fig. 15. ASF Negative Monitoring Report generated using Swine Buddy

The generated report is ready to be printed and includes consolidated data entered by the farmers. The report includes each farmer and swine information for each barangay. This feature is the enhancement of the current manual process the Municipal Veterinary Office is using.

3.2 Architecture Framework

Swine Buddy was created using the Monolithic approach which is why the Layered Pattern (three-tier architecture) was the core blueprint to build the requirements of the beneficiary. Fig. 16 shows the architectural framework of the chatbot system.

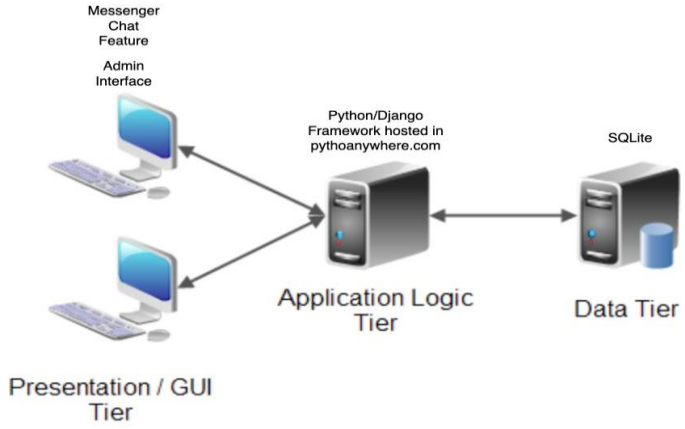

Fig. 16. 3-tier Architecture of Swine Buddy

The chatbot system is presented to the user dependent on the user's access level. The client (farmer) engaged the chatbot using the Meta Messenger App installed on a mobile device, computer, and web browser using the web version. The presentation tier for the client allows interaction using message conversation, buttons, and webview. The Admin Interface is accessible using the web browser in the form of a web app. Admin (veterinarian) interacts directly with the data using forms, lists, and filters.

The application tier makes sense to the data received from the application layer and takes the necessary action. The logic was formulated using Python/Django Framework and deployed to production in pythonanywhere.com. The response can be a direct change in the user interface or a request to the Messenger webhook to display messages in the chatbot. The database tier is used to store data needed information to provide logic to Swine Buddy such as tokens, farmer information, and swine information.

3.3 Evaluation Result

The selected respondents answer a series of questions to assess the Swine Buddy in terms of Usefulness, Ease of Use, Ease of Learning, and Satisfaction. Table 1 shows the result of the mean rating of each category and the overall result.

Table I: Overall Mean for Evaluation Result

Category	**Mean**	**Remarks**
Functionality	6.02	Strongly Agree
Ease Of Use	6.35	Strongly Agree
Ease Of Learning	6.39	Strongly Agree
Satisfaction	6.38	Strongly Agree
Average Weighted Mean	**6.28**	**Strongly Agree**

Swine Buddy received a rating of 6.02 (Strongly Agree) in terms of Usefulness. This is a reflection of the findings of the previous study that farmers and veterinarians are interested in a monitoring tool in times of pandemic. The chatbot also received a rating of 6.35 (Strongly Agree) and 6.39 (Strongly Agree) for Ease of Use and Ease of Learning. The overall Satisfaction rating of the chatbot is 6.38 (Strong Agree).

The calculated overall Average weighted mean is 6.28 indicating that the respondents strongly agree with the implementation of the chatbot. Upon further interviews with the respondent, it was found that the reason behind the result is that most farmers are using Messenger App already and the structured messages delivered in the local dialect contributed to how easily they used it.

4. Conclusion and Recommendation

The result of this study supports the claim of the previous studies about the capability of chatbots to reduce waste and improve efficiency in the process. Swine Buddy gaining an average of 6.28 (Strong Agree), a very satisfactory

rating, is also a shred of evidence that farmers are willing to participate in the monitoring of swine health to minimize the impact of widespread disease. Furthermore, it was proven that chatbots can be a good candidate for delivering structured processes such as scheduling, monitoring, and record-keeping apart from the conventional web and mobile applications. Aside from Artificial Intelligence and Machine Learning, chatbots can be enhanced by real-time image processing as aside from text, chatbots also accept file formats including photos. This can be used to examine scenarios that apply to plants and animals which opens further studies that can be done to promote the usage of technology in agriculture.

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