DENGAR: AN ANONYMOUS GPS-BASED DENGUE AND GARBAGE REAL-TIME SMART REPORTER

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Abstract

An Unhealthy environment causes infectious and non-infectious diseases to the living beings. Human plays an important role in controlling disease spread, requiring every individual to maintain environmental cleanliness. One measure is to inform the relevant government authorities about Dengue breeding sites and improper waste management practices. Currently, there is no practical mechanism to lodge complaints anonymously, causing informers to face various challenges. To address this gap, an Android based prototype called 'DenGar Reporter' is introduced in this work, where any general public can inform authorities about untidy and health-risky locations during their travels. Authorities, including Public Health Inspector (PHI), MOH offices, Municipal councils and police stations, can receive reports through this prototype. This prototype will not reveal the details of the informer as it operates anonymously, instead it will report the scenario with graphical information, supporting media, and real-time GPS location. This system ensures that the anonymity of the user will be protected and he/she will not get any retaliation and negative impressions. The government's sole purpose is to eradicate dengue outbreaks and improper garbage disposal in Sri Lanka, necessitating information regarding the ignorant but not the details of the informer. The system is an Android application developed with Java and Firebase, establishing a centralized system to report the Dengue breeding sites and improper waste management nationwide. Government administrators monitor the automated system, ensuring informer details are used solely for data storage. The prototype has been tested with several user groups and demonstrates a positive impact in the society.

Keywords: Dengue, Garbage, Anonymous, Ignorant, Android, GPS

I. INTRODUCTION

The increasing spread of Dengue poses a growing threat to our society, yet many cases stay hidden and go unnoticed because some people are afraid to speak up, and as such these issues remain out of sight. The importance of addressing Dengue outbreaks necessitate the need for effective solutions, and this is where the concept of anonymous reporting apps comes into play. Anonymous reporting apps can motivate individuals to step up and share these issues proactively before it becomes too critical. This motivation is rooted in the concept of psychological safety, as highlighted in the research studies by Harvard professor Amy Edmondson, which emphasizes its importance in organizations. Anonymous reporting apps can make it easier for them to share information without revealing who they are. Anonymous reporting let you send a report without telling anyone your name and identity. To keep the person's identity a secret, the government should make sure they can't be found through the aspects like their IP address of the device, phone number, voice, or writing style. Also, all the information the person sends should be kept safe and encrypted so that no one can read it without permission.

As Dengue continues to spread, it is the responsibility of general public to assist the government and the medical officers in controlling this issue. Although some people are aware of the Dengue spreading, yet they are unable to control it. And there are some other people who are unaware of this and also neglect the rules and regulations.

To understand the crucial need for anonymous reporting, let's consider specific scenarios where individuals might hesitate to report health and environmental concerns. For instance, imagine a scenario where a resident identifies a Dengue

breeding site in their neighborhood but fears potential backlash from community members or local authorities for raising the issue. In such cases, the lack of anonymity can stop individuals from reporting, preserving the cycle of unreported cases.

Similarly, improper waste management practices in certain areas may be overlooked due to residents' concerns about facing social stigma or potential consequences for reporting on their neighbors. The DenGar Reporter app addresses these challenges by providing a secure and anonymous platform, encouraging individuals to share information without any fear of reprisals.

DenGar Reporter is a user-friendly app that caters to individuals across all technological skill levels. The app's accessible interfaces make it easy for anyone to use, regardless of their technological expertise. It serves as a motivational tool, encouraging citizens to provide valuable information about issues such as improper waste management and dengue breeding sites.

Therefore, the objective of this work is to build a smart, robust, flexible and real-time anonymous reporting android app based on GPS which meets the following criteria:

- Public Safety: One of the main reasons for the anonymous information collection is to protect the people and the society from the risk of dengue spreading and improper waste management.
- Anonymous Reporting: Enable individuals to report Dengue breeding sites and improper waste management anonymously, fostering a culture of open communication without fear of reprisals.
- Real-time Information: Provide a platform for real-time reporting, ensuring timely responses from authorities to address reported issues promptly.
- User-Friendly Interface: An user-friendly interface accessible to individuals with varying levels of technological expertise, promoting widespread usage.
- Geospatial Accuracy: Utilize GPS technology to ensure precise location reporting, aiding authorities in efficiently locating and addressing reported concerns.

- Community Engagement: Motivate citizens to actively participate in public health and environmental initiatives, creating a sense of collective responsibility for the well-being of the community.
- Moral Responsibility: Informing the ignorant of a sense of moral obligation is generally regarded as the best reason to do so.
- Faster Processes: Online reporting is easier and faster than offline reporting. That is when a person wants to contact a PHI, this takes more time to reach them but this app allows faster process where the informer need not to spare more time over the phone.
- Manageable: The system is not only easy for users but also easy for administrators as the system provide all the reports and update it on time.
- Increased service: A person can inform or report the dengue related issues without revealing their identity and this protects them from retaliation and revenge.
- Exposing Ignorant Activity: By exposing those people who are the root cause for the Dengue spreading and improper waste management will help the Medical Officers and PHIs to control the ignorant activities in the society or country by warning them.
- Preventing false information: As the app asks for the proof and the location of the situation, the informer cannot give any false information.
- Cost-Effective: Installing *'DenGar* Reporter' incurs a one-time-data-cost, but when we have to deal with other offline systems, we must pay our phone bills for contacting the Medical Officer or PHI. Therefore, no cost at all when comparing to the offline reporting systems.

The beauty of 'DenGar Reporter' lies in its dual purpose: not only does it enable reporting, but it also educates users about the spread of dengue and waste management practices, their consequences, and effective control methods. This smart, real-time app acts as a catalyst for a safer and cleaner Sri Lanka, with interconnected technologies working in harmony.

II.   LITERATURE REVIEW

A detailed study has been done related to the ways in which Dengue mosquito breeding places and improper waste disposal are reported and how mobile apps contribute to it. DenGar Reporter, our proposed system, not only draws inspiration from these studies but also introduces distinctive features that addresses specific challenges in the Sri Lankan context.

Automated Waste Control Management System (AWCMS) (Furqan Durrani et al., 2019) includes an electronic waste detection device and a central control unit for waste monitoring and detection in the bins placed in an area or a city. Different technologies like infrared sensors, GPS, microcontroller and GSM Module are used for this purpose. Location and the status of the bin are displayed in the GUI of the software. This mainly focuses on timely and automatic waste collection. DenGar Reporter extends this concept by integrating user-friendly interfaces for anonymous reporting, fostering increased public engagement in waste management beyond automated collected system.

The application of Unmanned Aerial Vehicles (UAVs) for mosquito-breeding site identification (Dias et al., 2018) and the comparative study with the Global Positioning System (GPS) (Schenkel et al., 2020) offers some valuable insights into efficient data collection methods. DenGar Reporter capitalizes on this knowledge by incorporating GPS functionalities for precise location reporting while ensuring a user-friendly mobile interface tailored to the Sri Lankan population.

Chaak (Lozano–Fuentes et al., 2013) serves as a model for mobile-based, real-time mosquito surveillance. DenGar Reporter builds upon this foundation by incorporating a centralized system and anonymous reporting features, aiming to enhance the speed and accuracy of dengue-related data collection.

Deep Learning and Image Processing in waste classification (Nowakowski & Pamuła, 2020) and IoT-based waste sorting (Haldi Widianto et al., 2021) showcase technological advancements. DenGar Reporter strategically employs user-friendly interfaces and efficient data processing methods to verify and classify reported scenarios, enhancing the accuracy and efficiency of waste

and mosquito-breeding site identification without the need for a complex deep learning model.

The CryHelp App (Kayem et al., 2015) stands out as a mobile-based crime reporting platform designed to ensure anonymity and privacy. Leveraging Java and the Eclipse SDK for Android development, this application has achieved an accuracy rate of 77.06%. DenGar Reporter draws inspiration from the principles of CryHelp, emphasizing the importance of anonymous reporting to encourage widespread public participation in reporting Dengue breeding sites and improper waste management practices.

The study on Dengue breeding container detection (Prachyabrued et al., 2020) introduces the use of Deep Learning and Google Street View (GSV) for accurate identification. While DenGar Reporter does not utilize Deep Learning, it acknowledges the effectiveness of technologies like GPS in recording the exact location. DenGar Reporter innovates by adopting a user-friendly approach for reporting, ensuring broad accessibility and simplicity for users.

In the realm of garbage detection systems (Patel et al., 2021), the use of Artificial Intelligence and Deep Learning for garbage sorting presents a technological leap. DenGar Reporter strategically refrains from the complexity of Deep Learning models but aligns with the objective of efficient waste management. It incorporates advanced image processing techniques and user-friendly interfaces to achieve automated garbage detection and reporting.

SpotGarbage (Mittal et al., 2016) highlights the ability of citizen-driven reporting through a smartphone app. DenGar Reporter extends this concept by emphasizing anonymity, ensuring users can report environmental concerns without fear of reprisal, contributing to a safer and cleaner community in Sri Lanka.

III. METHODOLOGY

The *DenGar* Reporter project employs an observational study design to evaluate the Android application in real-world settings. This approach was chosen to ensure a user-centric assessment, focusing on usability, impact, and ethical considerations. The design allows for a comprehensive understanding of how the app functions in diverse situations, contributing

valuable insights to its practical implementation and effectiveness in dengue prevention and waste management. The study's participants include a diverse range of individuals across Sri Lanka. The app is designed to be accessible to people from various age groups, technological proficiency levels, and backgrounds. The key independent variables in this study are the users' interactions with the *DenGar* Reporter app, including their reporting of dengue breeding sites and improper waste disposal. The dependent variables include response times to reported issues, issue resolution, and the overall impact on dengue prevention and waste management. Data is collected through the *DenGar* Reporter mobile application. The app allows users to report issues in real-time, and it collects various data types, including text input, images, and precise GPS coordinates. A cloud-based system manages the data, which is then made accessible to administrators for further action. Analytical techniques applied to the collected data involve assessing the frequency of reported issues, measuring response times for issue resolution, and analyzing trends in dengue prevention and waste management improvements. Statistical methods will be used to identify patterns and correlations in the data. Ethical approvals have been obtained to ensure the privacy and anonymity of app users, reducing the risk of retaliation for reporting. All data collected is strictly used for the purpose of dengue prevention and improving waste management practices, with user privacy and ethical considerations being paramount.

An overview of the *DenGar* Reporter is shown below.
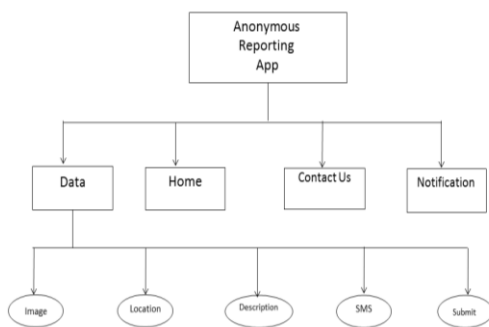
Figure 01: Overall Component of the *DenGar*

The overall mobile app consists 4 integrated components with sub parts.

i. Data: The Data component contains 5 main-modules. They are:

✓ Image: The informer is asked to add one or more images of the scenario in order to avoid fake reporting. Also, there is an option for the user to add images either by capturing it directly or to select from gallery. It is believed that, adding multiple images may clarify the scenario.

✓ Location: The informer is asked to add the exact Google Map location of the scenario. So that it will be informed to the relevant area PHI or Medical Officer to handle the situation.

✓ Description: The informer is asked to describe the situation in words and it is optional.

✓ SMS: The current location added by the informer will be sent automatically to the relevant authority as latitude and longitude to their mobile number as an SMS, where the informer details will not be revealed.

✓ Submit: The Submit button will be valid only if the images and the location are attached, where the description is optional. This information will be stored in Firebase cloud storage with the button click.

ii. Home: The Home page provides some information about the Dengue Breeding Sites, Proper Waste Management, Social Mobilization, Preventing Measures, Registered Mosquito Repellents and many others.

iii. Contact Information: The Contact Information provides the user with more and more ways to contact National Dengue Control Unit, Colombo Municipal Council and the area PHI which includes their Hotline, E-mail, Fax, Address and Website details.

iv. Notification: The Notification page shows the status of the report that is sent to the relevant authority by the user via this app. And it will notify the user when it is reviewed by the relevant authority.

The methodology of the system is a systematic way used to collect information and data in order to make and arrive at final decisions.
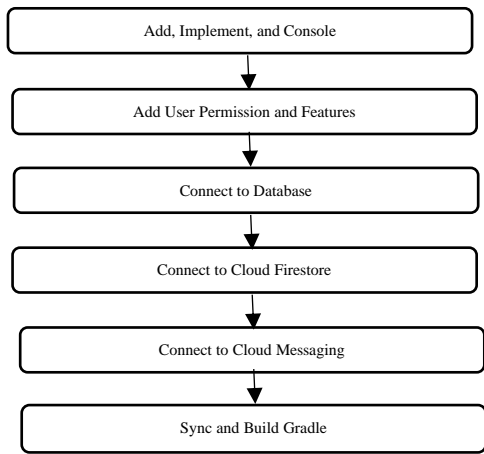
Figure 02:
Developmental Outline of the DenGar Reporter

IV. DESIGN AND IMPLEMENTATION
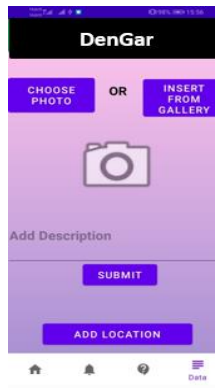

Figure 03: Interface for
Making Selections

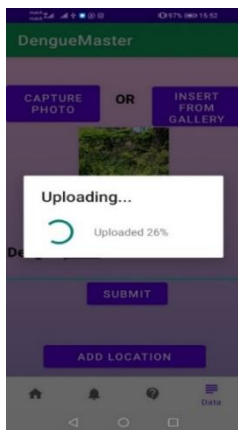Figure 04: Interface for
Managing Data
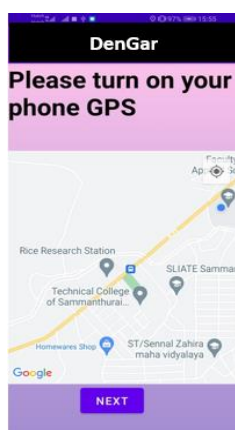

Figure 05: Processing
Image
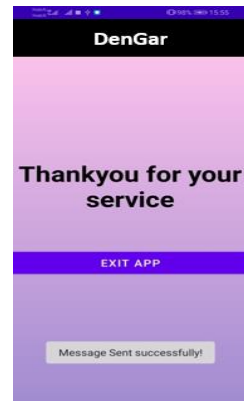

Figure 06: Interface for
Locating GPS Position
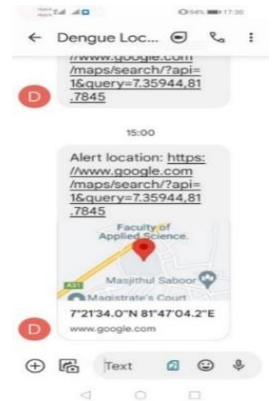

Figure 07: Interface Showing
Appreciation

Figure 08: Receiving
Location Alert via SMS
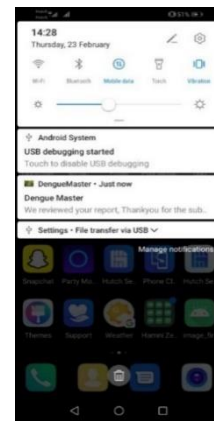in PHI Phone

Figure 09: Real-time Push Notification of
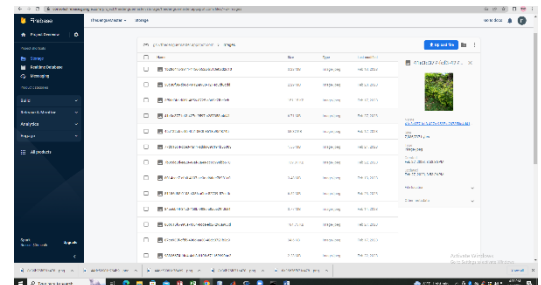Reviewed Message from the Application

Figure 10: Realtime Firebase Storage where
the images and media sent by the user is
saved.
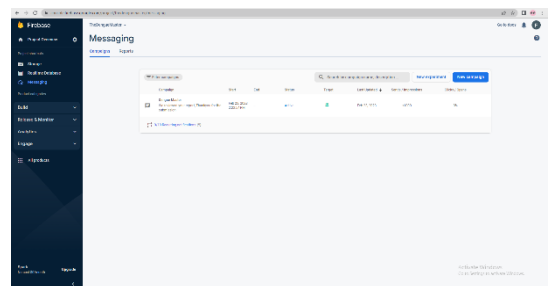
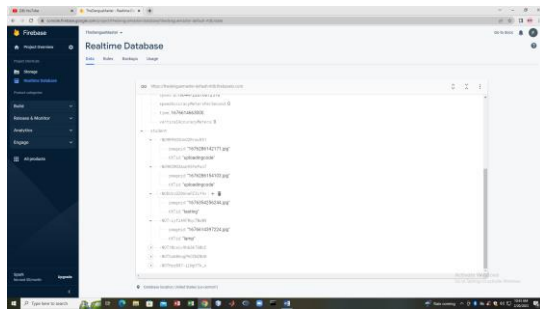Figure 11: Realtime Firebase Cloud for
Real-Time Push Messaging

Figure 12: Realtime Firebase Database
where all the data are saved

selected to acquire various opinions of the prototype.

Figure 13: User Satisfaction of the Dengar with Different User Groups

V. DISCUSSION

This study was focused on developing an Anonymous Reporting App where people can submit the dengue breeding places and improper waste management activities without revealing their identity. This app needs the information regarding the ignorant and not the details of the informer. The *DenGar* Reporter is a free, responsive app which could be available on all the types of Android Mobile Phones. Each and every Android user in Sri Lanka can install this app. This is app can be used by all the people in the society irrespective of their technological skills and knowledge. This is a user-friendly app where the interfaces are designed in an easy, accessible manner and understandable by both the expert users and the novice users. To avoid fake reporting, this app requests the informer for the exact GPS location and the picture or video or any media type of the scenario for the confirmation of the report.

According to a statistical analysis conducted as a part of this prototype's evaluation focused on the impact of anonymous reporting. The results indicate that, allowing people to submit reports anonymously does not increase the number of mean or harmful reports. It just shows that what matters most is addressing the issue, not finding out who reported it. This prototype uses Java in Android Studio and uses Firebase as its Database. The future work of this prototype will include the addition of new features and introduction to IOS and all the other types of Operating Systems and Computers.

For the evaluation of the *DenGar* Reporter, a graphical interpretation of the results and feedbacks are collected using a questionnaire to test the prototype with multiple users is shown below. Different groups of user groups are
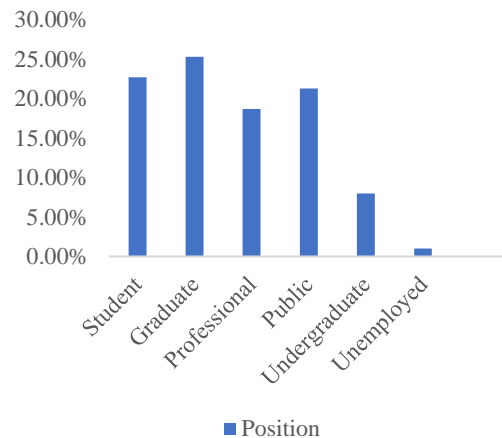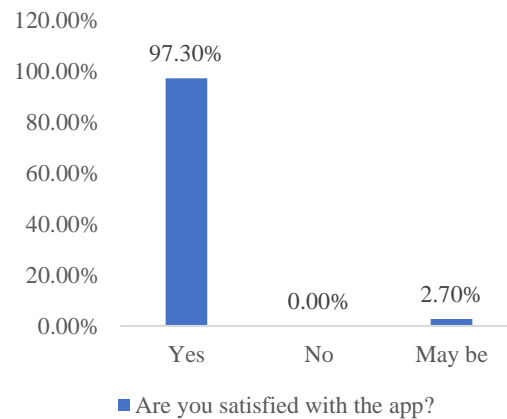

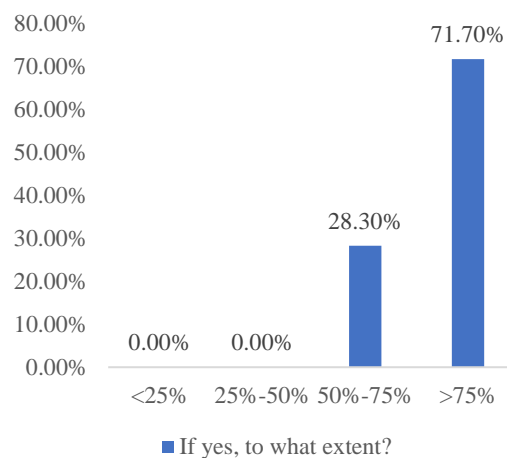Figure 14: User Satisfaction Rate of the Dengar

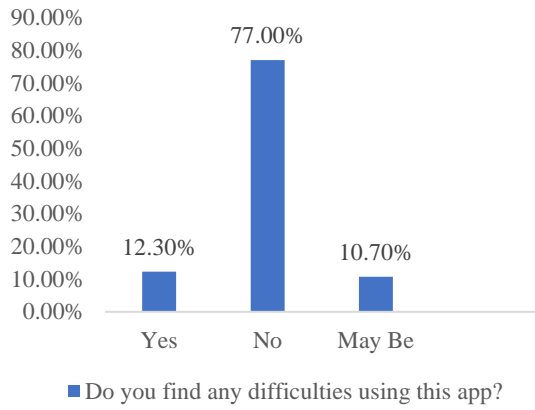Figure 15: User Satisfaction Range of the Dengar

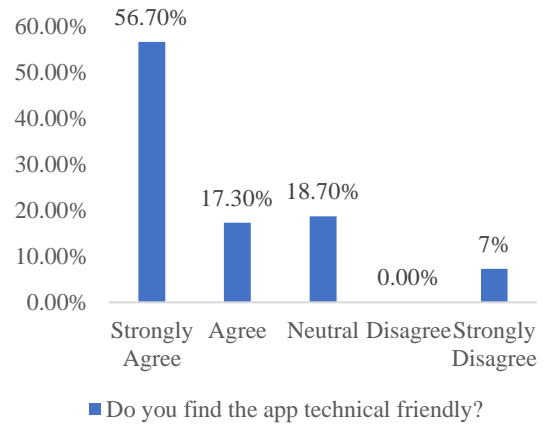Figure 16: User Difficulty Rate of the Dengar.

Figure 18: The Technical Friendliness of the App with the User.
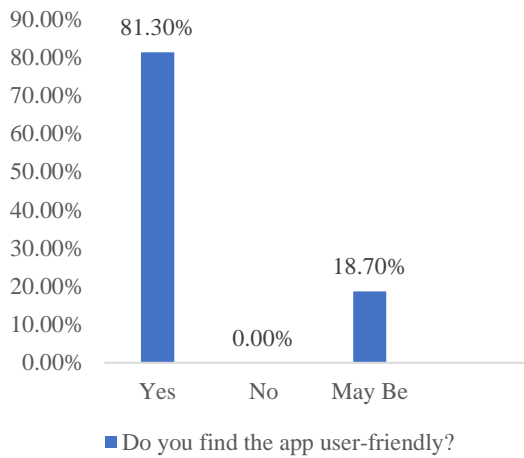

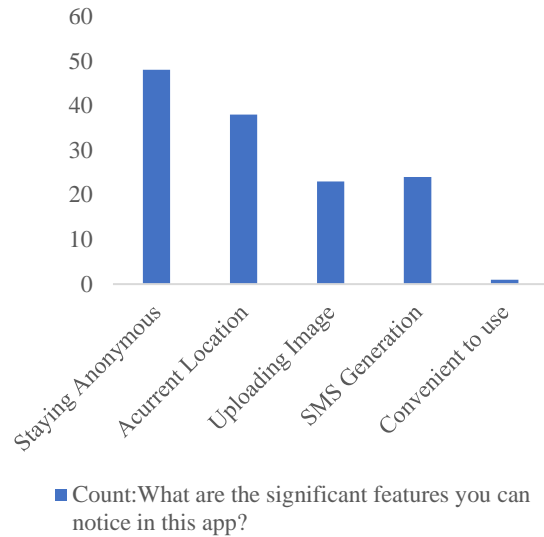Figure 17: User Friendly Rate of the App

Figure 19: The Count of People Who Noticed the Significant Features in the App.
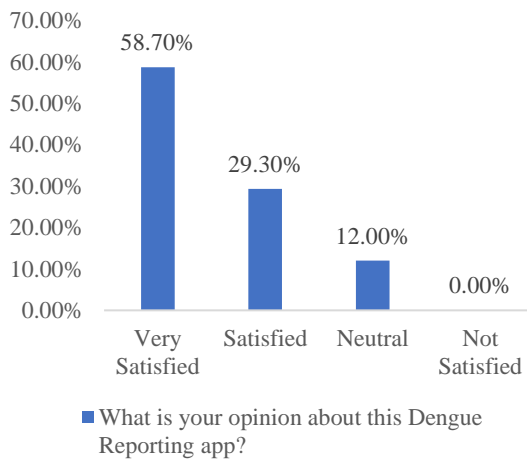

Figure 20: Overall User Satisafaction of the Dengar Reporter.

VI. CONCLUSION

The current work presents the development of an Android App, a prototypical approach for the Sri

Lankan to provide anonymous information about Dengue breeding places, improper waste management and the activities of the ignorant. The *DenGar* Reporter is a new digital app, which protects the informer identities and enable two-way follow-up interactions. These mechanisms also permit informers to securely share supporting files and documents. This app accepts the report at any time, without causing any inconvenience to the informer or the reporter. If an informer is worried about-facing retaliation and negative consequences, it makes sense that they might hesitate to report. In such cases, the government could miss out on incredibly important information, leading to potentially significant harm for both the government and the medical sector. However, when anonymous reporting is allowed, it removes these barriers and encourages a larger number of people to come forward. Therefore, this provides the highest level of protection to society against various risks. Anonymity makes it easier for people to overcome their hesitations. Typically, making a report is a one-time event, often filled with uncertainty. People might be afraid of facing consequences, so speaking out is an incredibly brave step to take. Yet, with the help of this anonymous reporting app, they can inform the dengue related and waste management activities easily without any fear. This prototype is evaluated with various users such as Undergraduate, Working Professionals, and General Public, resulting a positive outcome towards introducing its use within the community. DenGar Reporter has shown success in making a real-time impact, providing an easy-to-use interface, and involving the community effectively. However, our evaluation mainly looked at specific groups of users, so more research is needed to see how well the app works for a broader range of people. Also, we should explore using new technologies to make the app even better and study how it might affect public health and the environment over a longer time.

In Future, DenGar Reporter plans to enhance user capabilities with new features, by integrating the latest technologies for improved performance, and to explore platform expansion (iOS and web versions). These future initiatives reflect our commitment to continuous improvement, ensuring

DenGar Reporter remains an effective tool for a healthier and more sustainable Sri Lanka.

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