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Designing the 112 Call Centre Service System in Sidoarjo Regency using the Object-Oriented Analysis and Design (OOAD) Method

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Abstract

The 112 call centre in Sidoarjo district faces significant challenges, including a high number of false alarms, which account for 85% of all calls. This hampers the efficiency of the service, especially with the limited number of call takers and inefficient manual information flow. This research aims to develop a technology-based reporting system using an OOAD method (Analysis, Design, Build, Operate) approach to improve the reliability and efficiency of emergency services. The system includes E-KYC-based report verification features to filter false reports, real-time report status tracking, and integration between related parties such as the community, administration, and response units (police, ambulance, fire). The results show that the designed system is able to significantly reduce false reports, improve service response through report prioritisation, and provide community access to monitor reports independently. This approach not only overcomes operational constraints, but also provides more transparent and efficient emergency services. It is hoped that this system can become a standard model for modernising emergency services in the digital age.

Keywords: *Call Centre 112; Emergency Services; E-KYC Technology; OOAD method; System Design.*

1. Introduction

In the modern era, emergency services play a very important role in ensuring the safety and well-being of society. The Regency of Sidoarjo, with a population of approximately 1,955,000, faces a major challenge in providing an efficient and reliable emergency notification system. Various critical situations such as accidents, fires and crimes require a quick and accurate response. However, the biggest challenge facing this service is the high number of false or prank calls, which account for around 85% of all calls received by the 112 call centre [1], [2]. This phenomenon not only hampers the performance of the operators, but also potentially jeopardises the safety of people who really need immediate help. As technology evolves in the digital age, fast, accurate and efficient information management is a key requirement for emergency services. Information such as the location of the incident, the type of incident and the level of urgency must be processed appropriately to ensure a responsive response. However, the high number of false alarms indicates weaknesses in the existing system, requiring technological innovation to filter incoming data and ensure service reliability. The development of a system with integrated false alarm filtering features can be an important solution to improve the efficiency and effectiveness of emergency services.

Previous studies of the 112 call centre service in the city of Mataram revealed some significant problems in this system [3]. Firstly, the limited number of call takers cannot handle the high volume of calls, so emergency information is often delayed. Secondly, the system lacks a mechanism for prioritising reports, which means that all reports are treated equally without regard to their level of urgency. Thirdly, emergency reports are often poorly documented due to manual processes, especially when all call takers are busy handling other calls. Fourthly, it is difficult for the public to track the status of the reports they have made. , which lowers the level of trust in the service. Finally, the complex flow of information delivery, where information from call takers had to be manually forwarded to the relevant agencies, slowed down the response to emergencies [4], [5].

Along with the development of technology in the digital era, fast, accurate and efficient information management is a key requirement in emergency service operations. Information such as incident location, incident type, and urgency level must be processed appropriately to ensure responsive action. However, the high number of false reports indicates weaknesses in the existing system, so technological innovation is needed to filter incoming data, manage reports automatically, and ensure service reliability. One solution that can be applied is the development of an application system designed to simplify the flow of emergency reporting by utilising the latest technology. The scope of this research covers several important aspects to address the problems faced by the 112 Call Centre service and utilise technological innovation to improve its operational efficiency. The focus is on designing an emergency reporting workflow that involves three main parties, namely the public as a reporter, the 112 admin as a report manager, and action-taking units

such as police, ambulance, and fire department. The system is designed to enable efficient integration between these parties [6], [7].

This research aims to develop an innovative solution through the OOAD method (Analysis, Design, Build, Operate) approach in the development of an emergency service application that is able to minimise false reports with E-KYC-based verification features, provide real-time report status tracking, and support report management by call takers and related agencies. The OOAD approach allows the system to be designed based on in-depth analysis of operational needs and challenges, followed by comprehensive solution design, technology-based system development, and operational testing to ensure system feasibility before full implementation. With this approach, the resulting system is expected to reduce the number of false reports, increase the speed of response, provide access to the public to monitor the status of their reports. make it easier for call takers to convey information to relevant agencies, and support better coordination in handling emergencies [8].

The results of this research are expected to not only contribute to the development of emergency service technology, but also create a positive impact. This proposal can be a model for development for public service operations. With a better system, the public can get responsive and reliable services. In addition, the solution is similar systems in other areas, thus creating a new standard in the management of technology-based emergency services. Therefore, this research has great significance in supporting the transformation of public services towards the digital era. By combining the latest technology and a systematic analytical approach, this research is expected to provide sustainable solutions and have a direct impact on improving the quality of emergency services in Sidoarjo Regency, as well as a foothold for similar innovations in the future [9].

2. Research Method

This research employs the OOAD (Object-oriented analysis and design) method, approach used in object-based system design. OOAD integrates analysis and design using the concepts of classes, objects, and relationships between objects to create systems that are modular, flexible, and easy to develop[4]. This process includes the creation of UML (Unified Modeling Language) diagrams as a visual aid in system design and development[5].

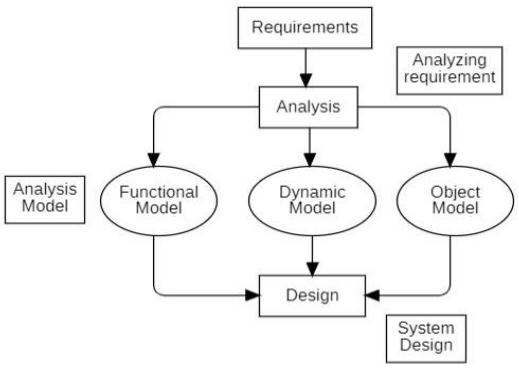

Fig. 1: Research method for designing 112 call centre system

2.1. Requirements

This stage focuses on collecting system requirements from various parties (users, centre admins, and related agencies). These needs include specifications of functions, non-functions, and desired system boundaries. This process involves various stakeholders such as the general public, call takers, and related agencies (ambulance, police, fire department). The information collected includes functional requirements (what the system should do, such as report status tracking, report verification), non-functional requirements (e.g. system performance, data security), limitations and risks that may arise in the development and implementation of the system.

2.2. Analysis

This stage aims to analyse the requirements that have been collected in the previous stage and formulate a more structured solution. There are three main models used:

1. Functional Model; this stage describes the main functions of the system, such as receiving emergency reports, verifying reports, and submitting reports to relevant agencies which can be described with a Cross Functional Diagram of the current system condition and Use Case Diagram to describe the main functions that can be performed by users in the system.
2. Dynamic Model; This stage analyses the behaviour of the system in responding to inputs or changes, such as how the system processes false reports or handles report prioritisation based on the level of urgency. It can be illustrated by activity diagrams that describe the flow of activities, such as the report verification process or report tracking flow. And sequence diagrams to illustrate interactions between objects, for example, between users, call takers, and related agencies.
3. Object Model; This stage maps the objects in the system, such as emergency reports, users, call takers, and action units, and the relationships between these objects can be described with a class diagram that serves to detail the design of objects to be implemented.

2.3. Design

The design stage aims to design a more detailed system blueprint based on the previous analysis. At this stage, the system is designed as a whole, both in terms of display (front-end) and process behind the scenes (back-end).
System Design; Designing the overall system workflow, including integration between web and mobile applications with the central server. In this study we only made a high fidelity design for an initial overview of the user interface for mobile applications.

3. Result and Discussion

In accordance with the title chosen by the researcher for this study, the results of the design of the 112 Call Centre service system show that the OOAD approach to the design stage is able to produce a systematic and appropriate system design. The designed system includes features such as E-KYC-based report verification, real-time report tracking, and user credit score management, which aim to improve the efficiency and reliability of emergency services. The results of this design are expected to be the basis for effective implementation to handle reports in a more structured and accurate manner.

a. Requirements (System Requirements Analysis)

Analysis of system requirements carried out by researchers is the basis for system design. The author analyses system requirements in terms of devices and functional aspects. The following are the results of the needs analysis carried out:

1. Hardware requirements :
    a. CPU: Intel Core i5 or equivalent (higher if required for smooth running of more complex applications).
    b. RAM: 8 GB or more.
    c. Hard drive: 100 GB or more.
2. Software requirements :
    a. Operating System (OS), Windows 10/11 or macOS (depending on developer/designer preference).
    b. Wireframe Design and Prototyping Application, Figma or Adobe XD/Sketch for wireframe design, interactive prototyping, and application layout.
    c. Code Editor (If required for further development), such as VS Code or Sublime Text.
    d. Local Server for Testing (If required), such as XAMPP or MAMP.
    e. Browser such as Google Chrome or Mozilla Firefox, to view and test the design results and prototypes under various conditions.
3. Kebutuhan fungsional

    Functional requirements include information about what must exist and be produced by the system and the processes that must be carried out by the system. The system we create consists of several processes, such as :

    a. Registrasi Pengguna
    b. Login pengguna
    c. Pengiriman Pelaporan Darurat
    d. Melihat Riwayat Laporan
    e. Menghapus atau Memperbarui Laporan
    f. Pengelolaan Credit Score Pengguna
    g. Pengajuan Banding Credit Score
    h. Input dan Verifikasi Laporan oleh Admin
    i. Penindaklanjutan Laporan Darurat
    j. Pelacakan Status Laporan secara Real-time
    k. Integrasi dengan Pihak Penyelamat
    l. Notifikasi dan Informasi

    To ensure a fast, accurate, and safe response in handling emergency cases, the 112 call centre system requires several functional requirements. Chief among them, the system must verify the user's identity through E-KYC (Electronic Know Your Customer), which confirms the validity of the data and prevents false reports. In addition, the system must support various communication methods, such as phone, text, and video calls, so that reports will be automatically routed to text in case other methods cannot be answered. Users should be able to access location information in real time through geolocation, which allows the relevant parties to respond quickly. In addition, the system should store the user's report history and risk score based on previous data, so that when a report is received, relevant information can be provided. To protect user data, strict encryption and access control should be implemented. And users can appeal if they feel the credit score reduction is inappropriate or unfair. The system allows the admin to review and adjust the user's score if the appeal is accepted.

b. Cross Functional Flowchart

Cross-Functional Flowchart (CFF) is used to describe the workflow of a system by showing the involvement of various parties (swimlanes) that contribute to the process. In the context of the 112 Call Centre system, these swimlanes represent users, call centre admins, and rescuers (ambulance, police, or fire department). In the context of the 112 Call Centre system, the following are the functions of the current CFF and the system development CFF

1. Current CFF

Serves to understand the manual workflow, find weaknesses, and provide an overview of the initial state of the system.

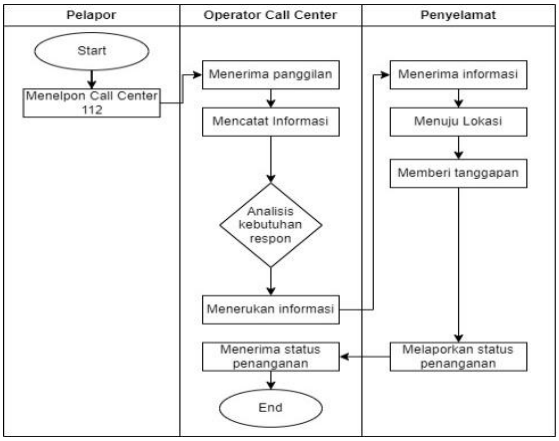

Fig. 2: CFF current for 112 call centre

Based on figure 2, explain the 112 system. The 112 system starts with the complainant contacting the call center via telephone to report an emergency. Once the call is received by the call center operator, important information such as the location of the incident, the nature of the case, and the emergency experienced by the reporter is recorded in detail. The operator then analyzes the response needs to determine the steps to be taken, including the type of emergency service to be dispatched, such as fire, police, or ambulance. The information is forwarded by the operator to the appropriate emergency services. The rescue team receives the information from the operator and then immediately heads to the scene to provide assistance. During this process, the emergency response team also reports the response status to the call center operator as a form of information update, and finally the operator receives a status report from the emergency response team to complete the reporting flow.

2. System Development CFF:
   Serves to understand the manual workflow, find weaknesses, and provide an overview of the initial state of the system.

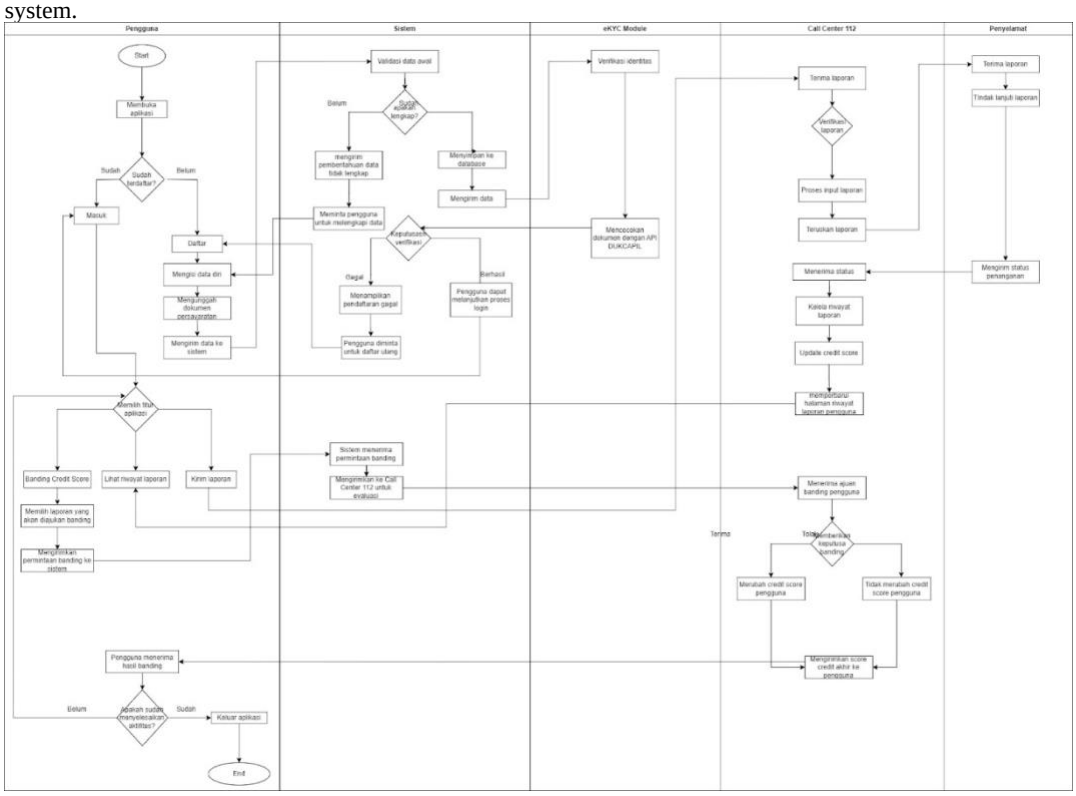

Fig. 3: System Development CFF for 112 call centre

The reporting system for call center 112 shown in the diagram in figure 3 is a collaboration-based framework for handling emergency reporting involving several main components, namely users, systems, eKYC (electronic Know Your Customer) modules, call center 112, and data storage. The system starts the process from the user who has to register or login. Once successfully verified, users can access the service to view or send reports. The system utilizes the eKYC module to ensure user identity by matching data with official documents, such as Dukcapil, before the report is processed further. Once the report is received, the system engages the 112 call center to verify and process the report. The status of the report is then updated in the system, and the user's credit score is adjusted based on the outcome of the report, ensuring a fair and transparent feedback mechanism. The process also integrates follow-up report handling mechanisms, both through automated and manual systems,

involving relevant officers. Ultimately, the system is designed to ensure fast, accurate, and secure reporting, while providing a digital record for future decision-making and analysis.

c. Use case diagram

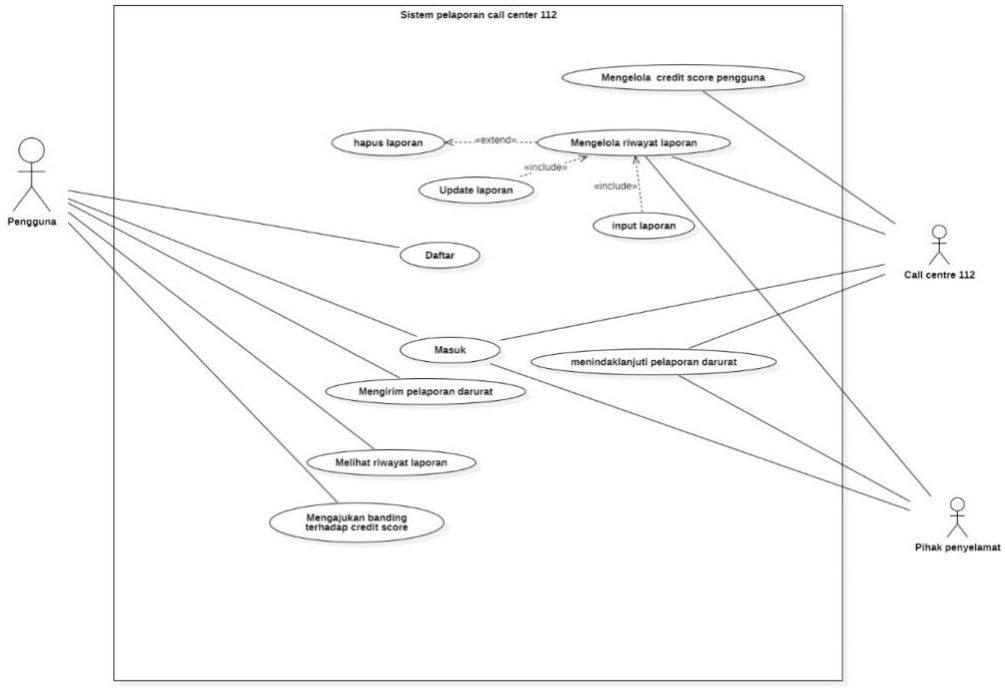

Fig. 4: Usecase for 112 call centre

Figure 4 shows the Use case of the 112 call center reporting system includes various actors, namely users, call center 112, and rescue parties. Users can initiate interaction with the system through the sign-up or login feature. After successfully logging in, users can input emergency reports that include details of the incident, location, and other relevant information. User-entered reports will be managed by the system, including storage in the report history. The 112 call center is tasked with following up on incoming emergency reports. Officers at the call center verify the validity of the report, forward it to the rescue party, and ensure follow-up is carried out. Users also have access to view their report history, including the status of handling reports that have been submitted. In addition, the system also includes a user credit score management feature, which is used to assess the quality of reports submitted. If users feel that their credit score is not appropriate, they can appeal through the system. This feature ensures transparency and fairness in report evaluation. With this flow, the system supports an emergency reporting process that is fast, structured, and can be monitored by all actors involved.

d. Activity Diagram

1. Send emergency reporting

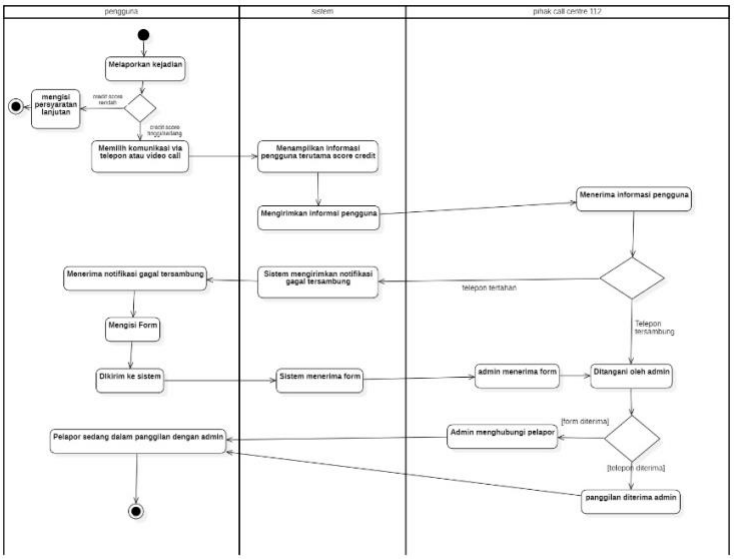

Fig. 5: Activity diagram for a.send emergency reporting

Figure 5 shows that it starts with the user reporting an emergency event. Before proceeding, the system evaluates the user's credit score, which may affect the accessibility of the service. After that, the user selects the communication mode, i.e. via phone or video call, to further report the incident. The system then displays the user's information, including their credit score, to the call center admin. This information is sent to the call center for processing. If there is a problem in connecting the communication, the system will send a notification to the user that the phone or video call failed to connect. Users can fill out a reporting form as an alternative, which is then sent back to the system for further processing. Once the form is received by the system, the call center admin accesses the form and starts handling the report. The admin may contact the reporter for confirmation or clarification of information. If the call is successful, the reporter will be in direct communication with the admin to discuss the details of the report. This flow is designed to ensure emergency reports are handled efficiently, both through direct and alternative communication, thus minimizing bottlenecks in the reporting process.

2. Follow up on the report

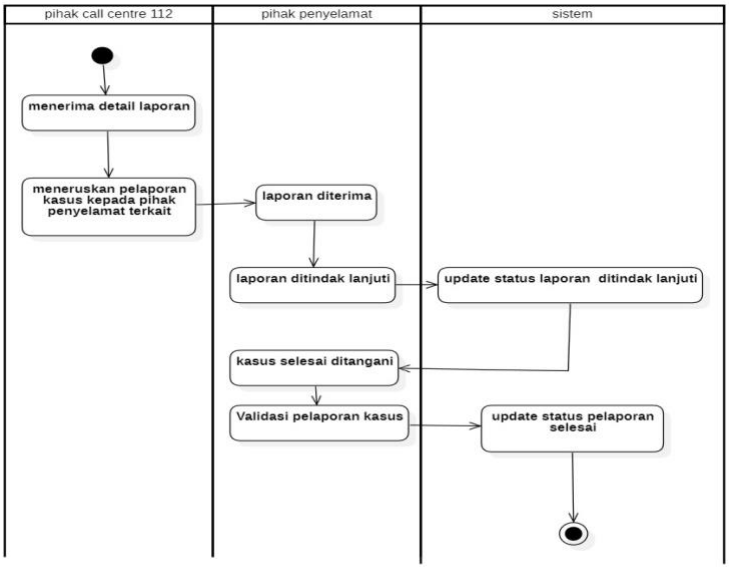

Fig. 6: Actvity Diagram for follow up on the report

Figure 6 shows the process begins when the 112 Call Center receives the report details from the public. After that, they forward the report to the relevant rescue party, who will be responsible for handling the case. Next, the rescue party receives the report and conducts an initial evaluation. If the report is acted upon, they will update the status of the report in the system. Once the case is handled, validation of the report is conducted to ensure the accuracy of the information. If all verifications go smoothly, the reporting status will be updated to "completed," indicating that action has been taken and the case has been handled.

3. View reporting history

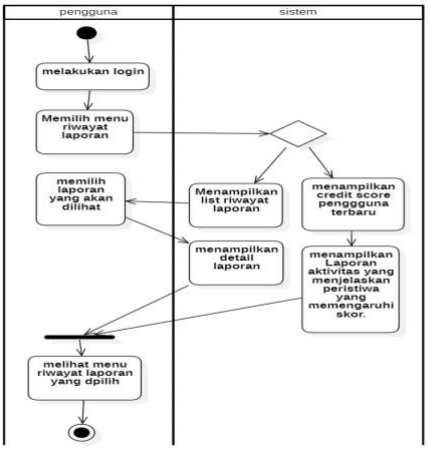

Fig. 7: Usecase for view reporting history

Figure 7 illustrates the process carried out by users in accessing and viewing report history. The process begins with the user logging into the system. After successfully logging in, the user will be directed to select the menu they want to access, including the option to view the history of reports that have been submitted previously. After selecting the report history, the system will display a list of relevant reports. Users can select a specific report to get more details. In addition, the system also displays the user's credit score, which provides an overview of their activity in reporting incidents. This

information is important to help users understand how their reporting history may affect the assessment and response from the system.

4. Manage credit score user

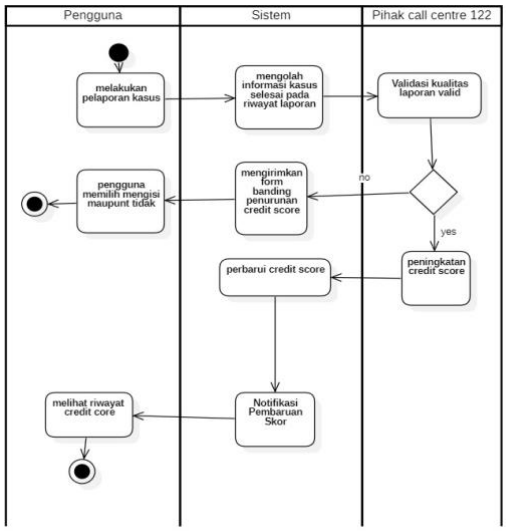

Fig. 8: Usecase for manage credit score

Figure 8 illustrates the process flow that users and the Call Center go through in handling case reports. The process starts with the user reporting a case through the system. After the report is submitted, the case information is processed by the system, which then sends the data to the 112 Call Center for validation.
After receiving the information, the Call Center verifies the quality of the submitted report. If the report is considered valid, the system will update the user's credit score based on the information received. Otherwise, the processing will be repeated to ensure all necessary data is available. The Call Center then notifies the user of their score update, reflecting the reporting activity and response to the reported case.

e. Sequence Diagram

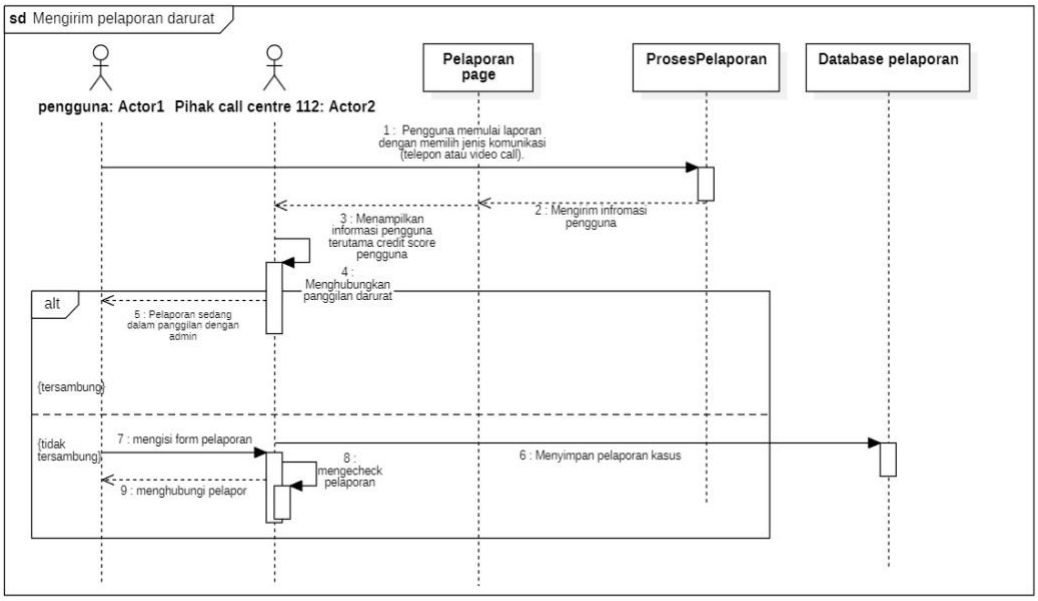

Fig. 9: Sequence for send emergency reporting

In the diagram in Figure 9, the process starts when a user submits a report through the application, which is then forwarded to the Call Center for processing. Upon receiving the report, the Call Center verifies the information and contacts the user via video call to get more details about the reported situation. There is a branch that shows an alternative step, where if the report is deemed insufficient, the Call Center may ask the user to provide additional information. Once all the information is obtained and verified, the report will be stored in the database for further handling. This diagram provides a clear understanding of the communication flow and steps taken in handling emergency reports, as well as the importance of feedback and verification in ensuring that each report is handled properly.

f. Class Diagram

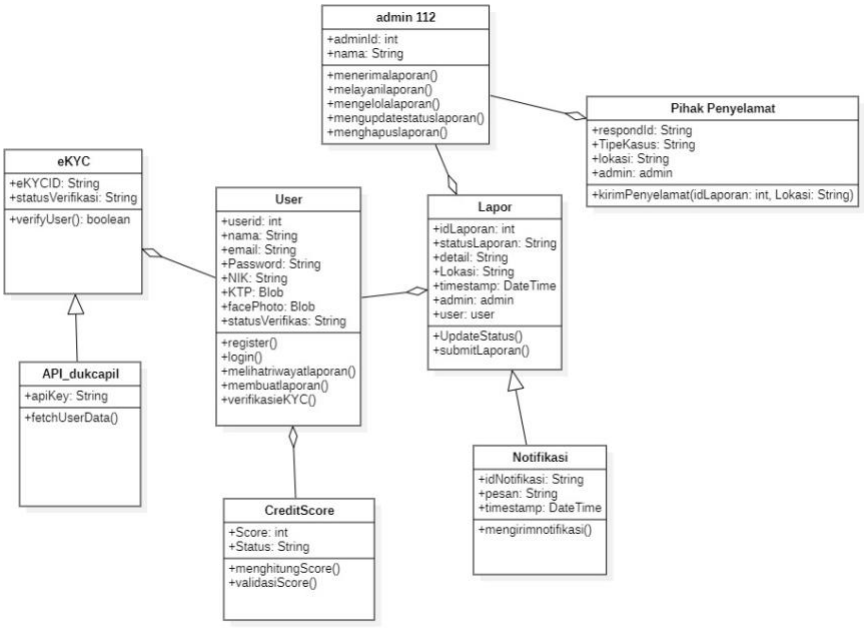

Fig. 10: Class Diagram for 112 call centre

Figure 10 shows that the diagram consists of several classes, including User, Report, Notification, and CreditScore, each of which has certain attributes and methods. The User class stores basic user information, such as name, identity number, and verification status, while the Report class manages the details of the submitted report, including the report description and date. The Notification class is responsible for sending information to the user regarding the status of the report and changes to their credit score. In addition, there is an Admin 112 class that manages and verifies incoming reports. The relationship between classes, such as between User and Report, shows that each user can create multiple reports, while the CreditScore class associates the user's credit score with their reporting activity. With this class diagram, developers can clearly understand the structure of the system and how data interacts with each other, which is important for efficient system development and maintenance.

g. System Design

1. Reporting menu

Fig. 11: High- fidelity for Reporting menu

Figure 11 shows the user interface for the Call Center 112 emergency reporting application. On the main screen, there are two main buttons: “Phone” in green and ‘Video Call’ in blue. These buttons are designed to make it easier for users to select the desired communication method when reporting emergency cases.

2. Credit score appeal

Fig. 12: High- fidelity for Credit score appeal

Figure 12 displays the complaint form in the Call Center 112 emergency reporting application. The form consists of several important sections, including fields to fill in the identity of the complainant, report details, reason for complaint, and type of problem. There is also an option to upload supporting documents, represented by a camera icon, which allows users to add relevant evidence or images.

3. View reporting history menu

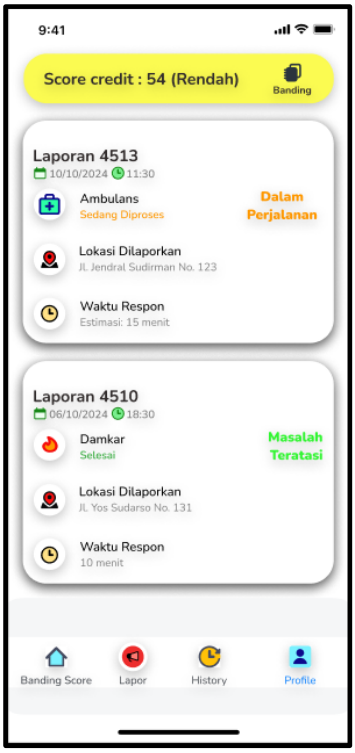

Fig. 13: High- fidelity for View reporting history menu

Figure 13 shows the history of the complaint status report in the Call Center 112 application. At the top, there is information about the user's credit score, which shows a score of 54 with a category of "Low."Below that, there are two reports: one relates to an ambulance that is on its way, complete with date, reported location, and estimated response time.The other report is related to a fire that has already been dealt with, with similar information

4. Conclusion

The design of the 112 Call Center service system for Sidoarjo Regency using the ADBO (Analysis, Design, Build, and Operate) method aims to create a system that is efficient, responsive, and easily accessible to the public in emergency situations.

Through the application of the ADBO method, the system is designed to have various key features that support the delivery of emergency reports via phone, video call and form filling, with GPS integration for accurate location-based reporting.
The Analysis process starts with identifying functional requirements that include user registration, login, emergency report submission, identity verification through E-KYC, and report status monitoring.The Design process includes the creation of wireframes and user interaction flows that facilitate access and report submission while ensuring the security and privacy of user data.

In the Build stage, application development is focused on technology integration that supports telephone, video call, form filling, and secure data management. The Operations stage aims to ensure that the application can function effectively in the field, with ongoing maintenance and feature enhancements based on user feedback.
In conclusion, the Call Centre 112 service system application designed using the Asian Development Bank (ADBO) method will help speed up the handling of emergency cases in Sidoarjo Regency, improve communication between the community and call center officers, and provide a transparent and organized platform for managing emergency reports. The system is also equipped with features for viewing report history, appealing users' credit scores, and monitoring report status in real-time. This application is expected to improve the quality of emergency services, increase public trust, and provide faster and more accurate responses in emergency situations.

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References

[1] Badan Pusat Statistik Kabupaten Sidoarjo, “Kabupaten Sidoarjo Dalam Angka 2024,” Sep. 2024, Accessed: Dec. 26, 2024. [Online]. Available: https://sidoarjokab.bps.go.id/id/publication/2024/09/26/eb4c3e5140826c899b34afc3/kecamatan-sidoarjo-dalam-angka-2024.html

[2] Dwita, “Call Center Darurat 112 Sidoarjo, Masih Mencatat 80% Panggilan Prank,” Warta Sidoarjo. Accessed: Dec. 26, 2024. [Online]. Available: https://wartasidoarjo.pikiran-rakyat.com/kabar-delta/pr-1818637032/call-center-darurat-112-sidoarjo-masih-mencatat-80-panggilan-prank?page=all

[3] I. Made, D. Mahardika, R. Afwani, and M. A. Albar, “Rancang Bangun Sistem Informasi Pelaporan Keadaan Darurat di Kota Mataram (Studi Kasus Nomor Panggilan Darurat 112) (Design of Emergency Reporting Information System of Mataram City (Case Study of Emergency Call Number 112)).” [Online]. Available: http://jcosine.if.unram.ac.id/

[4] S. Tiwari and S. S. Rathore, "Software Development Using Object-Oriented Analysis and Design Methodology: A Case Study," Journal of Systems and Software Engineering, vol. 4, no. 3, pp. 11–19, 2017.

[5] A. Dennis, B. H. Wixom, and D. Tegarden, Systems Analysis and Design: An Object-Oriented Approach with UML, 6th ed. Hoboken, NJ, USA: Wiley, 2015.

[6] C. Cahyaningtyas, : Perancangan, A. Android, «« B., E. Sediyono, and K. S. Wacana, “Perancangan Aplikasi Android Bank Sampah Menggunakan Metode Object Oriented di Wilayah Salatiga,” JIFOTECH (JOURNAL OF INFORMATION TECHNOLOGY, vol. 3, no. 1, 2023.

[7] A. Taufik, A. A. Muhaimin, M. Farhan, and P. Studi Pendidikan Teknologi Informasi, “PERANCANGAN MEDIA PEMBELAJARAN BERBASIS MOBILE APP MENGGUNAKAN ADOBE XD PADA MATA PELAJARAN HARDWARE JARINGAN KOMPUTER DI SMKN 3 BONE,” 2023.

[8] M. Maulana and R. Mujiastuti, “PENGEMBANGAN APLIKASI STRESS CHECKER (SOULUTION) UNTUK MENCEGAH MASALAH KESEHATAN MENTAL GEN Z BERBASIS WEBSITE,” Jakarta, Apr. 2024.

[9] S. Sumardiono, Yasril Ashil Rachmayanto, Tias Beni Purabaya, Rika Apriani, and Jafar Shadiq, “Perancangan aplikasi kas menggunakan action research dan object oriented analysis design method,” TEKNOSAINS : Jurnal Sains, Teknologi dan Informatika, vol. 10, no. 2, pp. 165–175, Jul. 2023, doi: 10.37373/tekno.v10i2.437.