

Implementation of Cloud Computing for SOS Application Back-End using Google Cloud Platform

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Abstract: This research discusses the implementation of cloud computing on the Backend of the SOS application using the Google Cloud Platform. The background of the research is based on the high crime rate in Indonesia, especially theft cases which reached 3396 cases in the period August-September 2024. The purpose of the research is to develop an application that can help users in emergency situations by providing information on the location of the nearest police station within a maximum radius of 5 KM. The method used is Agile Kanban, which was chosen because of its flexible nature and emphasizes rapid response to change. The Backend implementation uses Google Cloud Platform services including Maps API (Places API, Geocoding API, and Distance Matrix API) for location features, and Google Firestore for data storage. The results of the research show that the implementation of cloud computing for the Backend of the ResQHub application successfully displays the location of the nearest police station from the user, but there are still obstacles in the integration of Firestore for storing user data and signup/login authentication. Further research will focus on frontend development for mobile implementation and completion of Firestore integration.

Keywords: Cloud Computing, Agile Kanban, Firestore, Google Cloud Platform, SOS application

INTRODUCTION

Applications have become part of everyday life, the use and development of applications have been very advanced according to the needs of the community (Balapour et al., 2020). Application innovation will continue to follow technological developments. The components contained in the application are, UI / UX design, *backend development*, *security features*, *performance optimization*, and *testing* (Pan et al., 2024). Cloud Computing is the provision of computer services such as servers, storage, databases, networks accessed via the internet, the use of cloud computing itself provides innovation with speed, more flexible resources with payment methods that are made according to the use of services that have been used, allowing users to reduce operational costs for purchasing hardware, software, and server maintenance (Kaushik et al., 2021). Based on this, the demand for cloud services that has increased rapidly in recent years has resulted in a large spike in the scalability of cloud platform users. In today's world, cloud computing has become one of the main leading technologies. The benefits of the cloud have a direct impact on service providers and customers (Sharma et al., 2020), popular cloud computing service providers are known to be Microsoft Azure, Amazon Web Service, Google Cloud Platform so that companies such as those regularly change the pricing scheme to provide more customer-friendly services (Gupta et al., 2021), which in this research used Google Cloud Platform because it required Maps API integrated with Google. The research (Laszewski et al., 2011) explains the advantages of using Cloud Computing, including cost efficiency, by changing capital expenditures to operational expenditures, businesses can reduce costs associated with hardware and software maintenance, this allows for better allocation of IT budgets for other purposes. Scalability, cloud services can be easily increased or decreased on demand, allowing businesses to adjust resources without requiring significant infrastructure investment. Accessibility, users can access cloud services from anywhere with an internet connection, using a variety of devices such as PCs, tablets, and smartphones. Maintenance and Updates, cloud providers manage infrastructure and software updates, reducing the burden on internal IT teams and ensuring that users always have access to the latest features.

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The SOS (Save Our Souls) application is an emergency tool designed to provide rapid assistance in emergency situations. This application allows users to quickly send emergency signals, contact emergency contacts, or provide the user's location (Kumar., 2023). Based on data from the BARESKRIM POLRI regarding the trend of crime cases in Indonesia, it was quite high as of August - September 2024, with the main type of crime being theft as many as 3396 cases, which were divided into types of crimes in the form of robbery, ganging up to crimes using sharp weapons.

Previous research that discussed the design of Cloud Firestore was research (Liwanto et al., 2019), in this research, an application development was carried out that uses the Firestore service to disseminate information to all students in the form of broadcast messages sent in real time, the results of this research prove that the use of Firestore is more optimal and efficient and broadcast messages can be sent to students in real-time.

The next research discusses the creation of an Android-based SOS application (Muhammad et al., 2017), in this research an Android Location Based Services (LBS) application called SOS Broadcast was developed which allows users to send their location and security status to emergency contacts and security officers. This research aims to improve security by providing a quick response in emergency situations using the push notification and SMS features, in this research, the application can spread the user's location with an accuracy of 4 to 14 meters with an average response time of 1.53 seconds under optimal conditions, the results of this research are applications that are compatible with various versions of Android, but notification performance can be affected by the quality of the user's internet connection.

Based on the number of crimes that occur in Indonesia, this research was conducted to help users when they feel urgency or emergency by providing information about the location of the nearest police station with a maximum radius of 4 KM from the user's location. The difference from previous studies is that in the research conducted by (Alaidaros et al., 2021; Liwanto et al., 2019) using cloud computing as a back-end on broadcast message applications and research by (Bachtiar et al., 2024) creating SOS applications with SMS notification features and not using cloud computing as a back-end on the application. In this research, a combination of using cloud computing as a back-end on the application was used to create an SOS application but there was no SMS notification feature that was the same as the previous research.

LITERATURE REVIEW

Research that discusses the creation of an android-based SOS application (Khan et al., 2023), this research is based in Pakistan based on cases of people who lost their lives due to accidents or heart attacks, with this application, it is expected to help the community in providing a quick response in calling the nearest ambulance within 100 meters of the user's location using Google Maps, the features provided in this application are real-time tracking to monitor the position of the ambulance in real-time. Further research (Jadhav et al., 2023), in this research an android application was created that was designed to help someone in an emergency situation, especially for women. This research is based on cases in Thailand with high rates of violence against women, this application has features in providing fast notifications, GPS tracking, and SOS buttons.

Previous research that discusses back-end design is research (Maulana et al., 2024). The research discusses the design of Back-End based on REST-API in a food recipe recommendation application. This research uses Google Cloud Platform as its service so that it can be accessed more stably and quickly. The method used in this research is the waterfall method, with components of the back-end architecture used are databases, models, controllers, routes, and servers, which components will work together to ensure the application functions optimally, with the server functioning as a liaison between the client and the application, receiving requests from the client, and determining routes based on the request method. Furthermore, there are controllers that are useful for executing functions that match the route, the results will be sent back to the client as a response that matches the request.

Next, research using firestore services is research (Liwanto et al., 2019) conducted to disseminate campus information quickly and in real-time, which previously only used the Facebook application, the results of this research are the creation of a broadcast message application that can disseminate information to students quickly and in real-time and more effectively than the previous method of sharing information to students using the Facebook application. Further research on the use of firestore was conducted by (Semma et al., 2023), this research was conducted to build a student GPA report application as a case researched to measure the performance of read data. The results of this research, produced an analysis of calculating aggregate data through cloud functions more efficiently, this research contributes to guiding application developers who are new to NoSQL to understand the use of Firestore effectively.

The method used in this research is Kanban which has previously been researched by (Alaidaros et al., 2021), regarding the use of Kanban in technology company project management, Kanban is a flexible method using a workboard so that work monitoring can be carried out on each member in real-time, the results of this research indicate that Kanban is a method that is suitable for companies that often experience changes without strict and flexible control. Further research (Zasornova et al., 2022) discusses the use of Kanban according to the company's needs, if the company has flexible project management and faces a dynamic market, and has workflow

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visualization, limits work so that it does not multitask, and provides self-organizing teams capabilities to the team in the project.

METHOD

This research uses the Agile Kanban method because this method has a flexible nature and emphasizes a quick response to changes according to needs. The Agile method can make it easier for teams to follow existing changes, the use of cloud computing used in this research strengthens the reasons for using the Agile development method, ease of scalability that will be seen shorter, fast and continuous deployment, and more efficient collaboration and costs.

The Agile Kanban method has transparent work visibility, making it easier for the team to know the status of the task and easy to continue to the next process, task control is also available in Kanban which functions to help the team focus so that there is no additional work at one time that causes the team to have to multitask. The Agile Kanban method also does not have time boxing that requires developers or team members to focus on time, so it is said that this method is more flexible and work is monitored in real time.

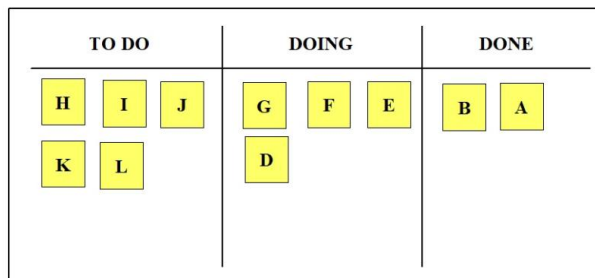


Figure 1. Kanban Workboard

This research uses the Kanban method which can help in the process of working on the Back-End of the application to continue to be in accordance with the purpose of the application, Kanban is one method that can help in providing flexibility in conducting real-time monitoring, this is important for the use of API and Firestore so that the costs incurred remain under control and in accordance with the capabilities of researchers. The stages in the Kanban method are as follows:



Figure 2. Stages of Kanban Method

1. Visualize workflow & define the work items, a process of creating a workflow depicted with a Kanban work board, with three columns, namely, To Do, In Progress, and Done, and breaking down tasks into more structured items.

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2. Set work in progress limit, the process of setting the Limit on the number of work items that can be in each column at any given time.
3. Pull system & Manage flow, a process where cards are moved to the next column according to their status, as well as monitoring the flow of work items through the Kanban work board to ensure smooth processes.
4. Continuous Improvement, the process of gathering feedback from team members to make continuous improvements.
5. Reflect and Adapt, the Kanban adaptation process based on discussion results to increase efficiency.

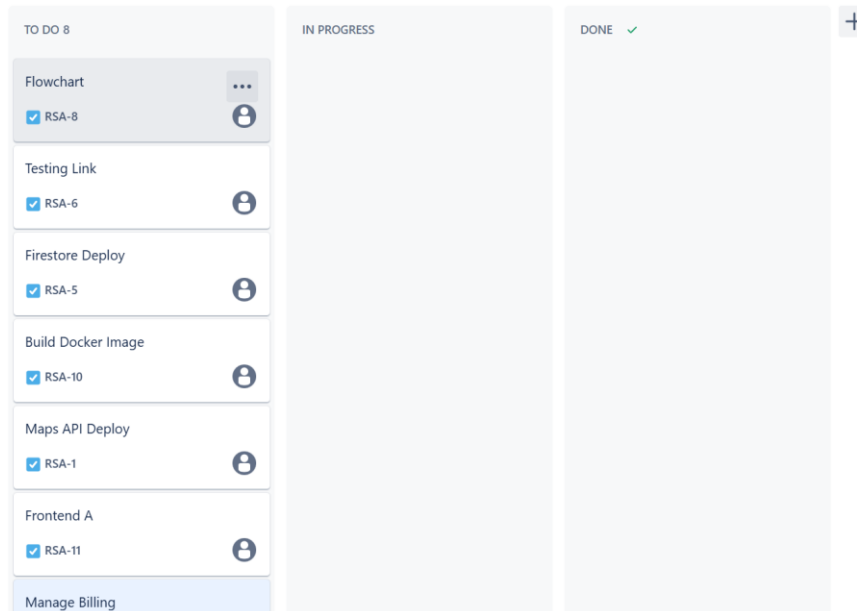


Figure 3. Workboard on Jira

Jira is a software from Atlassian that is made to help the development process with the Agile method, the features in Jira are made to facilitate the combination between teams with features that can be customized according to needs, Jira has two Agile methods, namely Scrum and Kanban, and in this research the Kanban method was used. The process of implementing the Kanban method, namely

Maps API is the main role of this research, Maps API is an API service used to integrate map features into applications, with Maps API users can access location designations, location searches, directions and provide detailed location data. The API used is taken from the Google Cloud Platform (GCP) service, GCP is used as a replacement for physical servers that are more flexible, scalable, and collaborative. The services that help the Maps API used in this research are divided into three, namely, Places API, Geocoding API, and Distance Matrix API. The three APIs have their respective functions and roles, including:

1. Places API, used to obtain location data and information about a particular place, which in this research was used to obtain information on the location of the nearest police station from users.
2. Geocoding API, used to convert addresses that were previously geographic addresses in the form of latitude and longitude into human-readable addresses.
3. Distance Matrix API, is used to obtain the distance and travel time between the user's location and the destination, which in this research is the police station and the hospital closest to the user.

Another service from Cloud computing used in this research is Google Firestore, a cloud-based NoSQL database from Google Firebase, used to store and organize data on applications in real-time which is needed to store user history when using the application, if the user uses the application with a new location, then firestore will automatically change the data without the need for database access (auto sync). The use of Firestore is also suitable for this research because it requires rapid development without having to create manual queries and table structures.

RESULTS

The system workflow using Flowchart can be seen in Figure 3. Flowchart is needed in the research process to represent the flow of a system that will be run, in the Kanban method, Flowchart is included in the To Do column to be used as a visualization of how the system will be created and run.

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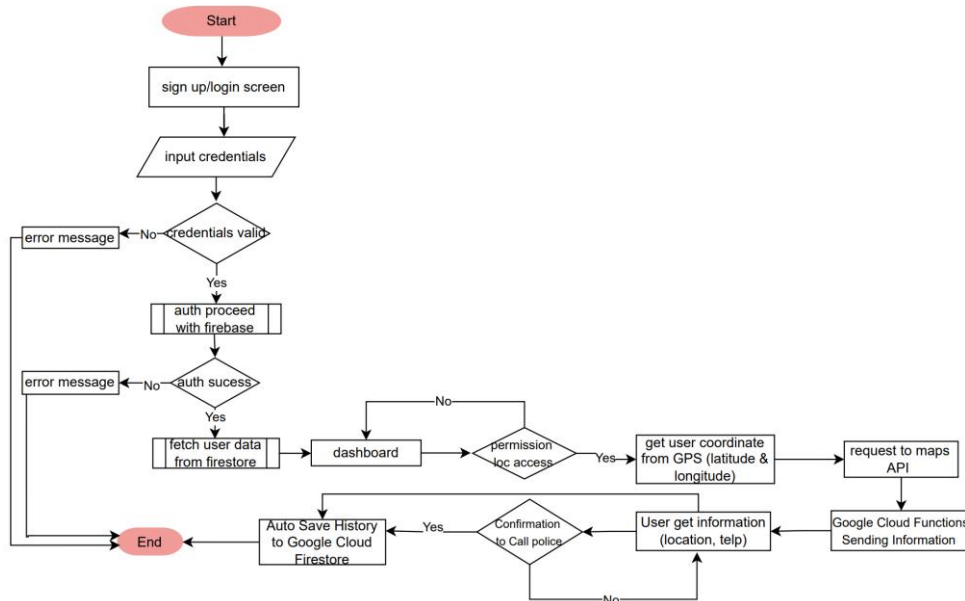


Figure 4. Flowchart

Users sign up/login using a Google account or email, the system then checks credentials or determines access rights for users by logging in with a Gmail or Google account that has been registered on the device being used, if the check is successful, the account will be sent to the Cloud Firestore admin as an authentication token, so that the admin can only receive a token without knowing who the application user is, after successfully authenticating, the user will enter the dashboard and will be asked for location access permission, after the user agrees, the GPS will automatically get the location value in the form of latitude and longitude, then the value will be sent via the API server to the Google Cloud Function to be converted into information to the user in the form of the name of the nearest police station or hospital with a maximum radius of 4km from the user's point of location, the application will ask the user for confirmation in the form of confirmation to make a call from the contact listed, after that all user location history will be saved to Cloud Firestore.

To Do

This process is a planning stage for activities to be carried out in application development to be more organized. Frontend is included in the To-Do stage because in this research it was only carried out until the Google Cloud Platform implementation process on the application's Backend service. Can be seen in Figure 5.

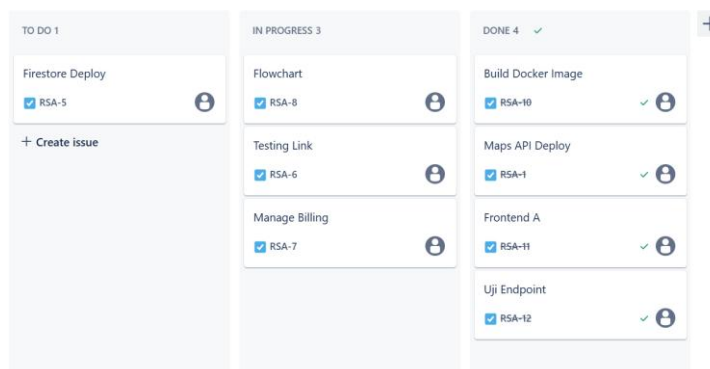


Figure 5. Kanban Method

In Progress

This stage is a task or part that has been completed in the research, this stage aims to track and ensure that no tasks are neglected, in Figure 5, in this research, Manage billing will continue to be in the In-Progress stage because special monitoring is needed so that the costs incurred by using Cloud Run and Firestore services are still within the limits of ability.

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Done

This stage is a task or part that has been completed with the aim of providing an overview of the progress of the development carried out.

Implementing Google Cloud Platform as a Backend Service

The architecture of this application uses Cloud-based Architecture from Google Cloud Platform services so that all processes starting from processing API requests to storing data are managed in the cloud without the need to be run on a local physical server (on-premise), the implementation process uses Cloud Run to handle requests from users and forward them to Firestore for data storage. As can be seen in Figure 5. The main API used is the Maps API with integration from three other APIs, namely, Geocoding API, Distance Matrix API, and Places (New) API, these three APIs will be integrated in the Deployment process using Cloud Run with the help of Node.js. The process of running the three APIs when the user's coordinates have been obtained via GPS, then calling the Places API to search for the nearest police station, for each search result location, the Distance Matrix API is called to calculate the distance and travel time, and using the Geocoding API to display the address.

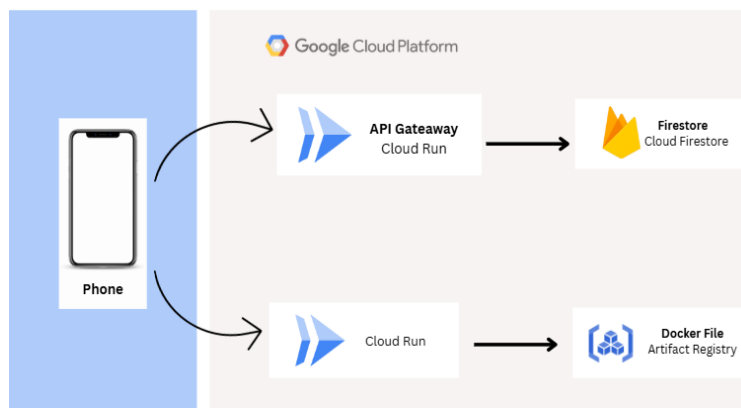


Figure 6. Architectural Design

The Whole Back-end built on Google Cloud Platform using Node.js as a runtime environment that will run code on the server side, in this case to run the API process as providing the location of the nearest police station to the user with Maps API. The deployment process uses Cloud Run (Figure 7) with docker repository on GCP using artifact registry (Figure 8) to ensure reproducibility and transparency of the code created. The implementation of using Node.js is directly included in Cloud Shell so that it does not require local code development by relying on Docker files to facilitate the build and deployment process without requiring additional configuration.

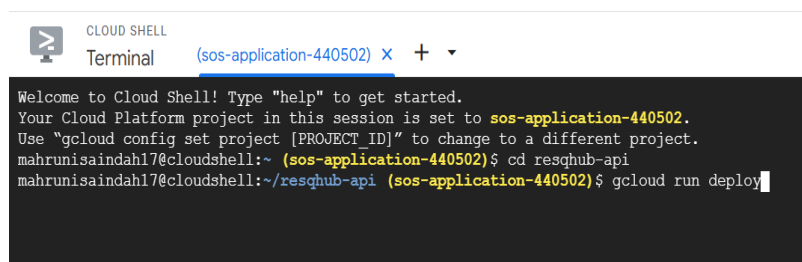


Figure 7. Deployment Cloud Run

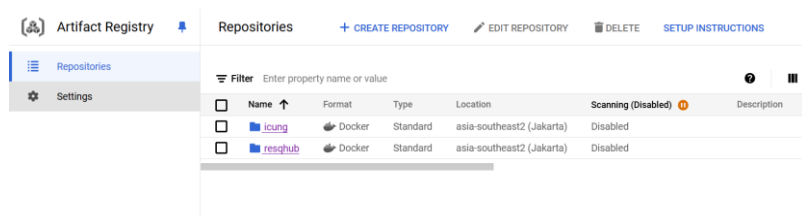


Figure 8. Docker Files in the Artifact Registry

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DISCUSSIONS

The API Endpoint testing carried out was adjusted to the needs of the Frontend with the results in Figure 9.

```

CLOUD SHELL
Terminal (norse-objective-439607-d7) x + v
Open Now: No
Website: Not available
mahrnisaindah17@cloudshell:~/resqhub-test (norse-objective-439607-d7)$ curl -X POST 'https://resqhub-api-62
-d '{
  "lat": -7.7856768,
  "long": 110.3888384,
  "rad": 5000
}'
Found 20 police stations nearby:
1. Polsek Sleman
Address: Jalan Magelang KM.12,5, Krapyak, Triharjo
Phone: Not available
Rating: No rating
Open Now: No
Website: Not available
Google Maps: https://www.google.com/maps/place/?q=place_id:ChIJCZLxUIVZeI4R8PaXVe8f04o
2. Polsek Gondomanan
Address: Jalan Lobaningratan No.1, Prawirodirjan
Phone: Not available
Rating: No rating
Open Now: Yes
Website: Not available
Google Maps: https://www.google.com/maps/place/?q=place_id:ChIJJo6T--4RXei4Rtq3b3fizacu
    
```

Figure 9. Endpoint Testing

Testing was conducted using the `--request POST` command equipped with Longitude and Latitude for the location of Yogyakarta City, displaying 20 Police Stations with a radius of 5 km. After Endpoint testing was conducted, API testing was conducted to users using a simple Frontend design, this was intended to determine how accurate the response given to users was, testing was conducted by sharing a link to go directly to the main page by requesting location access permission and then displaying the results from the nearest police station from the user (Figure 10). A telephone number with the status Not Available indicates that Google's Places API did not find any information about the telephone number, so it displays the results, the same as the website and rating that do not display any results.

Find Nearby Police Stations

Latitude: -7.7856768
Longitude: 110.3888384

Searching for police stations...

Polsek Gondomanan
Address: Jalan Lobaningratan No.1, Prawirodirjan
Phone: Not available
Rating: No rating
Open Now: Yes
[Open in Google Maps](#)

Figure 10. API Testing

Testing was conducted on users in the Yogyakarta City location on the API testing Frontend, a flexible radius was entered, meaning that users are free to enter how many kilometers the search for the nearest police station will be carried out, so that there are no restrictions on the search radius of the nearest police station from the user, based on the results, it was found that the location of the police station closest to the user is located in position Number 1 on the search results list, this is expected to make it easier for users when they feel urgent so that they can immediately see the first list of results and automatically open GMAPS when clicking the 'Open in Google Maps' link to be able to see the travel map to get to the location of the police station.

CONCLUSION

Based on the final results up to API testing, the implementation of cloud computing for the Backend of the ResQHub application using Google Cloud Platform can run as desired by displaying the location of the nearest police station from the user, but there is a failure in the Firestore integration process to store user data and signup/login authentication, this is because there are still errors in the Backend implementation process. The Frontend that was created is still an initial design that will later be developed so that it can be directly implemented

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on the mobile application, this will be done in further research along with the Firestore integration process from the Google Cloud Platform service.

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