Revealing the Popularity of Indonesian Local Government Mobile Apps in Google Play Store

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Abstract: In this research, we revealed the popularity of mobile apps affiliated with the provincial governments in Indonesia. To the best of our knowledge, this is the first study to conduct an empirical analysis related to this area. In total, we found 283 mobile apps available on the Google Play Store and correlated to 32 province governments in Indonesia. In this research, we scraped metadata of each provincial government-affiliated apps available at the Google Play Store and gathered the information based on three indicators, including the number of installs, number of reviews and score ratings. As a result, we found that 69.9% of mobile apps had a number of installs smaller than 1000, 89% of mobile apps had reviews less than 100 and 50.2% of mobile apps had scored less than 3. In addition, based on the popularity index that we defined, we found high disparities in the popularity index among provinces in Indonesia. There is only 1 province that has a Popularity index above 90, indicating that the popularity of mobile apps affiliated to the provincial government in Indonesia is considered to be low. Hence, these results can be tailored as a reference for the provincial government in determining the level of effectiveness and impact of an app when developing mobile-based software in the future.

1 INTRODUCTION

Android consider being the most successful mobile Operating System globally. This is based on the number of mobile apps developed in this platform as well as the market share of devices supporting this platform around the world. Based on Statista, in July 2021, there were 2.8 million Android apps available in Google Play Store (Statista.2021). This number considers being the lower bound of total Android apps available globally, because there are a number of marketplaces other than the Play Store available, including Xiaomi market, Tencent, LG and some other marketplace related to the device vendors. In the number of market share, Android recorded to have around 86% of the total mobile platform in 2020, as mentioned in (Samhi, Allix et al. 2021). The open source model and the freedom to customize the Android platform have made it easier for many vendors to adopt this platform, thereby increasing the compatibility of mobile apps on devices with a very diverse range of technologies and prices.

This phenomenon attempting a lot of institution, including the Indonesian province government, to leveraging Android-based applications (apps) in order to support their daily operations. In total, we found 283 Android apps affiliated to 32 provinces (except Maluku and North Maluku) available in Google Play Store. These apps were developed for several purposes including presentation recording, policy dissemination, community aspiration submission, and other citizenship services. However, to the best of our knowledge, there has never been a study showing the effectiveness of using these government-owned applications.

A parameter that can be used to measure the effectiveness of mobile apps is the level of popularity of these apps for their users. Therefore, we conducted an empirical study to review how popular mobile apps belong to the provincial government in Indonesia. In this study, we use the indicators

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available on the Google Play Store which include the number of installs, the number of reviews and the score rating. We create tools to scrape the metadata and analyze the information contained in these indicators. We also rank the level of popularity of mobile apps among all provinces in Indonesia and introduce a measurement method that we call the Popularity Index.

We believed that this is the first empirical study to measure the popularity of mobile apps affiliated to the Indonesian province government. We also expect that the result of this study can be used as a reference for the province to make a policy in case of mobile apps development in the future.

2 RESEARCH METHODS

To reveal the popularity of Indonesian province government mobile apps, we followed six stage of research as shown in Figure. 1. More detail of these stages is explained in the following sub sections.
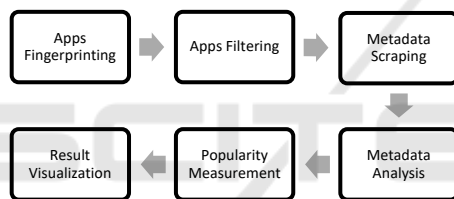

Figure 1: The six-stages of research methods to reveal the popularity of Indonesian province government mobile apps in Google Play Store.

2.1 Apps Fingerprinting

This stage is used to find mobile apps affiliated with the provincial government in Indonesia in Google Play Store app market. This stage is considered to be challenging because we have to fingerprint apps from the corpus of 2.8 million apps available on that app market (NPM.2021). At this stage, we collecting the apps candidate by identifying a certain keyword (province's name) appears in the Apps' name or Apps' description as a conducted by (Sentana, Ikram et al. 2021). For this purpose, we created Python script and take advantage of the google-play-scraper library developed in Java script by (NPM.2021). We made a list of 34 provinces in Indonesia and used them as keywords to be sent to the Google Play Store Search Page. After the Google Play Store returns search results for each keyword, we then scrap the content page and collect information which includes Apps ID, Apps name, and Apps Description.

We managed to collect 854 candidate apps that corresponding to 34 keywords which are the name of the province. This result is considered to be a coarse-grained form of list, because any snippet word contained in the Apps' identifier that corresponded to the keyword will be considered as candidates. For example, when we search based on the keyword "provinsi Maluku", then any Apps that have the "Maluku" snippet in its name or description will be considered as candidate Apps. Moreover, the search result based on a province name often returns a massive number of irrelevant data and overlap data from one province to another. Hence, we did some manual searching to get valid data in the process of forming candidate apps list. This candidate then filtered in the next stage.

2.2 Apps Filtering

This stage is used to manually filter the candidate lists generated in the previous stage. For this purpose, we analyse the name and description of each app on the candidate list and determine the app's affiliation with each provincial government. In a certain case, we have to do cross validation to Play Store website to get a comprehensive understanding on each candidate apps in the list. This stage cannot be done automatically, considering that determining app affiliation to each province requires context understanding based on apps description in the metadata.

As this measurement intended for apps affiliated to province government, we then exclude apps owned by non-province governments, police departments, courts, attorneys, and apps owned by representatives of the central government located in each province. The result of this stage is a list of App IDs that correspond to each province in Indonesia. In total we found 283 apps affiliated to 32 provincial governments. Jakarta is listed as the province with the highest number of Mobile Apps with 36 Apps, followed by West Sumatra with 28 Apps. We were unable to identify Mobile apps from Maluku and North Maluku provinces. More detailed about the number of apps per province can be seen in Table I.

2.3 Metadata Scraping

After the App ID list is obtained, the next step is to scrape the metadata of each app. The Play Store provides information related to apps which includes the name, description, developer, number of installs, score rating, number of reviews, and even the date of the last update. For this purpose, we have modified

Python and Java Script at the Apps Fingerprinting stage to collect information that matches the filtered list of App Ids. To assess the popularity of an app, we use three indicators including the number of installs (I), the number of reviews (R) and the score rating (S). The number of installs is an indicator of how many times the app has been downloaded and installed on the user's device. While the review is the number of reviews from users of apps. The Play Store allows users to provide reviews and provide a rating in the form of a star rating which is worth 1 to 5, after installing apps on their device. The aggregation results from this user review used by Play Store to create a rating score for each app.

Based on our observations, these three indicators are appropriate parameters to measure the level of popularity of Android apps, which is in this research are Android apps that affiliated with provincial governments in Indonesia.

2.4 Metadata Analysis

The next stage is to analyse the metadata that has been collected. At the early stage of analysis, we sorted the value of selected indicator metadata for each apps. By the number of installs, we found "*SAMBARA*" (*id.go.bapenda.sambara*) to be the most downloaded and installed app of 3,862,879 times, followed by "*PIKOBAR Jawa Barat*" (*id.go.jabarprov.pikobar*) that installed in 957,898 devices. Both apps are regulated by the West Java province government. While the least installed app was recorded by "*Boyang Aspirasi Prov. Sulbar*" (*com.thp.boyangaspirasi*) that was installed by 32 users and owned by West Sulawesi province. By this indicator, we found 198 (69.9%) province government mobile apps in Indonesia were installed less than 1000 times.

While by Review indicator, "SAMBARA" and "PIKOBAR Jawa Barat" again showed their domination by 10.539 and 4.130 number of reviews, respectively. In opposite, we found 252 (89%) province government apps that recorded only have less than 100 reviews and 136 (48%) of the apps recorded 0 reviews.

In addition to both indicators, we found 110 (38.8%) apps recorded Score ratings more than or equal to 4, 31 (10.9%) apps recorded Score in the range of 3 to less than 4, and 142 (50.2%) province government apps recorded the Score rating less than 3. The range of those scores indicates that the apps obtained positive, neutral and negative sentiment respectively, as explained in the user-review analysis conducted by (Tangari, Ikram et al. 2021).

The distribution of data on the ECDF score rating looks more encouraging than the other two indicators. The proportion of the number of ratings above 3 having a greater proportion than those below 3. There are about 53% of mobile apps owned by the provincial government get a positive score and the rest are neutral or negative. A score rating of 3 is considered to be neutral value, while values above are considered to be positive and below are considered to be negative (Tangari, Ikram et al. 2021).

To have an insight into the data distribution per province, we then aggregate the value in each indicator and group them by province. As a result, we found West Java dominated the number of installs by an average of 374,967.4 installs per app, followed by Banten by 160,349.7 of average installed per app. West Java recorded the highest value in the average number of reviews by 1,304.3 and West Papua recorded the highest average score ratings of 4.3, even though West Papua only has 1 mobile app.

While the aggregation process also reveals the fact that 15 (44%) of provinces recorded average install rates less than 1000, 28 (82.3%) provinces recorded average reviews less than 100, and 26 (76.4%) provinces recorded average score rating less than 3. More detail about the aggregation result per province can be seen in Table 1.

2.5 Popularity Measurement

As we use three indicators to measure the app's popularity per province, then the next stage of this research is to combine the value contained in all indicators to form an index of average value per province. Since the Install rate shows having a high value among other indicators, then we normalized the value of each indicator to avoid dominance by a certain indicator.

For that purpose, we then introduce Popularity index (*Pi*) by ranked the province apps popularity based on the indicators explained previously. The *Pi* then denoted as followed:

$$Pi = (\tilde{I} + \tilde{R} + \tilde{S})/d * 100 \qquad (1)$$

$\tilde{I}$ represent the normalize form of average Install rate for each province that resulted from min-max normalization denoted as followed:

$$\tilde{I} = (I\_(n) - I\_min)/(I\_max - I\_min) \qquad (2)$$

I_n represent the value of install number for corresponding apps, while I_{max} and I_{min} respectively represent the maximum and minimum value in install vector which is the highest and the lowest install rate among all Apps. The similar operation is also

conducted to define $\tilde{R}$ dan $\tilde{S}$ that represent the normalized form of average review and average score respectively. Since we prefer to display the index in range of 0 to 100, then we multiply the equation to 100 and divided it by the number of indicator (d).

Based on the calculation using Formula (1), we found that West Java obtained the highest Pi of 97 from 14 apps affiliated to that province, followed by North Sumatera with Pi of 38 obtained from 3 mobile apps. Ironically, by using this index we found 33 provinces obtained Pi less than 50, indicating the high disparity of apps popularity among provincial governments in Indonesia. More detail about the Pi obtained by each province can be found in Figure 2. The Pi result was plotted in each province Geolocation in the notation of $x(y)$, where x represents the Pi score and y represent the number of apps regulated by each province.

2.6 Result Visualization

The last stage in this research is to visualize the results of data analysis and popularity measurement into geolocation image. The most challenging part of this stage is to find the geolocation data of 34 province in Indonesia. Most of the currently data available in the Internet only consist of 33 provinces without North Kalimantan. Fortunately, we found a link provide by Kompas (Purba.2021) that directing us to the *Shape file* of the newest Indonesian province geolocation. *Shape (SHP) file* itself is a collection of files containing geometry and index feature that represent multiple *dot* based on *longitude* and *latitude* coordinate of a certain area.

We then leveraging *Geopandas* library in Python to convert the *Shape* file into *GeoJson* data so we can merge it with the Popularity Index (Pi) and the result from data aggregation per province. Then we leveraging *Matplotlib* library to plot the index and data on the top of geolocation data as shown in Figure 2. We also adding *heatmap* indicator (Blue color) to represent the value of Popularity index on each province.

As a takeaway for this stage, we provide the *Shape files* and *Geo Json files* of Indonesian province in our online repository and can be found in https://github.com/budisentana/indonesian_mobile_apps.

3 RESULT AND DISCUSSION

Since the Apps Filtering stage, we have found disparities in terms of mobile apps adoption among all provinces in Indonesia. At this stage, we found that the number of applications owned by the provinces in the western and central parts of Indonesia was higher than the provinces in the eastern part of Indonesia. Surprisingly, we found West Sumatra have the second largest number of mobile apps (28 apps) after Jakarta. This number far exceeds the average ownership of mobile apps by provinces on the island of Sumatra.

On the other hand, the number of mobile apps ownership by provinces in eastern Indonesia is consider to be very low. Papua and West Papua have 4 and 1 apps respectively, East Nusa Tenggara only has 2 apps and even Maluku and North Maluku have 0 mobile apps. This provides an overview of the existing IT maturity levels in each province. This phenomenon can be related to many factors including the readiness of infrastructure and human resources who manage these facilities.

During the metadata analysis stage, we found a high gap of data in each indicator. In general, the applications owned by the provincial governments in Java and Bali relatively have a higher number of installs and the number of reviews compared to provinces in other islands. For example, *"SAMBARA"* owned by West Java province has the number of installs and the number of reviews, respectively 3,862,879 and 10.539. If we compare this apps to *"RIC DPMPTSP" (com.dalakriau.ricdpmptspriau)* owned by province of Riau, which only has 66 number of installs and 9 number of reviews, then the difference is very significant. This presents its own challenges in the data analysis stage, where we cannot directly present the data and compare it between indicators in the process of determining the popularity of mobile apps.

In this stage, we also reveal discouraging facts related to data distribution on each indicator. We found 69.9% of mobile apps were installed less than 1000 times, 48 % does not have any reviews, and 49% have a negative score rating. This fact shows the low willingness of citizens to use the facilities that have been prepared by the government. The factors that cause this are beyond the scope of this research. However, from our observations, most of the existing reviews show low maintenance of existing apps, causing many problems and affecting the willingness of citizens to use these apps. This can be very ironic considering that we have found several applications that are intended for public hearings to absorb

aspirations and accommodate public complaints. With this condition, the purpose of developing these mobile apps will not be achieved due to the low desire of the people to use the applications provided by the government.

Table 1: Summary of Metadata Scraping of Indonesian province government mobile apps, order by apps number per province.

No	Province Name	App #	Average Install	Average Review	Average Score
1	Jakarta	36	93107	400.4	3.3
2	West Sumatera	28	2225.7	9.1	1.9
3	South Sulawesi	23	1625.3	12.7	1
4	Yogyakarta	19	27623.4	150.6	2.5
5	West Java	14	374967.4	1304.3	3.9
6	Riau	13	138.7	6.2	2.9
7	West Nusa Tenggara	12	268.1	2.4	1.9
8	West Kalimantan	12	9546.9	53.8	1
9	Bali	11	2944.9	7.1	1.9
10	Gorontalo	9	3072.2	27.8	1.3
11	West Sulawesi	9	293.8	6.9	1.6
12	Lampung	9	127.7	4.9	2.1
13	North Kalimantan	8	1994.1	6.8	2.9
14	South Kalimantan	6	5780.7	30	3.7
15	Riau Islands	6	24307	59.8	2.8
16	Aceh	6	3297.7	23.2	2.8
17	Central Kalimantan	6	94.7	0.8	0.8
18	North Sulawesi	6	32436	113.2	3.1
19	Bengkulu	5	844.8	5.8	1.5
20	East Java	5	436.6	2.4	2.7
21	South Sumatera	5	329	1	0.9
22	Central Java	5	2731.6	17.6	3.4
23	East Kalimantan	4	153.5	1.3	1.1
24	Jambi	4	166	0	0
25	Papua	4	3100.5	16.8	2.4
26	South East Sulawesi	4	943.5	6.3	2.4
27	Central Sulawesi	3	4604.3	31.3	3
28	Banten	3	160349.7	1050.7	0.9
29	North Sumatera	3	13397.3	202.3	4
30	East Nusa Tenggara	2	98	0	0
31	Bangka Belitung	2	377.5	4	2.4
32	West Papua	1	7047	62	4.3
33	Maluku	0	0	0	0
34	North Maluku	0	0	0	0

In the Popularity Measurement phase, we are tempted to include popular mobile apps, such as Facebook or Instagram, as the upper limit of our proposed popularity index calculation. However, considering the low value of each indicator vector, we are afraid that the results given will make the index disparity even higher. Therefore, we only use the highest value in each vector as the upper limit of the calculation of this popularity index. For example, in the install number vector, we use the highest number of installs among all the applications in our research corpus. Likewise, for vector indicators for the number of reviews and score ratings.

The results of the popularity index calculation presented in Figure 2 still show a high data disparity, although only using the data in our corpus to determine the upper limit of normalization. In the picture, West Java has the highest heatmap level and a popularity index of 97 obtained from 14 applications. However, 33 other provinces have a popularity index below 50. This shows that the level of popularity of mobile apps owned by West Java is far above other provinces. This can be a benchmark for other provinces when developing mobile-based applications in the future.

Figure 2: Popularity index (*Pi*) of Indonesian Local Government Mobile Apps per province. West Java has the Mobile Apps with the most popular in Indonesia with 97 point obtained from 14 Apps. The data present in x(y) format where x represent *Pi* and y represent the number of apps per province.

4 LIMITATIONS

We were attempted to analyse the Mobile Apps affiliated with all District and City governments, which is the second level of local government in Indonesia. However, due to the massive number of mobile apps that we found during the Fingerprinting stage, we keep our focus on Province government apps and preserve the result for our future works. We are also considering analysing the sentiment from each user review as conduct by (Tangari, Ikram,.et all.2021), to determine the user's opinion related to local government apps. For this purpose, we believe the adoption of Natural Language Processing in Bahasa Indonesia, such as in (Iswanto, Poerwoto. 2018) and (Manik, et all. 2017), would be useful for our future works because most of the user review are written in Bahasa Indonesia.

5 CONCLUSIONS

This is the first empirical study that reveals the popularity of Indonesian province government mobile apps. We are using three indicators including the number of installs, number of reviews and score ratings available at the Google Play Store. The analysis result shows 69,9% of mobile apps affiliated with the province government installed less than 1000 devices. While 89% of those apps have less than 100 reviews and 50.2% of those apps have a negative score rating. In this study, we introduced a popularity index to rank the popularity of mobile apps among provinces in Indonesia. As a result, we found 33 provinces have a score less than 50. This result shows that the Popularity of the Indonesian province government is considered to be low.

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