Study of Android Applications Based on Astronomy

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ABSTRACT: The paper presents a detailed review about the evolution of contemporary apps on astronomy running on android devices by presenting a series of statistical data ,using variety of parameters and measurements. The paper also emphasizes how variety of features and functionalities influence the sales of these apps. Based on our research and analysis, we also developed an android app on astronomy tailored to meet the user- requirements.

Keywords- Usage Count ; Fact-wizard ; time-shift ; sky-map ; astro-calender ; Alt-azimuth coordinates ; equatorial coordinates ; telescope sync. ; UNITY

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1. Introduction:

Every day, around 3-4,000 apps are flashed on Google play stores, either by freelancing developers or private companies owning huge server rooms and data centres. There are approximately 200 android apps on astronomy for wide-range of utilities, loaded with features that are frequently upgraded on subsequent iterations and upon each new release of the software, there are upgrades available for downloads, that generate additional revenue. In our paper, we have restricted our study to astronomy-based apps and drawing significant conclusions based on comparative analysis of user groups interested in astronomy. Any app coined as "innovative" on Playstore , loaded with latest upgrades &features is, infact a successor of previous applications, where the developer simply imports the portion of source code that characterizes the functionality present in existing apps by using editors like android studio or Eclipse, making few changes in layouts, navigation patterns, content organization and in few cases, improving the overall throughput by rectifying the parameters or changing the structure of loops in efficiency algorithms. Thus, the road to evolution isn't somethinglike re-inventing the wheel, the developer should be able to use the right tools and adopt the right methodology to transform the way people approach their handheld devices and make the most out of the system resources like memory or processor.

2. Literature Review:

Couple of surveys had been conducted on smartphone users, especially the users operating on android platforms, dwelling upon the specific aspects like device features, battery life, storage optimization, data usage etc. Ever since the market witnessed a boom in the sales and distribution of handheld devices that are both, economically feasible and user-friendly, there has been a tantamount progression in the number of android apps published on Google playstore.

Recently, a survey conducted by Ericsson ConsumerLab on smartphone users across 40 countries presented a detailed report titled as '**Communication in the World of Apps'.** The survey was characterized by collecting numerical data on usage analytics of top 5 messenger apps in the market : whatsapp, hike, fb messenger, WeChat & Google+ Hangout. The analysis derived a few interesting results. Whatsapp acquired a whooping share of 98% of the total smartphone users, while hike acquired almost 44% of the total share in the app market, followed by 37% share by fb messenger, 32% share by google+ hangout and 26% share by hike.

On similar grounds, Getjar corp. released its global survey report in March 2011, that revealed some important facts, providing a quantitative evidence ofmonopoly of different android apps. The analysis was characterized by studying a specific proportion of smartphone users downloadingandroid apps in wide range of categories like gaming, social networking, messaging, security, e-commerce, travel, music, online transaction processing and news alert. The analysis revealed that around 60.8% of the android users in US & UK find social networking apps to be useful, followed by music (45.3%) and entertainment (38.6%) apps, while apps on e-

commerce had minimum proportion of downloads (10.2%) amongst all categories, with majority of survey respondents belonging to an age group of 18-35.

Thus, after learning these facts discovered by Ericsson ConsumerLab&Getjar, we are provided with the valuable insights on popularity of android apps, the categories they fall under, their global reach and variety of factors that influenced their sales in the app market. In this paper, we followed the similar approach to discover the specific criterion, an essential determinant which is responsible for popularity and sales of different android apps on astronomy. Based on that we developed an astronomy app '**Astronomy Quiz : Free Facts**' that is available on playstores. The users can download the file from the link provided below :

https://play.google.com/store/apps/details?id=com.harshwardhansingh.celestialinfo&hl=en

2. Objectives:

The study gathers a brief yet significant analysis on the usage patterns that we observed from the statistical data organized by Google. Now after analysing the key parameters like number of downloads & the cost of every other app on astronomy, we are expected to observe rising or declining trend in sales and distribution, and the total revenue generated by the applications, till date. After collecting the data, we interpolate the revenue chart using data gathered from Google Stats, based on parameters like number of downloads, net earnings through ad-mobs, in-app purchases(in case of upgrades or add-ons) as well as the gross earning(price of an app, in case of paid- apps). Next we study the usage analytics, that takes into the account a specific parameter called "Usage Count", and identify its correlation with the characteristic functionalities of the apps; thereby studying the utility of the features offered by these applications.

4. Study Area:

The study covers the details provided by the Google Playstores and app-engine directives. There are various modes of improving the sales of your software product on Google play store, internet being the most effective medium for promotions.

➤ Search Engine Optimization : SEO Optimizes the app visibility on webpage. Developer optimizes the search by adding few keywords or indexing and the target item features on the top of the list of all search results.
➤ Broadcasting your app details &playstore link over social media channels like facebook, twitter, linkdIN etc. : That really helps if you have a giant network marketing circle or a huge list of business contacts (clients, distributors, suppliers etc) in touch with you on social networking websites.

➤ Google Ad-sense: This is a paid facility provided by the google to increase the visibility of your app on Playstore. Almost 30-35% of the traffic is directed through ad-sense.

Study Analysis: Phase - 1

Below are the charts that illustrate a pattern established between the number of downloads and corresponding prices that we noted after evaluating the data from Google Stats. Based on the ownership of the app, we categorize the data into 2 streams: Individual records & Enterprise records, after taking a random sample of 64 apps on astronomy.
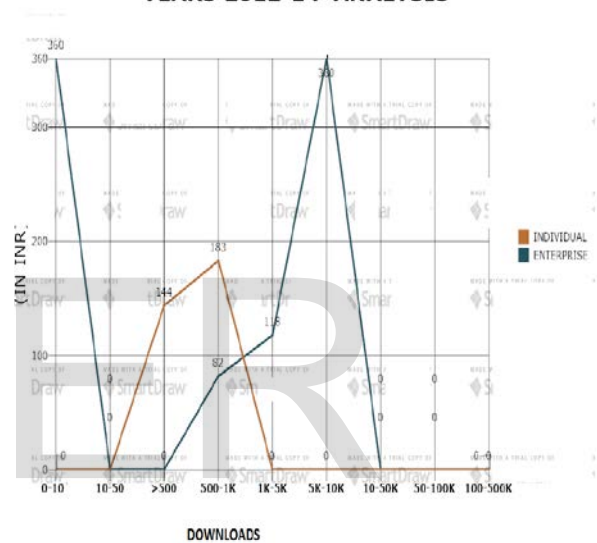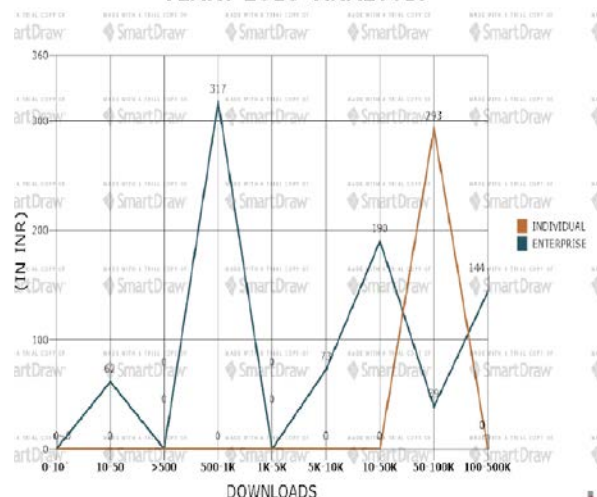
As we examine the 2012-14 analysis chart, there are certain peak values for prices in enterprise stream, and the individual stream, indicating the highest revenue hit by the developers. The width of the graph between 2 consecutive zero-values on

Y – axis indicates the *app count*(no. of apps published).Now, we calculate the average turnover of these apps using a short formula:

TOTAL REVENUE GENERATED BY APP = (PRICE + EARNINGS OBTAINED THROUGH AD-MOBS) * No. of downloads till date

Now, there are ad-postings that occupy a little space in the bottom or topmost portion of the screen, when user is running the app. Now in case the user is online, around 0.01$ (~ 0.65inr) of credit is transferred to the developer's account, each time the user taps the interstitial ad, and the browser redirects the user to the host projecting the ads.

FOR ENTERPRISE CATEGORY, THE HIGHEST EARNING RECORDED SINCE 2012 TILL 2014=(363.3 + 0.65) * 10,000

= 36,39,500 INR

FOR INDIVIDUAL CATEGORY, THE HIGHEST EARNING RECORDED SINCE 2012 TILL 2014

= (183 + 0.65)* 1000

= 1,83,650 INR

Above was a rough estimation of the revenue, that turns out to be greater than 36 Lakh Rupees in case of enterprise, while only around 2 Lakh rupees in individual stream.Now, that is quite obvious since the enterprise having significantly more amount of resources, budget size, labour etc outscores the individual developer by 18 folds!

Next, as we examine the analysis chart of the year 2015, developers recorded a remarkable progress in revenue, although there was a sharp decline in the app countin case of individual developers working on astronomy apps, while a steady increase in the no. of enterprises working on astronomy apps. The app count is nothing but no. of apps published over a particular time span. The ground-breaking shift from 7 figure revenue until 2014 to 9-figure revenue in 2015 was due to the fact that, in 2015, the lifecycle models were revised and despite lower no. of iterations in development phases, the market witnessed a lot many interactive features and functionalities that appealed large no. of user groups from all age groups.

FOR ENTERPRISE CATEGORY, THE HIGHEST EARNING RECORDED IN 2015

 = (144 + 0.65) * 500,000

= 102750000

FOR INDIVIDUAL CATEGORY, THE HIGHEST EARNING RECORDED IN 201 = (293 + 0.65) * 100,000

= 29950000

3.   Study Analysis: Phase – 2

4.   Now, before we proceed with the usage analytics, we'll study about the features being implemented in most of the astronomy apps. After testing a sample of 64 android apps on astronomy, we have broadly categorized their functionalities as follows:

➢ **Point & View:** The point & view feature enables the user to obtain relevant information about the heavenly bodies when the user points the device up in the sky.

➢ **Compass:** A widget showing the direction (north east west or south), on the skyMap.

➢ **ASTRO-CALENDER:** Astro-calender stores and highlights all the important events and occurrences in astronomy along the history lane.

➢ **TIMESHIFT:** An interactive widget that allows the user to simulate the view of sky thousands of years back and forth in time.

➢ **Skymap:** Google's interactive widget implemented by number of android apps on astronomy. It displays a topographical view of the sky, showing all the heavenly bodies and their approximate locations.

➢ **SEARCH-ENGINE:** Search function allows the user to browse the data about the celestial bodies using search engine that implements database connectivity tools like SQLite and performs a rapid search using the keyword entered by the user.

➢ **3D-MODELLING:** This feature allows the user to explore the celestial bodies like planets, moons, stars etc by simulation of their actual structures in 3D. The holographic images of all the known celestial bodies are collected and their 3D views are created using variety of tools and editors; one of them being UNITY.

➢ **GPS LOCATOR:** The feature that allows the users to calculate the spatial position of celestial bodies using Alt-azimuth and equatorial coordinates in real-time.

➢ **FACT WIZARD:** Collection of facts & figures of number of heavenly bodies, including a brief description about them. The information contained in the fact catalogue is organized in tree or top-down hierarchy.

➢ **TELESCOPE SYNC.:** This feature allows the device to control the movement and resolution of telescope connected to it using certain commands specifying the location coordinates that direct the telescope to point towards the desired location in the sky.
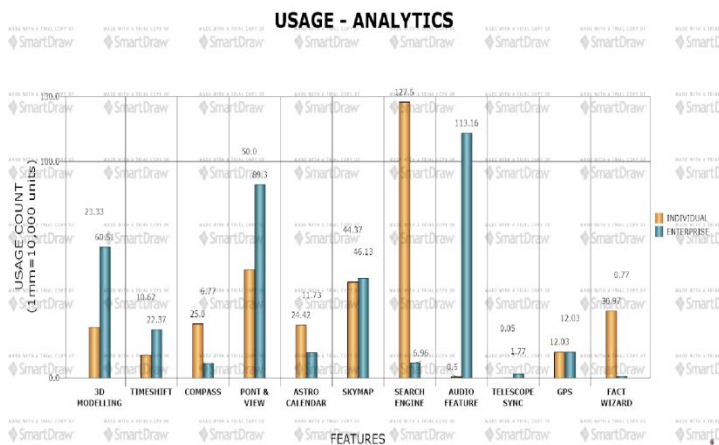
In the above chart, we tried to evaluate the usage count of features & widgets inbuilt in all astronomy apps. After studying this chart, we analyse the usability of these features. Again, here we divide our data into 2 streams: individual & enterprise; as highlighted in the chart with series of orange & blue bars respectively.

The usage count is a parameter that indicates the utility of the feature depending upon 2 critical factors: no. of downloads &app count.We calculate the usage count using a short formula:

Usage count = (average no. of downloads implementing a feature 'f') / app. Count

Where app. Count is the no. of apps implementing a feature 'f'.

We calculate average no. of downloads by taking a mean of all the datasets containing no. of downloads implementing a feature 'f'.

OBSERVATIONS:

From the above chart, we conclude that search feature has recorded a peak value in individual stream. Highest number of downloads have been recorded by the apps implementing the search feature and developed individually. Apps implementing the audio features like voice control, text to speech synthesizer or soundtracks record the highest percentage of downloads in enterprise category.

➢ Taking a look at some of the primitive (static, non-interactive) features like fact wizard and astro-calander, we observe that overall, there are huge no. of apps implementing these features, but such features do not contribute significantly towards the proportion of downloads on apps implementing them. From the sample (comprising of 64 apps on astronomy) we collected, we find that there are around

32.82% of all the apps implementing Fact wizard. Around71.428% of the apps implementing this feature were developed by enterprises, yet having significantly lower value on usage count compared to individually developed apps implementing fact wizard, due to the fact that most of the enterprise apps have higher app count and percentage of downloads being equal to that of individually developed apps implementing fact wizard. Thus, there is great proportion of enterprise apps implementing fact wizard but having less popularity on playstore.

➢ In case of apps implementing certain advanced features like GPS, the usage count of apps developed by enterprises equals the usage count of individually developed apps. From the sample (comprising of 64 apps on astronomy) we collected, we find that28.12 % of the apps implement GPS feature and calculate spatial coordinates (to specify object's location) in real time.

➢ Interactive features in apps developed by enterprises, have recorded more downloads compared to their individual competitors. These features include point & view, skymaps, audio features and timeshift. On the other hand, apps with static features like fact-wizard or astro-calendar have earned more downloads to individual developers. Moreover, there are apps implementing dynamic features like compass widget earning more downloads to individual developers compared to enterprises. Around 66.6% of the apps implementing the compass widget were developed by enterprises and rest of theapps by individual developers.

➢ Chart also indicates a feature 'Telescope sync' recording the lowest usage counton playstore. From the sample we collected, we find only 6.25% of all the astronomy appsare implementing this feature, the highest no. of downloads (around 100,000) being recorded by an app called "sky portal" developed by an enterprise.

Recommendations:

➢ Apps implementing more interactive features need considerable staff right from development
Phase till the end of testing and debugging phases before its deployment. This is evident from the fact that majority of such apps are being developed by a team of coders, data analysts, storage analysts, UI/UX designers, usability experts etc. working in joint collaboration and have significantly more budget and resources.

➢ If you're planning to create an app that implements audio features like voice control or text to speech synthesizers, or implementing advanced features like 3D modelling, it would be wise to consider building these apps in collaboration with your peer developers, having a broad spectrum of knowledge not only in development or testing

but also in layout designing, search optimizations, marketing etc.

➢ Although, cost factor never had any significant impact on declining sales of the app until 2014 ,sincethe 'paid' apps published by individuals witnessed upto 1 million downloads, implementing static features like fact-wizard or astrocalander. However, after 2014, the no. of individuals publishing the paid apps on astronomy dropped significantly.Probing with code optimization in source code of existing features resulting in performance upgrade, storage optimization and higher throughput will help improving the sales without doing any deduction in app's price.

Conclusion:

There are around 200 android apps on astronomy, currently active on Google playstores. After studying a sample of 64 apps on astronomy, implementing a blend of functionalities and widgets,we tried to analyse the factors contributing to their success in terms of no. of downloads and their net revenue, since the time they were created. The analysis was done on the basis of parameters like usage count, app count, no. of downloads, costs, evolution of features etc. We found that before 2015, the apps with static features had significant market share and after 2015, as the apps evolved in features and functionalities, we observed a declining trend in number and the cost of paid apps published by individuals, while the paid apps published by enterprises flourished and their numbers increased exponentially.

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