Data Analysis on How Camera Resolution Affect Memory and Battery Usage

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Abstract

The objective of this study is to observe how much effect does a mobile camera has on its battery and storage. The current generation of smartphones more frequently uses their mobile phone, which decreases the battery life to as short as several hours. Thus, it becomes necessary to understand the effects of different cameras on their battery and storage. How is battery consumed across the different Megapixel Cameras Aperture? This paper presents a battery & storage study on smartphones focusing on various brands and models. We have observed Android Mobiles of different brands and models, tested its front as well as a back camera having distinct megapixel cameras aperture. We have observed the time taken to drain mobile battery while continuing the recoding of the video and having camera applications on at the same time then how much average storage of a video occupies in free memory. Previously the time taken for recording the video was 5 min and now we will extend the time for more 5 min for further study and we will see whether memory consumption is doubled or it goes beyond and we will also observe the battery consumption. Based on the output and observations we have discussed and presented our conclusion.

Keywords: battery life, Memory, smartphones, android, Camera, Megapixel, storage.

Research Objectives

1) Objective 1: Observe the effects of mobile camera on its battery.
2)Objective 2: Observe the amount of memory consumed after taking a video and stored in the memory.
Objective 3: How does the different camera Resolutions gives the different result according to their aperture.
Objective 4: To Make the analysis on the bases of gathered data and come up with an conclusion.

Literature Review

According to the research work in "Power Consumption Analysis, Measurement, Management, and Issues: A State-of-the-Art Review of Smartphone
Battery and Energy Usage " by Pijush Kanti Dutta Pramanik Published in the year December 10, 2019, This research work gives a generalized, but brief analysis of the power utilization causes of a smart-phone and also offers effective measures to minimize

the utilization for each factor. The important conclusion of this paper is based on four comprehensive points:
Smart-phone's power utilization assessment and estimation (includes power utilization analysis and designing)
power utilization management for smartphones (including power saving methods and approaches)
(iii)state-of-the-art of the research and commercialized developments of smart-phone batteries (including another power sources)
(iv)mitigating the hazardous issues of smart-phones' batteries (with a brief explanation of the problems).

According to the research work in "Users and Batteries: Interactions and adaptive energy management in mobile systems" by Nilanjan Banerjee in the year May 30 2014. They had presented the results of an extensive trace collection and a user study that provides a first glimpse into the battery use and recharge behaviour of mobile systems, in particular laptops and mobile phones. They have made three critical observations in three comprehensive user studies: (i) Many users frequently leave excess energy in the battery when recharging devices. (ii) Charging behaviour is more often than not driven by opportunity, context, and conservative practice, rather than low battery conditions

Significant variations occur across mobile users and systems.

Based on these three observations, They have created an adaptive energy management system, named Llama that can scale energy usage to user behaviour, probabilistically matching energy consumption with the expected recharge time. They have deployed this tool on several laptops and Smart-phones and received generally positive feedback.

The Research Work "Energy Consumption in Smartphones: An Investigation of Battery and Energy Consumption of Media Related Applications on Android Smartphones " published by John Elliot in Year 21 September 2017 targets to offer caring advice to the public regarding manufacturer specifications and standard practices among smartphone owners that can help world-wide to Reduce to GHG (greenhouse gas) emissions. The important objective is also to understand the Critically factors affecting smartphone battery energy consumption.

Methodology

This research work is based on the experiments performed and data collected through different mobile phones.

The method adapted was to record the video for a descent amount of time that would give diverse results which would make them easier to compare and would produce more reliable conclusion, so the video was previously shot for 5min and now we have extended the time for more 5min by both front and back camera of the mobile at 1080p and 60fps by the primary camera of the mobile and after then the data such as battery % drop was recorded for both front and back camera and made sure that while recording the video there was no application running in the background and the mobile data was OFF. So that the result obtained would be purely for the camera usage only.

The conclusion was obtained by comparing the front and back camera of the same mobile phones, this was done to avoid the ambiguity and hassle as the factors such as Battery Capacity, Processor etc. were different for different mobile which would alter the conclusion or else would have produced less reliable result. So, resolution impact on storage and battery was done which were working on the same parameters such as Battery Capacity and Processor, the major factors for the performance of any mobile phones

Mobile_Name	back(5min)	front(5min)	back(10min)	front(10min)	Battery_back(5min)	Battery_front(5min)	Battery_back(10 min)	Battery_front(10min)	Resolution_back(MP)	Resolution_front(MP)	Aperture_back	Aperture_front	Capacity
Asus ROG phone 5	620	526	1300	1100	2%	2%	3%	3%	64	24	f/1.8	f/2.5	6000
Asus Zenfone 5z	528	252	1100	555	3%	1%	3%	1%	12	8	f/1.8	f/2.0	3300
Asus Zenfone M1	755	685	1600	1400	2%	1%	2%	2%	13	8	f/2.2	f/2.0	5000
Google Pixel 4	630	437	1300	974	2%	1%	3%	2%	12	8	f/1.7	f/2.0	2800
Honor 9A	607	306	1300	712	3%	1%	3%	2%	13	8	f/1.8	f/2.0	5000
Honor 9N	441	481	882	972	2%	2%	3%	3%	13	16	f/2.0	f/1.8	3000
Narzo 10A	618	411	1300	835	2%	2%	3%	3%	12	5	f/1.8	f/2.4	5000
One Plus Nord	666	322	1700	644	3%	2%	4%	3%	48	32	f/1.7	f/2.4	4100
Oneplus 7T	356	311	712	650	1%	1%	1%	1%	48	16	f/1.6	f/2.0	3800
Oppo Reno 7	650	514	1300	1100	1%	1%	2%	2%	16	13	f/1.8	f/2.0	5000
POCO X2	757	644	1500	1200	1%	1%	2%	2%	64	16	f/1.8	f/2.2	4500
Realme 1	607	306	1200	700	3%	1%	4%	2%	13	8	f/2.2	f/2.2	3410
Realme 3	356	311	712	662	1%	2%	2%	3%	13	13	f/1.8	f/2.0	4230
Realme 6 Pro	728	252	1400	504	3%	1%	4%	2%	64	16	f/1.8	f/2.0	4300
Realme U1	210	224	420	448	1%	2%	2%	3%	13	25	f/2.2	f/2.0	3500
Redmi note 11	720	619	1400	1200	3%	2%	4%	3%	50	13	f/1.8	f/2.4	5000
Redmi Note 6 Pro	756	745	1500	1400	3%	4%	4%	5%	12	20	f/1.9	f/2.0	4000
Redmi Note 7	756	760	1500	1500	2%	3%	3%	4%	12	13	f/2.2	f/2.0	4000
Redmi Note 8	774	667	1500	1500	3%	2%	4%	3%	48	13	f/1.7	f/2.0	4000
Samsung M10	518	212	1100	524	3%	2%	4%	2%	13	5	f/1.9	f/2.0	3400
Samsung A12	716	660	1500	1300	3%	2%	4%	2%	48	8	f/2.0	f/2.2	5000
Samsung A21	650	614	1400	1300	1%	1%	2%	3%	16	13	f/1.8	f/2.0	5000
Samsung A30	727	619	1500	1300	1%	1%	2%	2%	16	16	f/1.7	f/2.0	4000
Samsung A5OS	452	415	950	830	2%	1%	3%	2%	48	32	f/2.0	f/2.0	4000
Samsung A70	618	510	1300	1100	2%	2%	3%	3%	32	32	f/1.7	f/2.0	4500
Samsung A71	730	637	1500	1300	2%	1%	3%	2%	64	32	f/1.8	f/2.2	4500
Samsung Galaxy F22	630	417	1200	952	2%	2%	3%	3%	48	13	f/1.8	f/2.2	6000
Samsung J7 Prime	618	612	1500	1300	3%	2%	3%	3%	13	8	f/1.9	f/1.9	3300

Observations

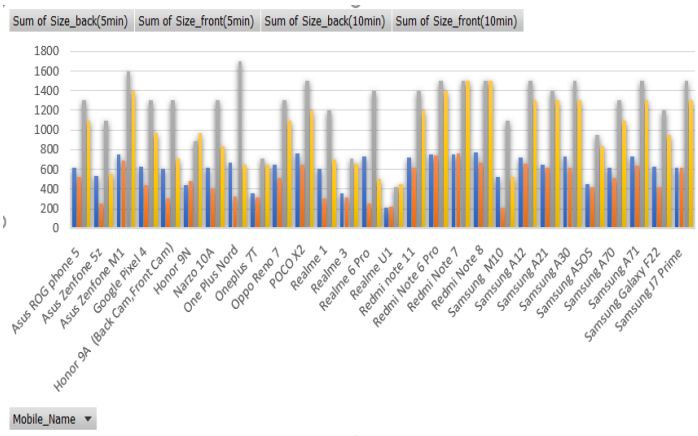

Fig1.1[(Storage Usage)]

Fig 1.1 represents number of mobiles having particular number of Storage sizes with respect to time taken for recordings of the videos**.** The time taken for the recordings is for 5minutes and for 10minutes.
As shown in the fig1.1 Redmi Note 7 and Redmi Note 8 has recorded same size for front as well as back for 10minutes as compared to the size recorded for 5minutes.

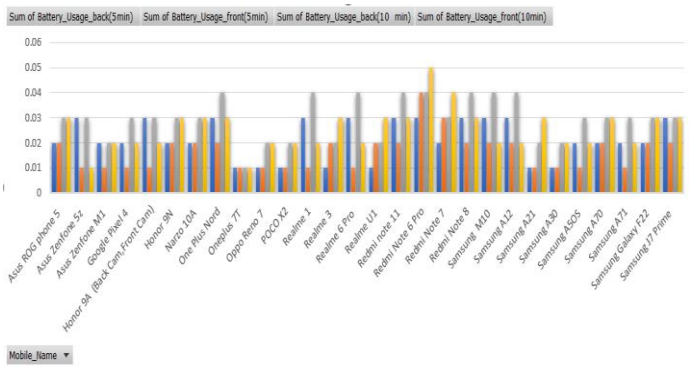

Fig1.2[(Battery Usage)]

Fig1.2 represents the battery consumption of different mobile phones showing how many battery(%) was consumed.
As we can see the battery consumption for 5minutes, The Redmi Note 6 pro, 3% of the battery was consumed in back camera, and 4% of the battery was consumed in front camera. For 10 minutes of battery consumption of Redmi Note 6 pro was 4% in back camera, and 5% for the front camera.

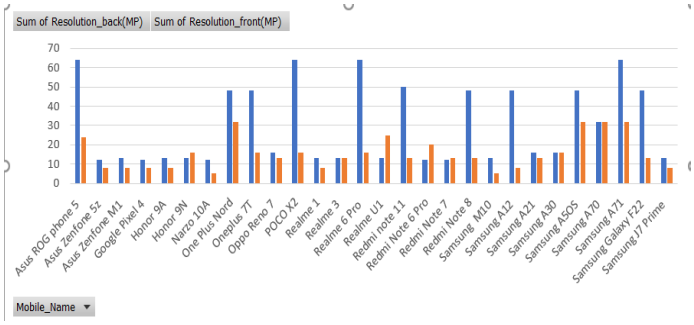

Fig1.3[(Resolution)]

Fig 1.3 represents number of mobiles having number of Mega Pixels(Resolution).
As Shown in the fig1.3 Asus ROG phone 5, Poco X2, Real me 6pro and SamsungA71 have higher Resolution compared to other smartphones devices.

Conclusion

From the tabulated data which was collected by the users.
we can say that:-

<u>Resolution impact on Storage:-</u>

From previous Observations we found that the Higher the resolution, Higher the storage but even we have some mobile phones whose resolution were same but even then they gave different sizes so on further study we observed that for such devices the factor that led to difference in size was the aperture of the camera lenses.
i.e. For the lens having lesser F-stops allows more light to pass in the camera and hence more enhanced was the video quality which led to the difference in video storage size as compared to that of lenses having greater F-stop, having the same camera resolution.

As per the previous findings we know about the apertures are responsible for memory consumptions
And now we have also further observed by extending the time of recordings,
If the light does not comes into the aperture the amount of memory consumption will remain approximately same then that of previously time taken for recording the videos and,
If the light passes through aperture with respect to time then the memory consumption will be higher than previously recorded videos.

Resolution impact on battery:-

As it was observed for higher resolution camera the battery consumption was also high as the storage was increased due to allowability of more light into the camera and hence the processor needed to process more data and consumed more battery.
We have also observed that the battery consumption not only affects because of aperture,
it also affects because of temperature.

References

Pijush Kanti Dutta Pramanik, Nilanjan Sinhababu, Bulbul Mukherjee, Sanjeevi kumar Padmanaban, Aranyak Maity, Bijoy Kumar Upadhyaya, Jens Bo Holmnielsen, & Prasenjit Choudhury "Power Consumption Analysis, Measurement, Management, and Issues: A State-of-the-Art Review of Smartphone Battery and Energy Usage" https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8930492

John Elliot, Ah-Lian Kor, and Oluwafemi Ashola Omotosho "Energy Consumption in Smartphones: An Investigation of Battery and Energy Consumption of Media Related Applications on Android Smartphones" https://www.researchgate.net/publication/319954899

N. Banerjee, A. Rahmati, M. Corner, S. Rollins, and L. Zhong, ''Users and batteries: Interactions and adaptive energy management in mobile systems,'' https://www.researchgate.net/publication/221568498_Users_and_Batteries_Interactions_and_Adaptive_Energy_Management_in_Mobile_Systems

Smartphone Camera Terms Explained Aperture, ISO, F-Stop, Bokeh #BackToBasics

https://youtu.be/ZNtjV_hTB4k

YouTube Video By "Technical Guruji" Video entitled as "What is Megapixel? How Important is it? Smartphone Camera?" https://www.youtube.com/watch?v=6v8T74 Hsjhg

N. Balasubramanian, A. Balasubramanian, and A. Venkataramani, ''Energy consumption in mobile phones: A measurement study and implications for network applications,'' https://ciirpublications.cs.umass.edu/getpdf.php?id=904

Megapixel mythology and photospace: Estimating photospace for camera phones

from large image sets. https://www.researchgate.net/publication/253115884_Megapixel_mythology_and_photospace_estimating_photospace_for_camera_phones_from_large_image_sets

study On How Camera Resolution Affect Memory And Battery Usage

https://ijcrt.org/papers/IJCRT_195111.pdf

YouTube Video By "BRIGHT SIDE" Video Entitled "10+ Reasons Your Phone Battery Dies So Fast" https://www.youtube.com/watch?v=xy6zyP7ZK2Q

Grace Metri, Abhishek Agrawal, Ramesh Peri, and Weisong Shi "What is Eating Up Battery Life On My SmartPhone: A Case Study." http://weisong.eng.wayne.edu/_resources/pdfs/metri12-battery_life.pdf

David T. Nguyen "Evaluating Impact of Storage on Smartphone Energy Efficiency" https://www.ubicomp.org/ubicomp2013/adjunct/adjunct/p319.pdf

"Understanding Human-Smartphone Concerns: A Study of Battery Life" Denzil Ferreira, Anind K. Dey, and Vassilis Kostakos https://www.researchgate.net/publication/225256651_Understanding_HumanSmartphone_Concerns_A_Study_of_Battery_Life