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Sustainability Analysis in Smartphones: A Feature Specific Approach

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Abstract- The aim of this project was to perform a Sentiment Analysis on the various features of Smartphones in order to discover which feature or technology would sustain in future and what are those features which the Smartphone OEMs should invest in, in order to increase their profitability and have an edge over the competition.

Sentiment Analysis help us interpret the Sentiment of the text or paragraph mentioned and usually the interpretation is categorized into three types viz. positive, negative or neutral. Based upon these categories we can classify our results and give appropriate judgement.

A survey was also performed in which questions relating to the outcome of the Sentiment Analysis results were asked, in order to support our findings from the Sentiment Analysis.

After performing both the tasks (Sentiment Analysis & Survey) its outcomes were compared side by side in order to give the final Conclusion, also the best alternative solution is given if some technology or feature is less likely to sustain in the coming times in the future scope and the conclusion section.

Index Terms- Sustainability Analysis, Sentiment Analysis, Feature Analysis, Polarity, Subjectivity

1. INTRODUCTION

Sustainability focuses on meeting the needs of the present without compromising the ability of future features or technologies to meet their needs. The concept of Sustainability is composed of three pillars: economic, environmental, and social—also known informally as profits, planet, and people. Sustainability encourages businesses to frame decisions in terms of environmental, social, and human impact for the long-term, rather than on short-term gains such as next quarter's earnings report. It influences them to consider more factors than simply the immediate profit or loss involved.

Analysis or moreover Data Analysis for our field of study highly refers to the fact that it is a process of obtaining data (Raw Data) and converting it into useful information, which would aid in taking future decisions. Data is collected and analyzed to answer questions, or disprove theories. Analysis is the science of collecting data and uncovering patterns and trends. Analysis is used extensively in science, from physics to the social sciences. As well as testing hypotheses, statistics can provide an approximation for an unknown that is difficult or impossible to measure. Data analysis has multiple facets and approaches, encompassing diverse techniques under a variety of names, and is used in different business, science, and social science domains. Because data analysis helps us to take more scientific and appropriate decisions, the businesses are running more effectively today.

Sustainability Analysis is a term which is formed by building up two words, Sustainable and Analysis. The word sustainability analysis together in our project means performing Analysis on the various features, which would grow and benefit in future and thus it could be sustainable in the time to come. According to a definition given by Deloitte, Sustainability analytics can help companies reduce resource use, making them less vulnerable to price and supply volatility. It can also help them anticipate future changes in supply, demand, and price, so they can hedge their resource purchases and lock in supplies at lower prices. A company can use advanced analytics to identify future risks in areas such as resource use, environmental impact, and labour practices—both inside its own organization and across its extended supply chain. These insights can help manage and mitigate risks before they become headline news.

Sustainability analytics can help companies understand the cost, impact, and performance of their past and present **sustainability** initiatives—and anticipate future conditions and requirements—helping them unlock hidden value and build a more resilient product and services.

Sentiment Analysis is a process of studying the various sentiments of customers related to a product, service, etc. Sentiment Analysis is a **Machine Learning (ML)** based technique, which generates a Polarity score which is usually in the range of **-1 to +1** (negative, neutral or positive). The scores are generated on the basis of the text, sentence or paragraph being analysed. The sentiment score indicates the following:

- 1: Negative Opinion

0: Neutral Opinion

+1: Positive Opinion

Sentiment analysis (also known as opinion mining or emotion AI) refers to the use of natural language processing, text analysis, computational linguistics, and biometrics to systematically identify, extract, quantify, and study affective states and subjective information. Sentiment analysis is widely applied to voice of the customer materials such as reviews and survey responses, online and social media, and healthcare materials for applications that range from marketing to customer service to clinical medicine.

Understanding people's emotions is essential for businesses since customers are able to express their thoughts and feelings more openly than ever before. By automatically analyzing customer feedback, from survey responses to social media conversations, brands are able to listen attentively to their customers, and tailor products and services to meet their needs.

In short using Sentiment Analysis to analyze the review of the product would tell us whether the customers are happy or sad about our pricing plans. Customer service, etc.

2. METHODOLOGY

There are various types of methodologies for performing sentiment analysis, but in this research paper we have used the one which is most relevant as per our needs. The types or the categories of Sentiment Analysis are as follows:

- Lexicon-based Technique
- Machine Learning Technique
- Hybrid Technique

Lexicon-based Technique: This approach utilizes a sentiment lexicon to describe the polarity (positive, negative and neutral) of a textual content. This approach is more understandable and can be easily implemented in contrast to machine learning based algorithms. But the drawback is that it requires the involvement of human beings in the process of text analysis.

The more prominent the information volume, the more noteworthy the test will be for sifting through the noise, identifying the sentiment and distinguishing helpful data from various content sources. Lexicon based approach can further be divided into two categories: Dictionary based approach (based on dictionary words i.e., WordNet or other entries) and Corpus based approach (using corpus data, can further be divided into Statistical and Semantic approaches).

The key points to be drawn from these are as follows:

- ✓ Lexicon-based technique is a linguistic or a language-based technique.
- ✓ It analyses word or sentence or paragraph in order to draw the sentiment scores.
- ✓ They rely on word map, by mapping the terms to either positive, negative or neutral

Machine Learning Technique: The machine learning (ML) approach treats sentiment analysis as a pattern recognition problem using established techniques for classification or prediction. The main advantage of ML-based SA is that it does not rely on word dictionaries, which may be very costly to create and maintain. Instead, a broader set of features are extracted from data, which are more comprehensive than typical sentiment terms (i.e. adjectives), and include nouns representing objects and verbs representing attitudes towards those objects. However, ML based techniques need labelled data sets for supervised training, which has been identified as their shortcoming.

Some of the approaches of Machine Learning Based Techniques are as follows

- ✓ Support Vector Machines (SVM)
- ✓ Artificial Neural Network (ANN)
- ✓ N-Gramm Model
- ✓ Naïve Bayes Classification

Hybrid Technique: The hybrid approach of sentiment analysis exploits both statistical methods and knowledge-based methods for polarity detection. It inherits high accuracy from the machine learning (statistical methods) and stability from the lexicon-based approach.

For our Analysis we have used the Text Blob method which is a Linguistic-based Approach. The benefit of using this technique is it has a wider term coverage. The working of this method is explained in the next section.

3. WORKING

TextBlob is a Python (2 and 3) library for processing textual data. It provides a simple API for diving into common natural language processing (NLP) tasks such as part-of-speech tagging, noun phrase extraction, sentiment analysis, classification, translation, and more. TextBlob stands on the giant shoulders of NLTK and pattern, and plays nicely with both.

Setting up TextBlob

Textblob is not pre-installed in the jupyter notebook (Python), we need to install it by typing the below mentioned lines in the command prompt of Anaconda.

Pip install -U textblob

This will install TextBlob. For the uninitiated – practical work in Natural Language Processing typically uses large bodies of linguistic data, or **corpora.** To install corpora we should type the following code in the command prompt.

Python -m textblob.download_corpora

➢ NLP tasks using TextBlob

In order to perfrom sentiment analysis using TextBlob, the following code was used (This code was written in jupyter notebook)

➔ from textblob import TextBlob

➔ feedback = "(*Some feedback or text or sentence or paragraph should be assigned here whose sentiment analysis need to be done*)"

➔ blob = TextBlob(feedback)

➔ print(blob.sentiment)

The print(blob.sentiment) statement would give us two outputs, Polarity and Subjectivity. **Polarity** is also known as the sentiment score, which is in the range of (-1 to +1). **Subjectivity** generally refers to personal opinion, emotion or judgment whereas objective refers to factual information. Subjectivity is also a float which lies in the range of [0,1].

An example of sentiment analysis performed in python is shown below:

➔ import bs4

➔ import requests

➔ from textblob import TextBlob

➔ feedback1="The movie was very good"

➔ blob=TextBlob(feedback1)

➔ print(blob.sentiment)

➔ Sentiment (polarity=0.90, subjectivity=0.78)

The bs4 is Beautiful Soup library in Python for extracting data out of HTML and XML files. In simple words, it puts the complex code of the web page in a readable format. The import requests is a module which allows us to send HTTP request using Python. The HTTP request returns a Response object with all the response data.

By reading the above feedback we can interpret without the use of any software that the user liked the movie. But we can't analyse thousands of feedbacks manually, thus we use the textblob method. After applying textblob we get two scores as shown above viz. Polarity and Subjectivity. We can see here for the feedback given, which is a positive feedback we get a polarity score which is close to 1 i.e., 0.90 and a subjectivity score of 0.78. Thus by applying this code in a loop we can get scores for as many feedbacks as we want.

3.1 Factors Affecting Sentiment Analysis

There are basically two factors affecting the score of sentiment analysis and they are Product length and Review length. The sentiment scores differ as per the product type or the service, because different sentiments are related towards different products and services. Review length is one of the main parameters in getting different SA Scores. Accuracy sometimes differs while analysing Phrase, Sentence or Paragraph. It is important to consider these factors while performing the analysis as deviation or non-linearity in these factors may not give us accurate results.

4. FEATURE SELECTION ANALYSIS

Up till now we have understood what is Sentiment Analysis and the working of it. Our research paper is based on Analysis of Smartphones, in order to start the analysis, we first need to select the features on which we need to perform the analysis. Since smartphone have lots of features, we need to select only those which the smartphones OEM'S would be paying attention to. Some of the trending features of smartphones are Foldable phones, Bezel less display, Big Strides, More MP camera, NFC (Near-field Communication), Notch Feature, Pop-up Camera, Dropping Head Phone Jack.

Above we have mentioned what are the trending features in smartphones, selected from the big pool of various features. However, in order to better understand and analyse it further, we have again narrowed down our selection of features and have selected a total of four features which are of utmost important and which the companies also pay attention to. Also we needed to collect data and reviews from people in order to perform the analysis, so one of the barrier we kept while selecting the final features were that everyone, even a Lehman should be aware of the features in order for the data to be accurate and the result to be efficient. These features somehow become the USP of the entire smartphone industry and these are the features towards which the market is attracted

to. We would be doing an in-depth study of how these features govern the market and perform sentiment analysis on these features so that we can analyse it more deeply. The selected features are as follows:

- NFC (Near-field Communication)
- Notch
- Pop-up Camera
- Exclusion of Head Phone Jack

5. MODELLING & RESULTS

After performing the Feature Selection Analysis, we finalized four features mentioned above on which we would be performing our analysis. In this section we would be implementing the model for each selected feature separately and would be discussing its results.

Sr. No	Polarity	Subjectivity	Sr. No	Polarity	Subjectivity	Sr. No	Polarity	Subjectivity
1	-0.383	0.700	1	-1.000	0.750	1	0.000	0.000
2	0.050	0.600	2	-0.233	0.267	2	-0.250	0.750
3	-0.004	0.532	3	-0.350	0.300	3	0.087	0.378
4	-0.393	0.518	4	-0.125	0.525	4	-0.204	0.671
5	-0.401	0.512	5	-0.132	0.510	5	0.000	0.100
6	-0.492	0.467	6	0.000	0.125	6	-0.762	1.000
7	0.000	0.113	7	-0.500	0.500	7	-0.194	0.311
8	0.083	0.302	8	0.000	0.000	8	0.065	0.499
9	0.056	0.833	9	-0.094	0.750	9	-0.002	0.544
10	0.000	0.000	10	-0.075	0.550	10	0.042	0.297
11	0.000	0.000	11	-0.200	0.333	11	-0.188	0.519
12	0.000	0.000	12	0.000	0.000	12	0.000	1.000
13	-0.268	0.507	13	-0.187	0.405	13	-0.052	0.096
14	-0.165	0.369	14	-0.250	1.000	14	-0.135	0.496
15	0.033	0.110	15	-0.663	0.663	15	0.100	0.400
16	-0.058	0.717	16	0.076	0.520	16	-0.139	0.300
17	-0.181	0.531	17	-0.500	0.500	17	-0.136	0.425
18	-0.046	0.435	18	-0.042	0.403	18	-0.100	0.394
19	0.000	0.000	19	-0.250	0.650	19	-0.292	0.375
20	0.100	0.400	20	-0.250	0.563	20	0.000	0.000
21	-0.129	0.620	21	-0.375	0.438	21	0.000	0.063
22	-0.005	0.553	22	0.050	0.497	22	-0.161	0.296
23	0.093	0.436	23	0.000	0.600	23	0.000	0.000
24	-0.116	0.373	24	0.060	0.248	24	-0.094	0.566
25	-0.218	0.454	25	0.000	0.125	25	-0.158	0.456
26	-0.306	0.533	26	-0.500	0.889	26	-0.083	0.117

NFC: There has always been a debate whether NFC is better to use or Bluetooth? The truth is both are outstanding at their own places, both operate in different situation, but both NFC and Bluetooth can perform similar functions. So, is it really necessary to provide both in Smartphones? As providing either of them would reduce the cost of manufacturing. In order to find out this we performed Sentiment Analysis on the people who use NFC and who don't. Also, we conducted a survey in order to make it clearer that what would be more profitable and which technology is likely to sustain in future.

Descriptive Analysis	
Mean	-0.140
Standard Error	0.024
Median	-0.094
Mode	0.000
Standard Deviation	0.208
Sample Variance	0.043
Kurtosis	3.510
Skewness	-1.638
Range	1.100
Minimum	-1.000
Maximum	0.100

The code used for Sentiment Analysis of NFC is as follows:

➔ **import** requests

➔ **import** bs4

➔ **from** textblob **import** TextBlob

- ➔ res=requests.get('https://community.phones.nokia.com/discussion/401/nfc-issues/p2')
- ➔ soup=bs4.BeautifulSoup(res.text,'lxml')
- ➔ soup
- ➔ soup.findAll("div",{"class":"Message userContent"})
- ➔ **for** num **in range**(**50**):

feedback=soup.findAll("div",{"class":"Message userContent"})[num].getText()

blob=TextBlob(feedback)

print(blob.sentiment)

Above shown are the results obtained after compelling the code.

Important Note (1): These Results are a snapshot from jupyter notebook directly. In order to understand these results, we have converted them into a better from in excel which is displayed below and further in the report also we would be using the excel format only because it is easier to read, also the results showed above are only a part from the entire set of results as the whole set of result couldn't be displayed as the number of rows were too many. However, at the end we have, summarized the total findings and done a descriptive analysis of the data in order to conclude the findings.

From the above analysed results, we can see that most of the polarity **score is less than 0, which indicates a negative sentiment.** Generally negative sentiments are expressed when the users don't like a product or a technology and they show the sentiment of hate towards it.

Below we have shown the descriptive analysis of the entire data set, in which finding the mean score, which would help us to determine the overall sentiment is the primary focus.

Polarity	Subjectivity	Polarity	Subjectivity
-0.600	-0.667	0.142	0.225
-0.800	-1.000	0.100	0.383
0.123	0.443	-0.092	0.508
0.069	0.681	0.000	0.000
0.000	0.000	-0.047	0.500
0.000	0.000	-0.039	0.421
-0.500	0.500	0.010	0.385
-0.525	-0.442	-0.254	0.623
0.186	0.395	0.350	0.550
0.167	0.283	0.033	0.455
0.000	0.000	-0.120	0.629
1.000	-0.300	-0.267	1.000
-0.031	0.679	-0.375	0.900
0.150	0.250	0.108	0.470
-0.292	0.542	0.218	0.423

Notch: A notch is essentially a cut-out, at the top, of a part of the screen display. Its advantage: It offers the ability to retain the display space on either side of it, for information such as date, battery statistics and more, and for apps. “Our research has shown that the space occupied by the notch typically goes unused in standard use. The notch makes optimal use of the vacated space," says Pete Lau, CEO, OnePlus. The notch is the outcome of two trends. The first is the shift towards minimal bezels—most of the phones launched since 2017 have had thinner frames around the display, so they are more compact—and phone makers can increase display size. This makes the phone an even better productivity device, since the extra display space can be particularly useful with apps such as document editors, or sharing screen space among two apps.

The code used for Sentiment Analysis of Notch feature is as follows:

- **import** requests
- **import** bs4
- **from** textblob **import** TextBlob

Polarity	
Mean	-0.055
Standard Error	0.053682229
Median	0.107575758
Mode	0
Standard Deviation	0.29889
Sample Variance	0.089335232
Kurtosis	1.740931384
Skewness	0.811896539
Range	1.5
Minimum	-0.5
Maximum	1

- res=requests.get('https://forums.overclockers.co.uk/threads/notch-vs-teardrop-vs-punch-hole-what-is-the-best.18850492/')
- soup=bs4.BeautifulSoup(res.text,'lxml')
- soup
- soup.findAll("div",{"class":"messageContent"})

Above shown are the results obtained after compelling the code. Before reading the results please go through Important Note(1).

From the above results we can see that polarity for most of the result is **negative and neutral.** This means that, people are liking the feature partially. In order to find out more conducted surveys so that we could make a proper conclusion for the same.

descriptive analysis of the entire data set, in which we found the mean score, which would help us to determine the overall sentiment which is the primary focus.

From the above table we can see that, the mean value is **-0.055** which indicates that the overall sentiment for this set of topics is negative and neutral.

Pop-up Camera: Pop-up camera is a built-in camera at the top side of the phone which uses a stepper motor to come out whenever the user needs it, Else it stays inside of the Smartphone. These types of camera’s were introduced in order to give users a full screen experience without any interruption. By putting the selfie camera inside a motorised pop-up mechanism, smartphones finally got to

Sr.No	Polarity	Subjectivity	Sr.No	Polarity	Subjectivity
1	-0.11	0.72	16	-0.11	0.72
2	-0.22	0.44	17	-0.38	0.60
3	-0.02	0.50	18	0.08	0.51
4	-0.11	0.72	19	-0.25	0.40
5	-0.38	0.60	20	-0.03	0.43
6	0.08	0.51	21	-0.28	0.43
7	-0.25	0.40	22	-0.11	0.72
8	-0.03	0.43	23	-0.22	0.44
9	-0.28	0.43	24	-0.02	0.50
10	0.00	0.10	25	-0.10	0.50
11	-0.22	0.46	26	-0.29	0.37
12	-0.16	0.46	27	0.00	0.10
13	-0.10	0.50	28	-0.22	0.46
14	-0.29	0.37	29	-0.16	0.46
15	0.06	0.33	30	0.00	0.00

offer a truly bezel-less display that stretches all the way to the edges. Because of a pop-up camera, you get an uninterrupted viewing experience making movies, TV shows and games look much better on your smartphones.

The code used for Sentiment Analysis of Pop-up Camera feature is as follows:

```
➔ import requests
➔ import bs4
➔ from textblob import TextBlob
➔ res=requests.get('https://www.androidauthority.com/rip-pop-up-selfie-camera-1094655/')
➔ soup=bs4.BeautifulSoup(res.text,'lxml')
➔ soup
➔ soup.findAll("div",{"class":"Message userContent"})
➔ for num in range(50):
feedback=soup.findAll("div",{"class":"Message userContent"})[num].getText()
blob=TextBlob(feedback)
print(blob.sentiment)
```

Above shown are the results obtained after compelling the code. Before reading the results please go through Important Note(1).

From the above results we can see that polarity for most of the result is **negative.** This means that, users are not liking the Pop-up camera feature. The summarized results is as shown in the table.

We can see from the above results that the mean of all the Sentiment Scores is -0.1271 which indicates that the overall Sentiment for this set of topic is **negative** and clearly it is not liked by users.

Descriptive Analysis	
Mean	-0.1271
Standard Error	0.047136948
Median	0
Mode	-0.107142857
Standard Deviation	0.188547793
Sample Variance	0.03555027
Kurtosis	-0.255273972
Skewness	-0.262750525
Range	0.670833333
Minimum	-0.3775
Maximum	0.293333333

Suspension of Head-Phone Jack: Head-Phone jack provided in the smartphones has usually a diameter of 3.5 mm and it is used to connect various types of earphones to it as well as different multipurpose cords of the same diameter for sound enhancement. It is also used to connect Auxiliary cable in order to connect it with Various devices.

Apple was the first company to start this trend, of removing the Head-Phone Jack from the phone. Apple wanted to start a new trend and make some changes in the appearance in the phone, so they started with the removal of headphone jack

phone. Apple claimed that they wanted to fit some more extra sensors in the phone, so that is the reason they removed it. However, the whole of this is not true, what the company was actually looking was to, push the sales of their Bluetooth air pods and make more profit. They claimed it that having a Head-Phone jack is old fashioned, but till date the number of users of wired earphones is more than the number of users of wireless users. Also, the number of sensors in the iPhone containing head-phone jack and that of not containing it is the same.

The code used for Suspension of Head-Phone Jack is as follows:

Polarity	Subjectivity	Polarity	Subjectivity
0.133	0.467	-0.300	0.825
-0.025	0.450	0.200	0.250
-0.500	0.600	-0.278	0.517
0.189	0.435	-0.400	0.600
0.000	0.000	-0.042	0.458
-0.781	0.900	-0.363	0.750
0.200	0.200	-0.152	0.146
-0.800	0.700	-0.333	0.667
-0.238	0.619	-0.250	0.500
0.000	0.000	-0.350	0.300
0.000	0.000	0.100	0.100
0.037	0.639	0.050	0.263
0.140	0.493	-0.212	0.417
-0.014	0.597	-0.475	0.692
-0.340	0.440	-0.391	0.730
-0.320	0.580	-0.275	0.625
-0.035	0.502	0.106	0.531
-0.250	0.433	0.125	0.675
-0.412	0.521	-0.550	0.700
-0.433	0.833	-0.246	0.456
-0.050	0.450	-0.300	0.633
0.000	0.100	-0.188	0.405
0.140	0.440	-0.306	0.515
-0.450	0.650	0.400	0.700
		0.000	0.000

- **import** requests
- **import** bs4
- **from** textblob **import** TextBlob
- res=requests.get('https://www.cnet.com/news/oneplus-6t-removing-the-headphone-jack-was-a-tough-decision/#comments')
- soup=bs4.BeautifulSoup(res.text,'lxml')
- soup
- soup.findAll("div",{"class":"Message userContent"})
- **for** num **in range**(**50**)

feedback=soup.findAll("div",{"class":"Message userContent"})[num].getText()

blob=TextBlob(feedback)

print(blob.sentiment)

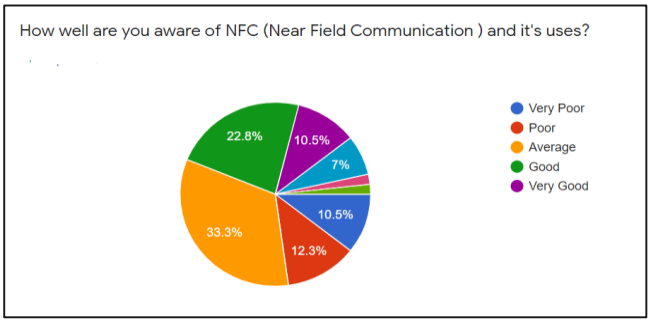
Above shown are the results obtained after compelling the code. Before reading the results please go through Important Note(1).

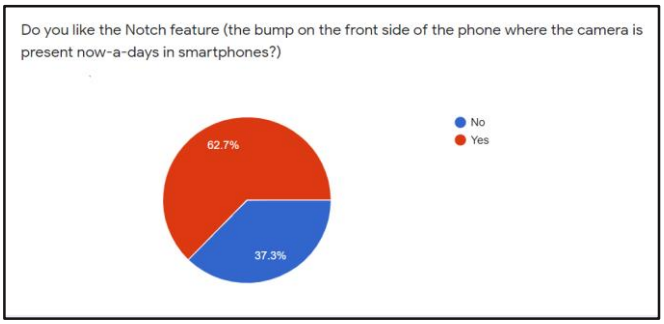
From the above results we can see that polarity for most of the result is **negative.** This means that, users are not liking that the head-phone jack has been suspended camera. The summarized results is as shown in the table.

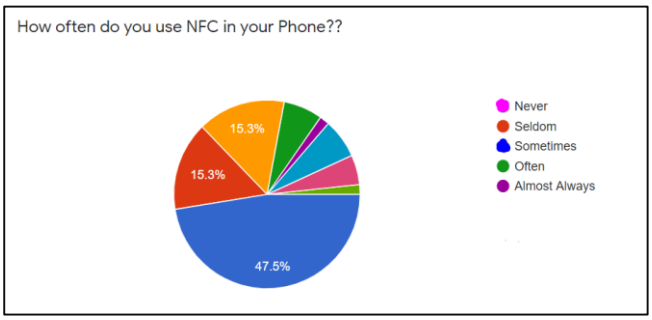
The mean score of sentiment results is **-0.159** which indicates that users show a negative Sentiment towards this step. These results are further discussed in the drawings section of the Sentiment Analysis.

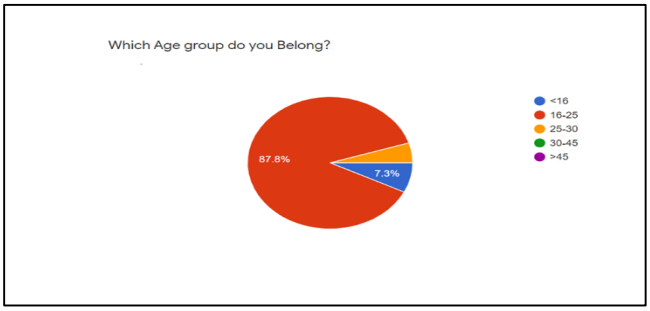
6. SURVEY RESULTS

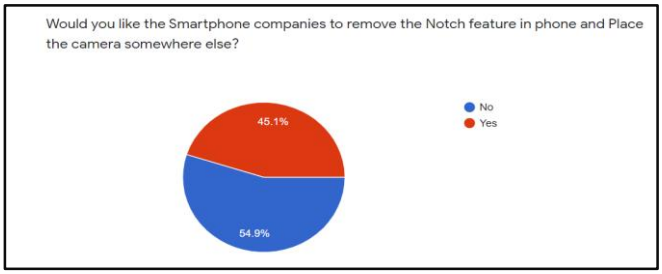
In order to support our findings of Sentiment Analysis, we performed a Survey in which people were asked different questions regarding the four selected features. The survey was conducted on Google forms. The snapshots of the survey are mentioned below.

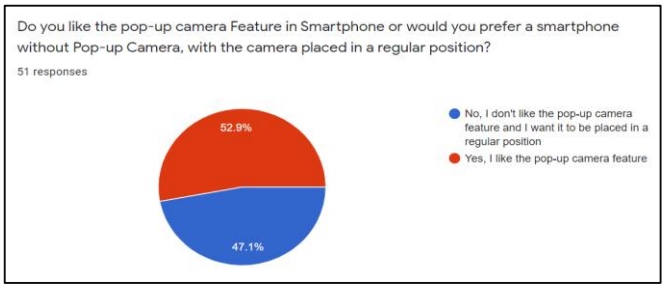


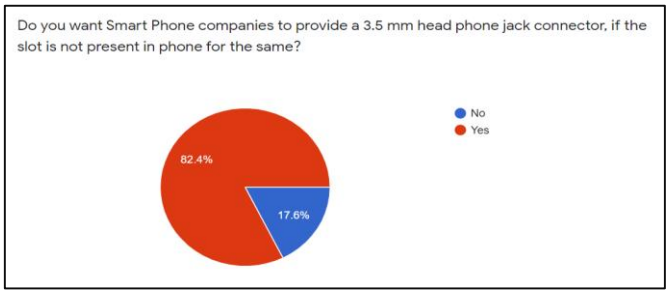


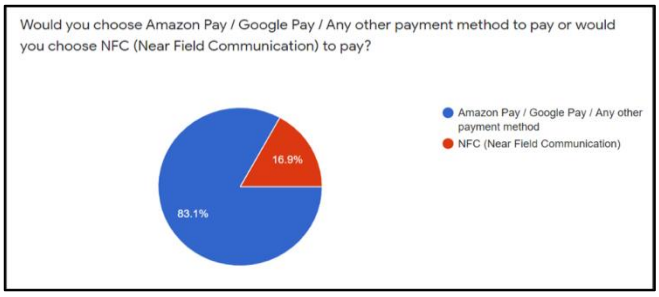












Descriptive Analysis	
Mean	-0.159
Standard Error	0.040409733
Median	0.14
Mode	0
Standard Deviation	0.282868134
Sample Variance	0.080014381
Kurtosis	0.259638605
Skewness	-0.0529963
Range	1.275
Minimum	-0.475
Maximum	0.8
Sum	6.244955083
Count	49
Largest(1)	0.8
Smallest(1)	-0.475
Confidence Level(95.0%)	0.081249214

7. ONCLUSION

This section includes the conclusion of each selected feature separately, as per the Sentiment Analysis done and tells us whether a particular feature or technology would sustain in future or no.

NFC:

In the summarized results we got to know that the polarity score for NFC is -0.140 which means it is on the neutral and the negative side. This score does not tend on the greater negative side, which means that users still like this feature but are facing some issues with it. After deep diving into further analysis, we chalked out that these were the issues which were faced by most of the users.

(1) The placement of NFC near the camera sensor was creating issues in detecting the signals.
(2) Many people didn't like the fact that the devices had to be brought in contact in order to use NFC as its range was about 20cms only.
(3) Some people believed that they had security issues using NFC for other purposes.

An example citing this issue is of Nokia 8 smartphone, where people constantly complained of the above-mentioned issues, and hence we saw the quick rise and fall of the smartphone.

Also, the questions asked in the survey support these findings, hence we conclude that NFC is a technology which can sustain in future, however smartphone OEM's need to address the above-mentioned issues for successful sustainment of the Technology.

Notch:

From the analysis we came to know that the Polarity score for Notch is -0.055, which is more on the neutral side. Since this score is skewed a little bit on the left side of the normal distribution graph, it means users like this feature but again as in NFC, they are facing some issues with it. After deeply Analysing the results, we found out these issues faced most by the users:

(1) Users like to have a full screen experience with no or minimal interruption.
(2) Out of the three category of notches users like to have Punch Hole. (This is shown in the Survey Section)
(3) Supporting the first point, Phones have no notch interruption and slightly larger bezels were also preferred the most.

The below table depicts the sales comparison of different smartphones addressing this issue.

Name of Smartphone	Units sold Globally	Type of Notch
Samsung Galaxy Note 8	10 million units	No Notch
Samsung Galaxy Note 9	9.7 million units	No Notch
Samsung Galaxy Note 10	7.6 million units	Infinity O Notch

Thus we conclude that the punch-hole Notch feature would only sustain in future, as users prefer having a punch-hole notch at the corner of the smartphone or no notch at all.

Pop-up Camera:

The polarity score for pop-up camera is -0.1271 which clearly indicates that users do not like this feature. The following issues were found, which were responsible for the negative sentiment.

(1) The user's complaint that the motor of the camera malfunctioned many times.
(2) Whenever a video call would come when the phone was in the pocket of the user, the camera would pop-up in the pocket leading to the breakage of the setup.
(3) There were many durability issues as the setup for the camera was very fragile.

It is technology which would not sustain in future and what should be its alternative is discussed in the next section.

Suspension of Head-Phone Jack:

The polarity score for head-phone jack is the most negative as compared to the other features. It has a score of -0.159. It clearly indicates that users are not liking the fact that the head-phone jack is suspended. Also, the survey results tell us that people are not supporting the fact that head-phone jack is not provided.

8. FUTURE SCOPE

The future scope of the selected features is discussed in this section.

NFC:

The use of NFC is not limited to smartphones only, it has many wide range applications as well. According to a survey about 90% people use their phone when they enter in a shop. NFC can be used in big retail shops. NFC tags are also easy to implement given their small size and inexpensive cost. They can be attached to variety of products: "posters, ski lift passes, stickers, business cards, prescription bottles and even ruggedized labels meant for outdoor use." Enabling these products with customized and contextual information maximizes customer satisfaction on an individual basis, and provides companies with the cutting-edge competitive advantage they need. Possibilities are endless, as experiences can be programmed with any sort of digital content, and can store a wide range of data, including product information, pictures, video, contact information, and links to mobile apps.

Notch:

Users like to have a bigger screen regardless of the fact whether notches are present or not. This thing could be solved by the fact if the phones cover the punch hole camera by adding screen pixels to it and make the smartphones with a curved edge screen as this would help to reduce the bezels as well providing larger display without any interruption.

Pop-up Camera:

Alternative to pop-up camera is a display which houses punch hole camera, the most liked by users or a phone which has curved display so the bezels are not too much and also the camera could be placed on the bezels. These two solutions are the best for the trend which is currently going on in the market.

Suspension of Head-Phone Jack:

When the users were asked in the Survey that if the company is not providing a Head-Phone Jack, would they like a head-phone connector to be provided instead? To which 82.4% users responded yes, so this could be one alternative for the same.

9. ACKNOWLEDGEMENT

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