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AN ONTOLOGY BASED SENTIMENT ANALYSIS

A Case Study

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AN ONTOLOGY BASED SENTIMENT ANALYSIS

A Case Study

Submitted by Syed Zeeshan Haider to the University of Skövde as a dissertation towards the degree of M.Sc. by examination and dissertation in the School of Humanities and Informatics.

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I hereby certify that all material in this dissertation which is not my own work has been identified and that no work is included for which a degree has already been conferred on me.

Signature:_____

An Ontology based Sentiment Analysis

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Abstract

Business through e-commerce has become popular recently due to the massive amount of information available on internet. This has resulted in the abnormal number of reviews on websites like www.amazon.com and www.ebay.com, where customers express their opinions about the purchases they have made. Analyzing customer's behavior has become very important for the organizations to find new market trends and insights. For the potential customer it becomes really difficult to get the knowledge about a product in the presence of such huge number of reviews and to sort the useful reviews and make good decision. The reviews available on these websites are in heterogeneous form i.e. structured and unstructured form and needs to be stored in a consistent format. Since good decision requires quality information in limited amount of time, Yaakub et, al.(2011) have proposed an ontology that uses a multidimensional model to integrate customer's characteristics and their comments about products. This approach first identifies the entities and then sentiments present in the customers reviews related to mobiles are transformed into an attribute table by using a 7 point polarity system (-3 to 3). The research proposed by Yaakub et, al.(2011) is in developing stage. The limitation of their approach is that the ontology proposed by them is too general. The authors have shown their desire that it should be tested for a large group of products. Also, Yaakub et, al.(2011) have used very short and simple comments for the manual extraction of features for which a sentiment has been expressed. Usually comments present on e-commerce websites are not that short and simple.
In order to fulfill the aim of this thesis project, a case study has been conducted on websites www.amazon.com and www.ebay.com and the ontology proposed by Yaakub et, al.(2011) has been refined for the three categories of mobile phones: smart phones, wet and dirty mobile phones and simple mobile phones. Further, sentiment analysis has been conducted by first using the ontology proposed by Yaakub et, al.(2011) and then by using the refined version of the ontologies for the three categories of mobile in order to compare the results.

Keywords: *Opinion analysis, Sentiment analysis, Ontologies, Opinion mining*

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1.Introduction

In organizations, enormous amount of information is generated by different processes (Castellanos, et al., 2010). A process is a set of activities which are related to each other and has the ability to transform the inputs into outputs as a result. The information for the processes comes from the internal and external data sources (Felden,et al.,2010). The generated information as a result of processes comprises structured data and unstructured data (Sukumaran & Sureka,2006). Decision making is mainly based on the knowledge acquired on the basis of semi structured and unstructured data (Negash & Grey,2008). Unstructured data spread across different entities of an organization. Management of such information is a daunting task and is usually managed by document management and file systems (Castellanos,et al.,2010).

Structured data is usually stored with a predefined schema. Data that is stored in relational database management system (RDBMS) and data in data warehouse are examples of structured data. It is easy to query, analyze and integrate it with other structured sources (Sukumaran & Sureka, 2006). Due to the nature of unstructured data, it is very difficult to search, retrieve and analyze and also very complex and non trivial to directly integrate it with the structured data (Sukumaran & Sureka, 2006). Unstructured data needs to be sorted, captured, codified, reconciled and integrated along with the structured data in order to process transactions efficiently without errors. This would result in increased revenue and reduce mismanagement (Castellanos,et al.,2010).

1.1.Problem

Due to the rapid expansion of the internet, business through e-commerce has become popular. Many products are being sold on internet and the merchants selling the products ask their customers to write reviews about the products that they have purchased. This is the reason behind the abnormal increment of the number of reviews on websites. The problem occurs when for a particular popular product, the number of customer reviews reaches hundreds and sometimes in thousands. This increment makes it very difficult for potential customer as well as for the manufacturer of the product to sort the useful reviews from the one that do not contain useful information and to make a decision whether to purchase a product or not. In addition to that few reviews are too long and contain few sentences that express opinions about the product. Also for the manufacturer it becomes more complex because many websites sell its products and a manufacturer usually produce more than one product (Hu,2004 ; Eirinaki et.al.,2011). For example a consumer is interested in buying a particular digital camera and wants to get the knowledge of different features, strengths and weaknesses of that camera. The consumer would also like to compare the features of this camera with other brands of cameras. This process of comparing requires manual searching of related websites which would need a lot of time. Information gained by visiting few websites would

provide incomplete and less information (Deshpande&Sarkar,2010). Since good decision needs quality information, so it is vital to analyze quality information in limited amount of time (Sukumaran & Sureka, 2006). The "Voice of the customer" in the form of shared opinions has become extremely valuable for the organizations and business (Deshpande&Sarkar, 2010). It is very important to analyze customer's behaviors and characteristics in order to find new market trends and insights which helps in maintaining the loyalty of current customers with the organization (Yaakub et,al.,2011;Gindl,et al.,2010).

For analyzing customer´s behaviors and activities a large amount of data related to customer´s purchasing pattern is required (Yaakub et,at.,2011). The process of opinion or polarity mining is complex due to the fact that the available raw data i.e. product reviews are present in unstructured and heterogeneous form on different websites. These websites include e-commerce web sites (e.g., Amazon.com), professional review sites (e.g., Cnet.com and ZDNet.com), consumer opinion sites (e.g., ConsumerReview.com and Epinions.com), news or magazine sites (e.g., Rollingstone.com) and bulletin boards or Usenet groups. The heterogeneous data present on these websites needs to be transformed into a consistent format. While conducting opinion mining various problems occur. The review page on the web might have some other information with the review which is also known as noisy raw data. There is also a possibility that facts are mixed with opinions that are present in a review. It is also very important to consider the level of text granularity in advance at which the polarity mining needs to be determined. Previous research has focused polarity mining at document level, sentence level, clause level and phrase level but domain knowledge was not considered during that research (Zhou & Chaovalit, 2007).

1.2. Aim and objectives

1.2.1. Aim of the research

The aim of this work is to refine Yaakub et, al's proposed ontology for examining customer sentiments present in reviews published on the web

1.2.2. Objectives

1. To refine the ontology proposed by Yaakub et,al. (2011) for different types of mobile phones, i.e. simple mobile phone, wet and dirty mobile phone and smart mobile phone

2. To evaluate and verify the refined version of the ontologies

3. To compare the verified ontologies with the ontology proposed by Yaakub et,al. (2011) by performing sentiment analysis

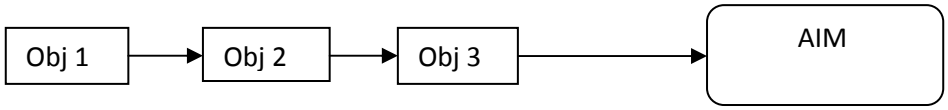


Figure.1: Interrelationship between the objectives in order to fulfill the Aim

2. Background

2.1. Research Area

There has been an enormous amount of increment in online content that includes huge number of articles that have been published along with a huge volume of information that is available on internet (Deshpande & Sarkar, 2010). According to a marketing research company "comcore" there are about 1.1 billion people around the globe who use internet and around 768 million are regular users of social networking sites that includes review sites, blogs etc. These statistics clearly suggest that there is a vast amount of information available on internet. The exploration of information on the internet has made the role of e-commerce and social networking sites more important. People not only use Internet for getting information about any product but also read reviews before buying. They also use this information for updating themselves for the current social and political issues that occur in their neighborhood, state or any other country around the globe (Eirinaki et.al. 2011).

This effective impact and rapid spread of information on internet has also made organizations cautious about their reputations. According to a study by Deloitte, "82 percent of purchase decisions have been directly influenced by reviews." The reason is quite obvious, consumer products and services that includes movies and restaurants to hotels are frequently being discussed by the websites in the form of shared opinions (Deshpande&Sarkar,2010). For example www.amazon.com is a very popular website where people do shopping via internet. This website allows users to express their opinions about a particular product they have bought. The new users read these opinions about product's features they are interested in buying and do comparison (Binali,et al., 2009).

Customer's comments usually covers various issues that are related to different types of products. Some comments are termed as general comments but some focus on certain types of specific technical issues related to any particular product. Also some comments are positive, some are negative and some may fall into the neutral category (Yaakub et,al.,2011). Special attention is required when there is a negative word like "didn't", "never" or "not" is present in the sentence. In order to cope up with negation words, the polarity of the word is inverted (Desdpsnde& Sarkar ,2010). It is also difficult to make sense when the comments given in a review by the user have discussed about a feature that describe product attributes at different levels. For example, a comment like: Nikon is a good camera in general but Nikon D4 is excellent. Also the opinions present in a comment may not only refer to a single entity or feature of a product. It is very important to integrate the customers opinions or sentiments for the features of a particular product (Yaakub et,al.,2011).

There are also some limitations when the judgment of sentiments depends on domain and context. For example, the sentiment word "long" in the context of movies represents a negative sentiment whereas in the context of games depicts positive sentiment. Word like unpredictable would indicate a negative sentiment for a product like a mobile phone or camera but a positive sentiment for a movie. Also, the sentiment word high in terms of the

resolution of camera depicts positive sentiment whereas in terms of price it is showing a negative sentiment. These situations can results in errors while conducting sentiment analysis (Desdpsnde & Sarkar,2010).

Opinion mining, sentiment analysis, sentiment extraction or affective rating are the few terms that have been used interchangeably by the researchers (Gindl,et al.,2010). By using natural language processing techniques structure and semantic information can be added to the content in unstructured text form. This would result in efficient integration of structured data with unstructured data, hence would add significant value to an organization and an organization can derive the single version of the truth. This transformation would result in efficient decision making, understanding and conducting other business functions (Sukumaran & Sureka, 2006). There is a strong need to analyze both structured and unstructured data together. Structured data is a good source for the organizations that provides information that is useful for answering "what" questions. On the other hand unstructured data provides information that is useful for answering "why" questions (Lahl,2011).

2.2.Structured data and unstructured data

Structured data includes typical transactional data, numeric data that is collected, stored, queried, accessed, analyzed and used by enterprises that enables them to perform informed and agile decision making and is considered ideal for capturing quantitative and transactional information (Lahl,2011). Unstructured data comprises data that is in the form of word documents, PDF files, e-mail messages, SMS text messages, media files, customer service surveys, transcribed comments recorded by call centers, web pages, text comments and presentations and also includes images, audio and video streams contracts (Lahl,2011;Yaakub et,al.,2011;Sukumaran & Sureka,2006).

2.3. Opinion Mining

According to Binali,et al.(2009),***"Opinion mining can be defined as the a sub discipline of computational linguistics that is concerned with the opinion that a document expresses. Sentiment classification is about determining the subjectivity, polarity (positive/negative) and polarity strength (weakly positive, mildly positive or strong positive) of an opinion text."*** (Binali,et al., 2009,p.).

Opinion mining and polarity mining has also been explained by Zhou&Chaovalit,(2007) and according to them, opinion mining is the extraction and separation of opinions that are expressed in text reviews of different products that includes automobiles, banks, movies, travel destinations, electronics and mobile devices. The task of determining positive and negative orientations of the information present in textual form is termed as polarity mining which is considered as a fundamental issue in opinion mining(Zhou&Chaovalit,2007).For detecting sentiments or opinion, reviews in the form of star ratings are a popular source . The reviews are labeled in the form of star ratings by the reviewer and are available in large

quantities (Zhou&Chaovalit,2007) . Analyzing customer´s behavior is not an easy task and for this purpose customer relationship management CRM can be used specially to handle structured data in a database. But it is very difficult to integrate customer's feedback and comments into the CRM system because they are mostly in textual form i.e. unstructured form (Yaakub et,at.,2011). Zhou&Chaovalit (2007)have proposed ontology supported polarity mining. With domain specific information, opinion/polarity mining can be enhanced by using ontology. They further state that ontology has an intense effect on broad range of enterprise systems and information management systems. The reason behind this effect is that semantic description behaviors and services based on ontology results in better coordination of software agents in a multi agent system. According to Desdpsnde and Sarkar(2010),once an entity of interest has been identified for example a camera, a structured sentiments can be extracted which is in the form (model, name , score) where score is the polarity that can be negative or positive value of the sentiment in the sentence. More dimensions can also be found in the sentence like resolution and price.

According to Eirinaki et.al.,(2011) opinion mining has been performed in various ways. In some works a semantic orientation of a review has been identified overall. In some other works opinion words are identified and extracted in order to determine the semantic orientation. The second category of work has further been divided into two sub categories. One type of work focus on the identification of opinion word and semantic orientation whereas the other one use features as tools for the representation of semantic orientation.

Research related to opinion mining has been done in the past that include subjective genre classification, sentiment classification, text summarization and terminology finding .*Genre classification* classifies text into different groups(Hu & Liu,2004) and some techniques used in it have the ability to detect those documents that express opinions (Karlgren & Cutting,94;Kessler et,al.,97).But they were unable to detect the semantic orientation (whether the opinion expressed in the document is positive or negative) of the opinions(Hu & Liu,2004). Hatzivassiloglou and Wiebe(2000) concluded that the presence and type of adjectives are the reason behind a sentence being subjective or objective. Hu & Liu,(2004) indicated that in spite of detecting the subjectivity of a sentence, Hatzivassiloglou and Wiebe were unable to determine the semantic orientation of the detected sentence. Also their work did not identify the features for which opinions have been expressed. Tong (2001)extracted sentiments from online discussions about movies by tracking and displaying the number of positive and negative messages by using a timeline. He identified author´s sentiments by using specific phrases like "Great acting", "uneven editing". This sentiment phrase was manually added to the lexicon and was also manually tagged with positive or negative labels. The lexicon was domain dependant (in this case for movies) and for any other domain it was required to build the lexicon again. According to Meersman(1999), a lexicon is a language specific ontology for example: English, Polish etc.

Zhou&Chaovalit (2007) have discussed two main categories of polarity mining techniques, first approach is called supervised approach in which basically a classifier is being trained by using the feature values of training data which is then evaluated by providing the test data in order to fine tune its performance. Feature selection is very important in this process of

polarity mining. Some linguistic feature that are used to describe text which includes bag-of-words, n grams, word position, header information and ordered word list. Also features based on substitution and proximity, frequent, non contextual words and parsimonious vocabulary are the other features that are considered in polarity mining. Star or scale based ratings with opinions present in reviews that are published on Web sites like Cnet.com and Amazon are an ideal training set for supervised techniques. Famous supervised machine learning techniques include Support Vector Machines, Naïve Bayes, maximum entropy classifier, AdaBoost, Markov Blanket classifier, voted perception, and maximum entropy conditional random field learner. The second approach unsupervised approach does not require explicit training process but the process has three steps. First words or phrases that express semantic orientations are extracted from the text and then their polarities are determined. In the last step the polarities of individual words or phrases in the text are aggregated. Turney (2002)used an unsupervised learning technique and used information present into the phrases of the documents by using the words "excellent" and "poor". According to Zhou&Chaovalit (2007), the unsupervised approach is considered rich in knowledge because it relies on external knowledge resources that are beyond raw data. Semantic orientation and linguistic heuristics are the two types of external knowledge that support unsupervised polarity mining. Both techniques have their strength and weaknesses as supervised models requires training and their performance depends on the quality and size of data that has been provided for training thus is time consuming. Whereas unsupervised techniques are considered efficient as they require little training but their performance is lower than supervised technique in polarity mining.

Several movie reviews were examined by Pang et,al.(2002) by using supervised learning methods and they concluded that unsupervised learning techniques outperformed supervised learning techniques and none of the existing methods at that time were able to handle the sentiment classification with accuracy. DeJong (1982) and Tait (1983), have classified template instantiation and passage extraction as the two categories that are related to text summarization. Spark(1993),has emphasized the extraction and identification of facts and entities that are present in a document. This approach was domain dependent and background knowledge was required to instantiate a template in order to extract details from it. Paice(1990) and Salton et.al (1996) both have discussed the passage extraction framework which has identified certain sentences from the text that represents most content of the document. Hu & Liu,2004 have discussed symbolic approaches and statistical approaches that are techniques related to terminology finding. Symbolic approaches rely on noun phrases i.e. syntactic description of terms whereas statistical terms uses words that form terms that are reoccurring and are close to one another.

2.4. Ontology

Ontology has been defined as the specialization of the conceptualization by Gruber(1993).The main aim of ontology is to provide knowledge about specific domains that are understandable by both the computers and developers. It also helps to interpret a text review at a finger granularity with shared meanings and provides a sound semantic ground of machine-

understandable description of digital content. The documents having metadata are annotated by using ontology. Ontology improves the process of information retrieval and reasoning thus results in making data interoperable between different applications (Zhou&Chaovalit, 2007) According to Meersman(2005), most of the ontologies in the community of information systems are known as data models that are mainly used for structuring a fairly narrow application domain. He claimed that " ontologies " that includes lexicons and thesauri may be a useful first step in providing and formalizing the semantics of information representation.According to Meersman (2005), in near future these ontologies will act as a semantic domain for the information systems and will be very useful.He also predicted with authenticity that:

" It is unmistakable that with the advent of e-commerce, and the resulting natural language context of its related activities, that ontologies, lexicons and the thesauri and research in their use for system design and interpretation will receive a major market driven push" (Meersman,2005,p.02)

According to Meersman, (2005), a lexicon is defined as a language-specific ontology, for e.g English, Polish. Whereas thesaurus is defined as either a domain-specific ontology or an application(s) specific ontology. Manufacturing, Laptop-manufacturing, Naïve physics, corporate law, Ontology theory are examples of domain specific ontology whereas Inventory Control, Airline Reservations, Conference Organization are examples of application(s) specific ontology. Domain specific ontology and application(s) specific ontology can be distinguished intuitively as the differences between the two types are not distinct. There is difference between ontologies and conceptual schemas but both are intimately related and are used to represent commonly perceived reality. Mathematically, ontology is the domain while the relational schema is the range of the semantic interpretation mapping. Both can be seen as a representation of a commonly perceived reality and intimately related.

2.5. Approaches for Opinion mining

Binali,et al.(2009) have explained the process of opinion mining by using a framework which has been logically derived by analyzing critically the existing research in opinion mining. Figure 2 represents the process of opinion mining. The first step in opinion mining is *item extraction*. Item extraction is to know about that item for which an opinion can be extracted e.g. Camera, Mobile, MP3 player etc. It provides a general opinion about the item whether it is good or bad. A negative opinion about any product does not mean that every aspect of the product has been disliked. It is also important to provide a justification to the reason about the feature that make a thing good or bad. The second step, feature extraction is important which helps in providing a sound ground to the subjective opinion.

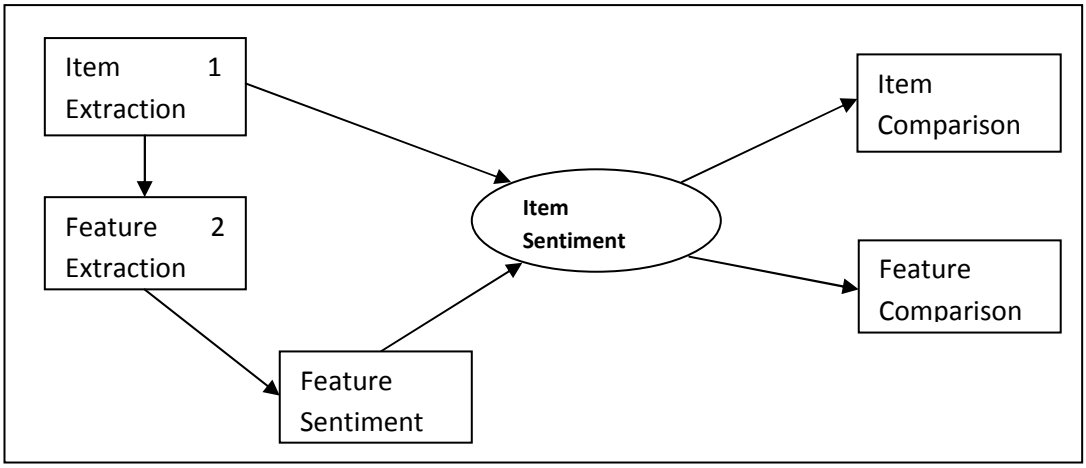


Figure.2:Adopted from Binali,et al.(2009.p 02)

Feature represents both components and attributes of a product. After features have been extracted, feature sentiment is identified which depicts the weaker and finer points of an item's feature. For example long battery, beautiful colors, excellent cast, poor actors. After these three steps the result is the overall sentiment for that item that has been expressed for that object for example buy/don´t buy, recommended/not recommended, excellent film/boring film. Item comparison provides a finer granularity of an opinion between two entities. It helps shoppers save a lot of time and helps in making decision. It informs a consumer, which entity has more positive reviews than other by comparing entity A VS entity B. Feature comparison provides a comparison of features of an entity with another. For example camera A has a better video quality and longer battery life than camera B.

Yaakub et, al.(2011) have also proposed an architecture that uses a multidimensional model to integrate customer's characteristics and their comments about products. This approach first identifies the entities and then sentiments present in the customers reviews are transformed into an attribute table by using a 7 point polarity system (-3 to 3). Where -3 represents poor, -2 represent reject, -1 represent weak reject, 0 represent neutral opinion, +3 represent excellent, +2 represent distinguish, +1 represent accept. A model is then produced on the basis of customer's comments for an entity and its features. The related data is then integrated into the data warehouse by using dimensions i.e. product dimension, customer dimension, time dimension and opinion dimension for example, the product dimension table includes product name, category, sub category and department.

Customer ID	Product ID	Time	Opinion

Table 1 *Data Structure*

The extracted opinions from the reviews in the form of their strength of polarities are included in the opinion table. The opinion polarity (ogc) is calculated by using a formula. This database can be used to create many data cubes which will be helpful in analyzing opinions of certain group of customers for any product. (Yaakub et, al., 2011).

$$\text{where } ogc(g, c) = \sum_{z=-3}^{3} (z * polarity(c, g, z))$$

Figure 3 represents the ontology proposed by Yaakub et,al.(2011), which is still in developing process. The authors have shown their desire that it needs to be further developed by conducting experiments on large group of products. One limitation of this research is that they have used very short customer comments for the manual extraction of sentiments for example, *"This mobile phone is very good"* and *"Camera and video quality need to improve"*. Usually reviews about products that are available on websites like www.amazon.com and www.e-bay.com are not that short and simple. Most of the reviews are long and contain opinions of customers about several features of the product.

Also, the ontology proposed by Yaakub et, al.(2011) covers features and its characteristics of mobile phone in general and in other technical terms. The reason is that customers usually write comments by using product features, for example: The battery life is short, screen colors are bright, phone has FM radio, and accessories are very bad. People buy mobiles according to their ease of use and according to the conditions they will be exposing the mobile. For example some elderly people are not technologically savvy and just want a simple phone. Many people work in extreme conditions like in coal mines, underground, construction and in places where normal mobiles will not last long. Some people wants to have the latest technology in their pocket and they prefer smart phones. So there is a need to specialize the ontology for different types of mobiles.

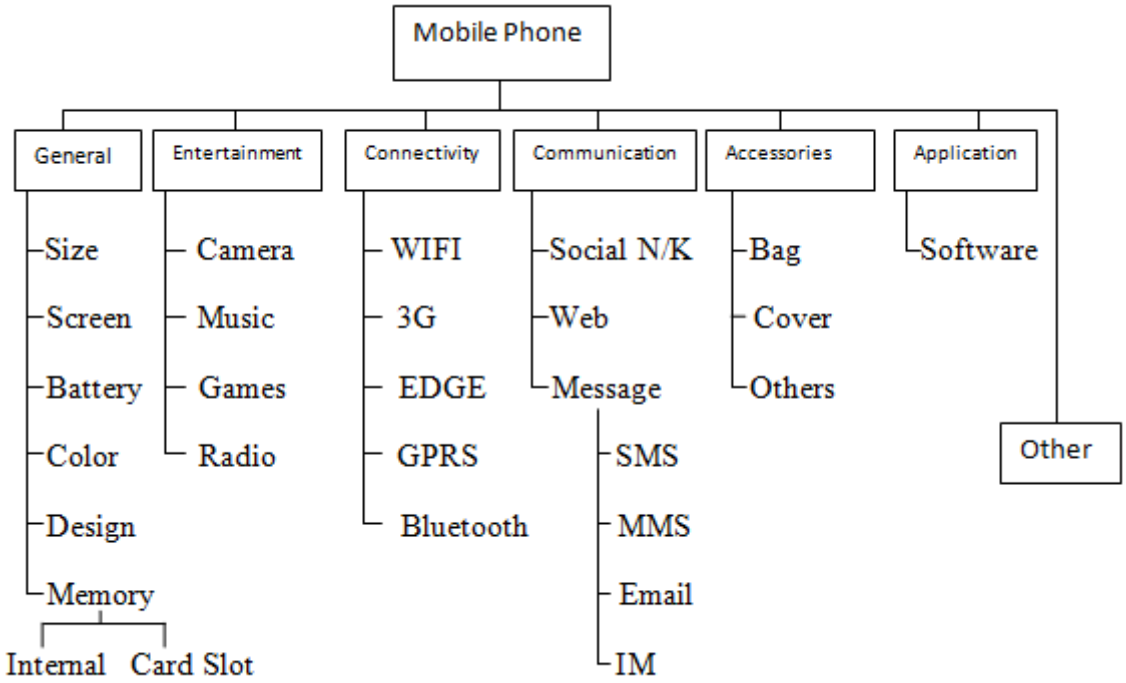


Figure.3 Proposed Ontology by Yaakub et,al.(2011,p.93)

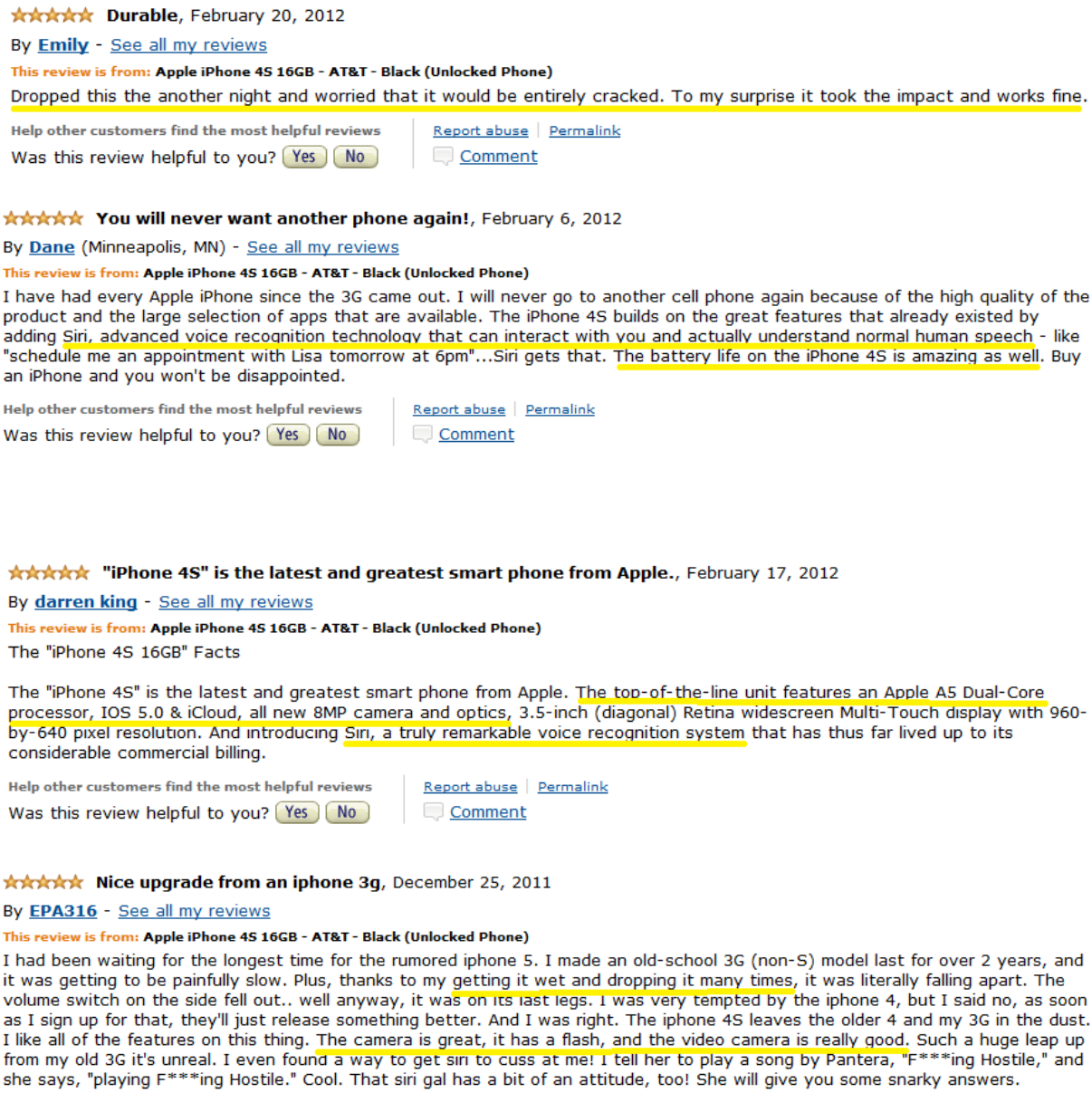
In order to evaluate the ontology proposed by Yaakub et,al.(2011), a pre study was conducted and reviews related to three types of mobile phones: smart mobile phones, simple mobile phones and wet and dirty mobile phones were chosen. The proposed ontology by Yaakub et,al.(2011) was evaluated after extracting features from the reviews for which a sentiment or opinion has been expressed by the reviewer. For instance after evaluating the proposed ontology by Yaakub et,al.(2011) by extracting the features of a smart phone "*iphone 4S 16 GB"*, it proved to be very much limited and needs to be further extended.

For example: The reviewers have discussed how durable the phone is? Is the phone water proof? Is the screen scratch proof? The durability factor was found important for the customer of the product and needs to be added into the ontology.

Since the camera is an important feature of a mobile phone, the customers were curious about the mega pixel count and the video capabilities of this feature. Also some mobile companies offer Image stabilization and flash feature and some cameras do not have these features. The feature "camera" which is a sub category of entertainment in the proposed ontology by Yaakub et,al.(2011) needs to be separated as an individual part of ontology.

Recent smart phones are now equipped with single and dual core processor technology and it is considered a very important feature that is missing from the proposed ontology by Yaakub et,al.(2011).In addition to that a new "voice recognition" attribute by the name of "Siri" has been introduced by iphone 4S that needs to be a part of the extended ontology.

Sample Reviews:



★★★★★ **Durable**, February 20, 2012

By **Emily** - See all my reviews

This review is from: **Apple iPhone 4S 16GB - AT&T - Black (Unlocked Phone)**

Dropped this the another night and worried that it would be entirely cracked. To my surprise it took the impact and works fine.

Help other customers find the most helpful reviews

Was this review helpful to you? Yes No

Report abuse | Permalink

Comment

★★★★★ **You will never want another phone again!**, February 6, 2012

By **Dane** (Minneapolis, MN) - See all my reviews

This review is from: **Apple iPhone 4S 16GB - AT&T - Black (Unlocked Phone)**

I have had every Apple iPhone since the 3G came out. I will never go to another cell phone again because of the high quality of the product and the large selection of apps that are available. The iPhone 4S builds on the great features that already existed by adding Siri, advanced voice recognition technology that can interact with you and actually understand normal human speech - like "schedule me an appointment with Lisa tomorrow at 6pm"...Siri gets that. The battery life on the iPhone 4S is amazing as well. Buy an iPhone and you won't be disappointed.

Help other customers find the most helpful reviews

Was this review helpful to you? Yes No

Report abuse | Permalink

Comment

★★★★★ **"iPhone 4S" is the latest and greatest smart phone from Apple.**, February 17, 2012

By **darren king** - See all my reviews

This review is from: **Apple iPhone 4S 16GB - AT&T - Black (Unlocked Phone)**

The "iPhone 4S 16GB" Facts

The "iPhone 4S" is the latest and greatest smart phone from Apple. The top-of-the-line unit features an Apple A5 Dual-Core processor, IOS 5.0 & iCloud, all new 8MP camera and optics, 3.5-inch (diagonal) Retina widescreen Multi-Touch display with 960-by-640 pixel resolution. And introducing Siri, a truly remarkable voice recognition system that has thus far lived up to its considerable commercial billing.

Help other customers find the most helpful reviews

Was this review helpful to you? Yes No

Report abuse | Permalink

Comment

★★★★★ **Nice upgrade from an iphone 3g**, December 25, 2011

By **EPA316** - See all my reviews

This review is from: **Apple iPhone 4S 16GB - AT&T - Black (Unlocked Phone)**

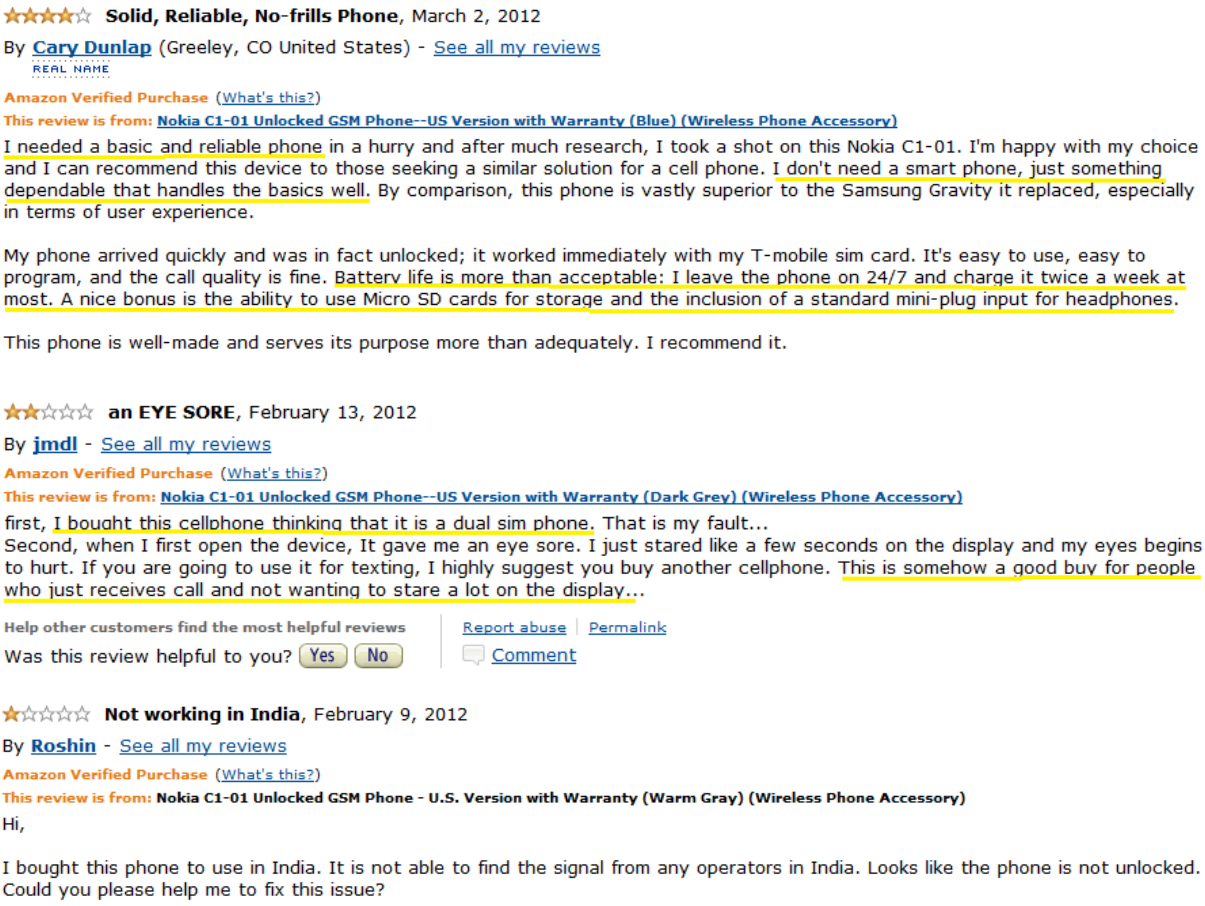
I had been waiting for the longest time for the rumored iphone 5. I made an old-school 3G (non-S) model last for over 2 years, and it was getting to be painfully slow. Plus, thanks to my getting it wet and dropping it many times, it was literally falling apart. The volume switch on the side fell out.. well anyway, it was on its last legs. I was very tempted by the iphone 4, but I said no, as soon as I sign up for that, they'll just release something better. And I was right. The iphone 4S leaves the older 4 and my 3G in the dust. I like all of the features on this thing. The camera is great, it has a flash, and the video camera is really good. Such a huge leap up from my old 3G it's unreal. I even found a way to get siri to cuss at me! I tell her to play a song by Pantera, "F***ing Hostile," and she says, "playing F***ing Hostile." Cool. That siri gal has a bit of an attitude, too! She will give you some snarky answers.

There were a blend of reviews that were written by persons of different ages, who are technologically savvy and also those who were not. The reviews written by the non technologically savvy people were simply expressing whether the product is good or bad. They were not explaining in their comments what features or attributes of a product makes that entity good or bad. Most of the people who have recently switched from a simple mobile phone to smart phone seemed to be praising the long lasting battery of their simple phones. They did not consider that the latest applications and communication softwares that are now installed in the smart phones consumes a lot of battery power.

Further we evaluated the proposed ontology by Yaakub et,al.(2011) for simple mobile phones. After evaluating the ontology proposed by Yaakub et,al.(2011) by using our chosen

mobile model i.e.Nokia C1 -01, the ontology accommodated most of the features of our chosen simple mobile phone and needs to be specialized for this simple phone category with minor alterations. The durability attribute is missing in the ontology that has been proposed by the Yaakub et,al.(2011). A very important feature of a mobile phone having dual sim slots needs to be added. Now a days people use more than one operator services and try to enjoy the various cheap offers by the different operators. Another reason behind this is that it is cheaper to call to same operator and is expensive if you call to a different operator. It was also noted that the buyers/reviews were also found complaining that they were unable to use the phone in Costa Rica or outside USA. They did not check the band feature of the mobile and its compatibility with their home country service provider. Feature that show either the phone is dual band or quad band needs to be added.

Sample Reviews:



★★★★☆ **Solid, Reliable, No-frills Phone**, March 2, 2012

By **Cary Dunlap** (Greeley, CO United States) - See all my reviews
REAL NAME

Amazon Verified Purchase (What's this?)

This review is from: **Nokia C1-01 Unlocked GSM Phone--US Version with Warranty (Blue) (Wireless Phone Accessory)**

I needed a basic and reliable phone in a hurry and after much research, I took a shot on this Nokia C1-01. I'm happy with my choice and I can recommend this device to those seeking a similar solution for a cell phone. I don't need a smart phone, just something dependable that handles the basics well. By comparison, this phone is vastly superior to the Samsung Gravity it replaced, especially in terms of user experience.

My phone arrived quickly and was in fact unlocked; it worked immediately with my T-mobile sim card. It's easy to use, easy to program, and the call quality is fine. Battery life is more than acceptable: I leave the phone on 24/7 and charge it twice a week at most. A nice bonus is the ability to use Micro SD cards for storage and the inclusion of a standard mini-plug input for headphones.

This phone is well-made and serves its purpose more than adequately. I recommend it.

★★☆☆☆ **an EYE SORE**, February 13, 2012

By **jmdl** - See all my reviews

Amazon Verified Purchase (What's this?)

This review is from: **Nokia C1-01 Unlocked GSM Phone--US Version with Warranty (Dark Grey) (Wireless Phone Accessory)**

first, I bought this cellphone thinking that it is a dual sim phone. That is my fault...
Second, when I first open the device, It gave me an eye sore. I just stared like a few seconds on the display and my eyes begins to hurt. If you are going to use it for texting, I highly suggest you buy another cellphone. This is somehow a good buy for people who just receives call and not wanting to stare a lot on the display...

Help other customers find the most helpful reviews

Was this review helpful to you? Yes No

Report abuse | Permalink

Comment

★☆☆☆☆ **Not working in India**, February 9, 2012

By **Roshin** - See all my reviews

Amazon Verified Purchase (What's this?)

This review is from: **Nokia C1-01 Unlocked GSM Phone - U.S. Version with Warranty (Warm Gray) (Wireless Phone Accessory)**

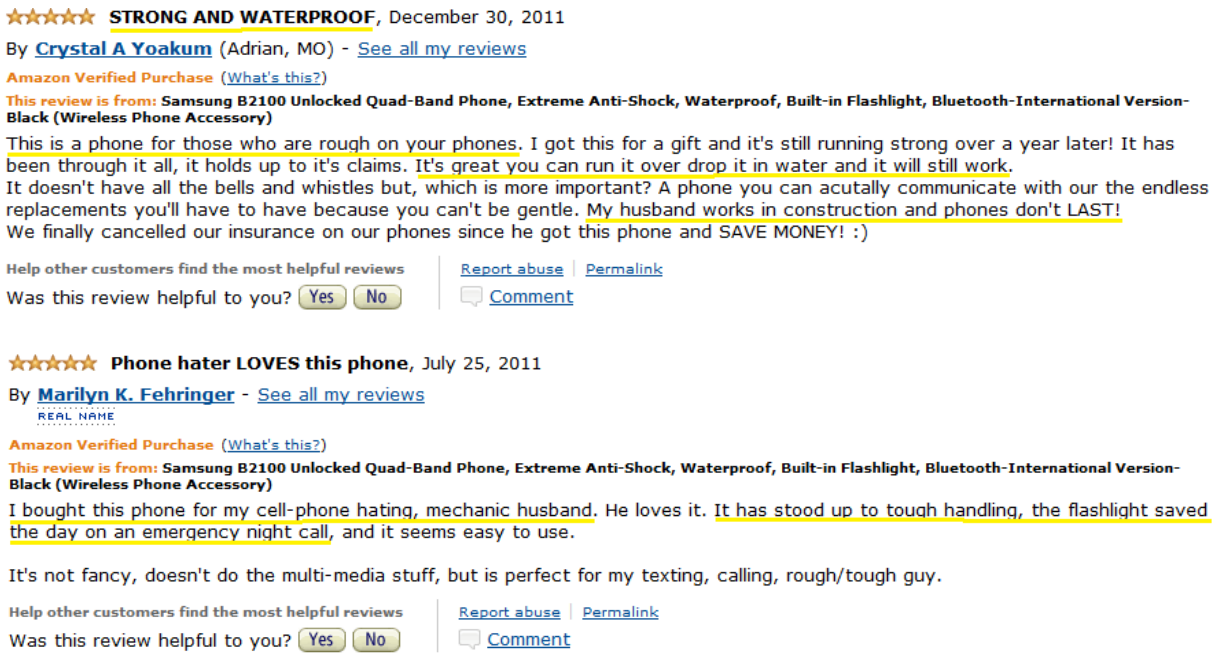
Hi,

I bought this phone to use in India. It is not able to find the signal from any operators in India. Looks like the phone is not unlocked. Could you please help me to fix this issue?

At last we evaluated the proposed ontology by Yaakub et,al.(2011) for the third category of mobile phones i.e.for wet and dirty mobile phone. After evaluating the ontology proposed by Yaakub et,al.(2011) by using mobile phone model i.e. Samsung B 2100 Quad-band, it was found that the proposed ontology covered most of the aspects related to the wet and dirty

mobile category . The durability attribute along with flash light needs to be added in to the specialized ontology.

Sample Reviews:



★★★★★ **STRONG AND WATERPROOF**, December 30, 2011

By **Crystal A Yoakum** (Adrian, MO) - See all my reviews

Amazon Verified Purchase (What's this?)

This review is from: **Samsung B2100 Unlocked Quad-Band Phone, Extreme Anti-Shock, Waterproof, Built-in Flashlight, Bluetooth-International Version-Black (Wireless Phone Accessory)**

This is a phone for those who are rough on your phones. I got this for a gift and it's still running strong over a year later! It has been through it all, it holds up to it's claims. It's great you can run it over drop it in water and it will still work.
It doesn't have all the bells and whistles but, which is more important? A phone you can acutally communicate with our the endless replacements you'll have to have because you can't be gentle. My husband works in construction and phones don't LAST!
We finally cancelled our insurance on our phones since he got this phone and SAVE MONEY! :)

Help other customers find the most helpful reviews

Was this review helpful to you? Yes No

Report abuse | Permalink

Comment

★★★★★ **Phone hater LOVES this phone**, July 25, 2011

By **Marilyn K. Fehringer** - See all my reviews

REAL NAME

Amazon Verified Purchase (What's this?)

This review is from: **Samsung B2100 Unlocked Quad-Band Phone, Extreme Anti-Shock, Waterproof, Built-in Flashlight, Bluetooth-International Version-Black (Wireless Phone Accessory)**

I bought this phone for my cell-phone hating, mechanic husband. He loves it. It has stood up to tough handling, the flashlight saved the day on an emergency night call, and it seems easy to use.

It's not fancy, doesn't do the multi-media stuff, but is perfect for my texting, calling, rough/tough guy.

Help other customers find the most helpful reviews

Was this review helpful to you? Yes No

Report abuse | Permalink

Comment

3.Research method

Since the initial examination of the problem and its proposed solution includes thorough examination and evaluation of reviews and opinions/sentiments that have been expressed by the reviewers in the reviews. A pre study was conducted on reviews related to different types of mobile phones that were available on website www.amazon.com. To carry out the proposed research, case study was the chosen method that was validating our research as well as was reliable enough for our requirements for developing the new refined ontologies.

In order to achieve our first objective we chose reviews from the website www.amazon.com that were related to three different models of smart mobile phones, two different models of simple mobile phones and two different models of wet and dirty mobile phones. 25-30 latest reviews for each model of mobile phone were selected. The reason behind choosing reviews from the website www.amazon.com was that it is world's largest online retailer and multinational electronic commerce company.(http://en.wikipedia.org/wiki/Amazon.com)

Since some mobile phones were very much popular among people for example "iphone 4GS", there were enormous number of reviews written about them. Some mobiles are not that popular among people for example "Nokia 1661," and there were less reviews available (25 reviews at the time of review selection). So we decided to choose 25-30 latest reviews. Mobile phone features and their attributes and components were extracted manually and ontologies were created.

The three chosen smart mobile phone sets were:

1.Samsung Galaxy SII G-19100 *X 29 Reviews*

2.Sprint HTC Evo 4G *X 30 Reviews*

3.Nokia N8 X 30 Reviews

The two chosen simple mobile phone sets were:

1.Nokia 1661 X 25 Reviews

2.Samsung A 107 X 30 Reviews

The two chosen wet and dirty mobile phone sets were:

1.Casio G´zOne *X 29 Reviews*

2.Motorola Tundra *X 30 Reviews*

For second objective, the refined ontologies were thoroughly evaluated and verified by using the reviews that are present on website www.ebay.com. Same models of mobiles were chosen for analysis that were selected in first objective.

The reason for choosing the website www.ebay.com for the verification of the refined ontologies was that it is also an online auction and shopping website where people buy and sell products worldwide. (http://en.wikipedia.org/wiki/Ebay)

To accomplish the third and last objective sentiment analysis was conducted. First, opinion polarities were calculated by using one of the refined versions of mobile ontology and then by using the ontology that has been proposed by Yaakub et,al. (2011) and then results were compared. Opinion polarities were calculated by using the formula:

$$\text{where } \operatorname{ogc}(g, c) = \sum_{z=-3}^{3} (z * polarity(c, g, z))$$

4.Investigation and Analysis

4.1.Investigation:

4.1.1. To refine the ontology proposed by Yaakub et,al. (2011) for different types of mobile phones i.e. simple mobile phone, wet and dirty mobile phone and smart mobile phone

In order to accomplish the first objective, three models of smart mobile phones, two models of simple mobile phones and two models of wet and dirty mobile phones were selected. For each model of mobile phone 29-30 latest reviews were selected and an ontology was created after extracting the features. Since mobile phone buyer's interest varies according to their use and requirement some people are not concerned whether the mobile has all the advanced features and means of connectivity like blue tooth. They just want a mobile phone which they can use for making calls and receiving calls and for simple texting. Also some people want to buy mobile according to the working environment they will be exposing it. Some people want to have the latest technology in their pocket.

So first a refined ontology for smart mobile phone was developed. All features and attributes related to smart mobile phone were extracted manually.

The three chosen smart mobile phone sets were:

1.Nokia N8 X 30 Reviews

2.Sprint HTC Evo 4G *X 30 Reviews*

3.Samsung Galaxy SII G-19100 *X 29 Reviews*

1.Nokia N8 X 30 Reviews

Below are the features that have been extracted from the reviews of smart mobile phone model Nokia N8.

Link to the selected mobile model reviews:

http://www.amazon.com/Nokia-Touchscreen-Featuring-Navigation-Camera-U-S/product-reviews/B003ZX7RL4/ref=cm_cr_pr_btm_link_2?ie=UTF8&pageNumber=2&showViewpoints=0&sortBy=bySubmissionDateDescending

1.By Lyndon, April 17, 2012

{phone}

2.By Charles Z.Kalko April 13, 2012

{built,like tank}{camera,amazing}{phone,best}{signal strength}{voice quality,great}

{volume,great}{navigation application,better}{phone}{keypad,not smooth}{opera}

{social networking}

3.By Harry April 13, 2012

{phone,like}{camera,like}, {antenna,like},{battery life,like}{antenna,best}

{3G, 2G}

4.By **Denis** April 12, 2012

{Phone,love}{phone,sturdy}{charge hold,well}{messaging or email}

{voice commands,good}{memory,internal 16GB:external,32GB micro SD} {screen} {radio,well}{music}{radio}{blue tooth,excellent}{body,sleek}{opera mini browser}{WiFi}{symbian OS}

5.By Glen A.Ritter April 10, 2012

{WiFi}{camera,awesome}{GPS}{quick,office}{32 Gb micro SDHC} {facebook,email,web}

6.Marcos Almeida March 30, 2012

{battery life,amazing} {Navigation} {Media Playback} {texting}, {email} {phone calls,great choice}{micro sd }{FM radio}

7.Simon 403 March 28, 2012

{device,crap}{battery,nightmare}{web browsing,dissaster}{operationg system,buggy}

8.By Telemom March 22, 2012

{touchscreen}{GPS with Voice navigation}{12mp camera}

9.Carlos Maldonado March 22, 2012

{lagauage other than English}

10.By santisoft March 22, 2012

{phone,excellent}{camera,awesome}{HD video}{Fast Belle OS}

11.By Williams March 21, 2012

Language used other than English

12.By Isha rose March 20, 2012

{phone,sucks}

13.By marina March 19, 2012

{camera}

14.By Tomas March 18, 2012

{camera,great}{display,great}{mail & internet}{3G}

15.By Pelo March 18, 2012

{micro SD card slot}{Fm radio}{music player}{OS}

16.By Maged March 16, 2012

{features,great}{weight,light}{processor,good}{camera}{touch}

17.By Alberthino March 16, 2012

Language used other than English

18.By Sylvia March 16, 2012

{phone,love}

19.By Tim March 15, 2012

{software}

20.By Richard March 13, 2012

{item,problems}

21.By M.Shaikh March 13, 2012

{12 MP camera}{text messages}{GPS with voice navigation}{battery,lasts longer}

{talk time,3 hours}{software updates,Belle}

22.By Dre March 11, 2012

{features,love}

23.By Rr.jay March 10, 2012

{12MP Camera}{Facebook & Twitter}{symbian OS}

24.By G.Tian March 09, 2012

{accessories,zip log bag}{battery}

25.By Viv Le March 09, 2012

{head set,did´t work}

26.By N.Hussain March 07, 2012

{software updates} {phone,excellent} {camera,too good} {voice,clear}{speaker volume,good}

27.By Raghunath Sarvepalli March 07, 2012

{call quality,very poor}{reception,not good}{battry life,good}{phone build,good}

28.By Willy T March 06, 2012

{camera,freezes}{belle software}

29.By Rahi March 05, 2012

{great camera}{touch screen}{3G}{WiFi}

30.By Igor March 04, 2012

Language Used Other than English

2.Sprint HTC Evo 4G *X 30 Reviews*

Below are the features that have been extracted from the reviews of smart mobile phone model Sprint HTC Evo 4G.

Link to the selected mobile model reviews:

http://www.amazon.com/HTC-Android-Cell-Phone-Sprint/product-reviews/B004KFXTOA/ref=cm_cr_pr_btm_link_next_4?ie=UTF8&pageNumber=4&showViewpoints=0

1.By James Jacobs March 2, 2012

{processor}{screen & display, amazing}{3G}{WiFi}{battery}{SD card}{Tough case in Black}{keyboard,large}{speaker,loud}{camera,great}

2.By Rosey February 24,2012

{HTC EVO, doesn´t work}

3.By Bobby February 20,2012

{battery}{screen brightness}{applications}

4.By Alyssa February 15,2012

{phone,love}

5.By Diane February 15,2012

{charger}

6.By Sabrinavee February 14,2012

{charger,not working}{battery,dislike}{phone,good}

7.By David G Sillman February 09,2012

{touch screen, not working}{camera, not working} {batteries}

8.By Andrzej Wierzbicki February 09,2012

{SD card}{fast processor}{WiFi ,great}{audio,better}{touch screen,bright}{battery life,terrible}{5GB internal memory}

9.By Benjamin K.Lee February 05,2012

{4.5 inch screen}{voice calls,clear}{speaker phone,good}{Bluetooh,excellent}{battery life, not the best}{camera, not the best}{phone memory,not best}{SD card}

10.By Soheil Abdollahi February 04,2012

{vibrator,lose}{touch screen,bad}{Donot buy}

11.By B.Goldstein January 28,2012

{Android,Os}{camera}{phone camera ,crashes}{speech recognition/voice search}

12.By dawn January 28,2012

{dual camera}{durable}

13.By GW MS January 28,2012

{phone}

14.The rob January 22,2012

{phone,like}

15.By DTSimmons

{motherboard, needs replacement} (this feature is not considered in the ontology)

16.By Allison R.Sjoblom January 16,2012

{camera,better}{4G}{email}{phone,great}{camera,problems}{battery}

17.By Stephanie Marie Kelly January 12,2012

{phone,good}{battery,bad}

18.By Ashlee January 08,2012

{phone,great}

19.By Liloirendil January 08,2012

{phone,worked well}

20.By FT January 04,2012

{voice feature}{3G,4G}{camera}

21.By Purplesnow December 31,2011

{charger}{battery}{screen}{phone}

22.By Anne December 30,2011

{phone,cool}

23.By RyuuHime December 29,2011

{phone}

24.By Joseline December 27,2011

{phone}{camer,didn´t work}

25.By OregonBay December 25,2011

{hardware,top notch}{sotware}{battery}{Android}{speaker}{bluetooth}{voice clarity}

26.By James Lee December 18,2011

{phone,amazing}

27.By Bruce Rucker December 08,2011

{phone}

28.By JR December 01,2011

{phone}{4G}

29.By kharbout Novemebr 28,2011

{phone,good}{battery}

30.By CME Novemebr 28,2011

{phone,good}{screen,cracks easily}

3.Samsung Galaxy SII G-19100 ***X 29 Reviews***

Below are the features that have been extracted from the reviews of smart mobile phone model Samsung Galaxy SII G-19100.

Link to the selected mobile model reviews:

http://www.amazon.com/Samsung-i9100G-Unlocked-Smartphone-Touchscreen/product-reviews/B004QTBQ2C/ref=cm_cr_pr_btm_link_next_2?ie=UTF8&pageNumber=2&showViewpoints=0&sortBy=bySubmissionDateDescending

1.By Arcangel March 2, 2012

{phone,excellent}{earphones}{screen colours,amazing}{dual core processor}{battery life,good}{battery,good}{voice recognition}{bluetooth}

2.By Irene March 1, 2012

{phone,best}{screen,vivid}{32GBSD card }{Android}{battery,life,good}{screen,large }

{8MP camera with HD videos}

3.By earagon March 1, 2012

Language used other than English

4.By Martin February 25,2012

{phone,love}{use,easy}

5.By D,carpenay February 24,2012

{Android phone}{memory slot}{battery}

6.By Anderson February 23,2012

Language used other than English

7.By Marcelo Susevich February 18,2012

{product,doesn´t On}

8.By Juan Munoz February 14,2012

Language other than English used

9.By Niro February 08,2012

{mobile}

10. By AS February 04,2012

{battery lasts 3 hours}{charger & phone,heats up}{screen}{music}{GPS}

{32 GB memory}{quick office}

11.By D.Soto February 03,2012

{phone, best}{resolution, good}{connectivity, good}

12.By Gabrielorg February 03,2012

{android}

13.By bernardo Tessarollo

{phone,great}

14.By DT January 25,2012

{phone}{applications,excellent}

15.By Jose January 23,2012

{Android device}{phone,best}{screen ,amazing}{camera,nice}{call quality,good}

16.By Brent Huffman January 22,2012

{phone,awesome}{SD card slot}{voice recognition,works well}{facebook}{pictures & video}{battery}

17.By Djacobus January 17,2012

{screen}{software}{android software}

18.By S.Lir January 15,2012

{battery}{connectivity}{SD card slot}

19.By Wael Salman January 14,2012

{phone}{battery}{camera}

20.By Joseph Polard January 14,2012

{US adapter}{GPS}{WiFi}

21.By Thereviewguy January 14,2012

{android}{sim card}{battery life,not amazing}

22.By DO January 02 ,2012

{phone}{screen,perfect}

23.By MC January 01,2012

Language other than English used

24.By carlos Ospina January 01,2012

{phone,amazing}{GPS}{screen,amazing}

25.By Johanlopez December 31,2011

{screen,responsive}{weight of phone, imperceptible}{battery duration 6 hours}{camera,priceless}{Android}

26.J:Wang December 30,2011

{screen,gorgeous}{Amoled plus screen better than Retina}{dual core CPU}{Touchwizbrowser}

27.By Neudis Cana December 27,2011

Language used other than English

28.By O.Khouri December 27,2011

{phone,bugs}{application that use camera,worst}{email,not working}

29.By Diego December 25,2011

Language other than English use

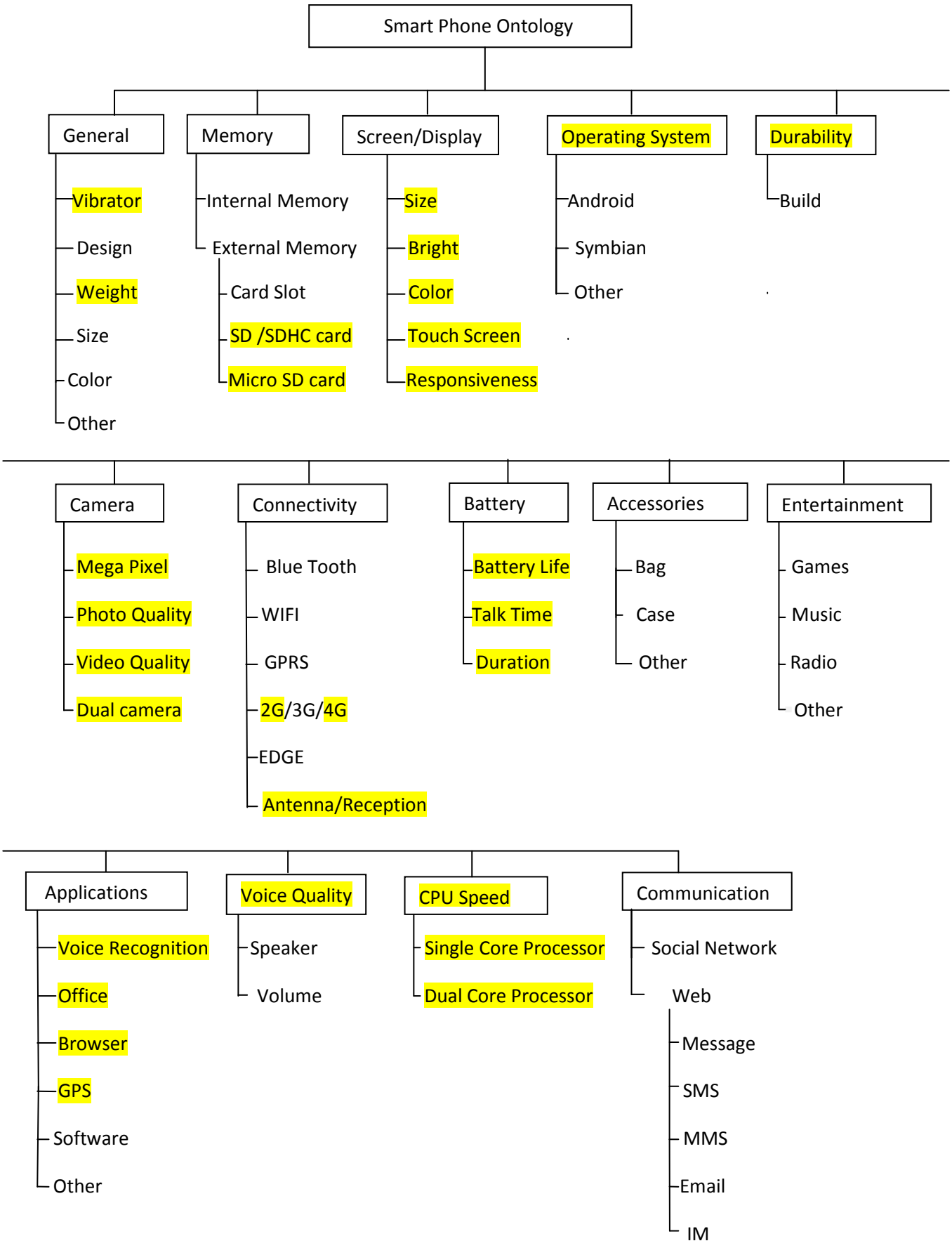


Figure.4 Refined ontology for smart mobile phone (based on Amazon reviews)

Figure 4 represents the refined ontology for the smart mobile phone which has been developed after analyzing the reviews present on website, www.amazon.com. The yellow color in the diagram depicts those features and sub categories of features that have been identified after analyzing the selected reviews. All highlighted features and subcategories of features were missing from the proposed ontology by Yaakub et, al.(2011) and have been added into the newly refined ontology for smart mobile phone.

After developing refined ontology for smart mobile phone, a refined ontology for wet and dirty mobile phone was developed. All features and attributes related to wet and dirty mobile phone were extracted manually.

The two chosen wet and dirty mobile sets were:

1.Casio G´zOne *X 29 Reviews*

2.Motorola Tundra *X 30 Reviews*

1.Casio G´zOne *X 29 Reviews*

Below are the features that have been extracted from the reviews of wet and dirty phone model Casio G´zOne.

Link to the selected mobile model reviews:

Http://www.amazon.com/Casio-GzOne-Phone-Verizon-Wireless/product-reviews/B000LNFZ7E/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

1.By J,April 22,2011

{phone dropped in water,worked great}

2.By Olivia,September 10,2010

{phone,best}{phone dropped,no issues}{storage,enormous}{camera,great}

3.By Ken Allen,July 30,2010

{Phone survived , drops: kicks:water:dust:mud}{built quality,awesome}

4.By Craig Bolon,July 9,2010

{phone,survived}{application}{adapter cable}

5.By Snakepudding,March 20,2009

{hostler,prolem}{antenna}{water proof}{battery}{flash light}

6.By D.Apgar,March14,2009

{dropped from 35´,still works}{been wet, never failed}{in temp -10,phone make calls}

{phone,rugged}

7.By Auabarrel,November 18,2008

{phone durability,like}{buttons}{speaker}

8.By Andrea,November 6,2008

{phone,big}{phone,ugly}{phone designed to be used and abused}

9.By Hideyo,March 6,2008

{phone,shock resistant}{phone,water,resistant}{LED can be used as flash}{screen}

10.By Karibbeankool,November 25,2007

{navigational keys,disappointed} {digital clock}

11.By S.Urban,Novemebr 20,2007

{phone,sturdy}{call quality,great}{menu,easy to navigate}{antenna}{camera,fine}{flash}

12.By B:Whittington,September 3,2007

{phone,waterproof}{speaker}{menu,muddled}

13.By Eagle,September 1,2007

{phone,durable}{headst,weired}{speakerphone,loud}{flash}{display,clear}{texting}{video}

{internet}

14.By Raul felix,August 28,2007

{phone,tough as tank}

15.By D.meyer,August 20,2007

{phone,waterproof}{phone,dust proof} {phone,drop proof}{battery }

16.By Jonathan Hukill,August 18,2007

{phone,excellent }

17.By K.Cabana,August 8,2007

{battery}{great signal}{phone,dropped many times}

18.By Talmage L.larson,July 29,2009

{phone,survived,extreme heat}

19.By Billy,June 28,2007

{2 MP camera,great} {phone,waterproof}{loud speakers}

20.By Emily Bronte,June 23,2007

{screen,big}{buttons,big}

21.By A.Keller,Hune 11,2007

{phone,best}

22.By Corisa M.Colonnello,June 1,2007

{display screen,freezing}{buttons of keypad,not working}

23,By lars Peterson,May 25,2007

{phone,fantastic}

24.By T.Creasman,may 24,2007

{phone,pleased}{phone,heavy}{display,great}{battery}

25.By T.Gabrielli,May 17,2007

{voice,clear&loud}{camera,decent}{voice recognition/dialing,problems}

26.By Jeffery L.Hudson,may 15,2007

{camera,good}

27.By D.Mills,April 28,2007

{2MP camera}{flashlight}{speaker,clear}{battery life,good}

28.By KLMills32,march 3,2007

{LED light}

29.By Ryan McNabb, January 30,2007

{battery}{camera,good}{camera flash}

2.Motorola Tundra *X 30 Reviews*

Below are the features that have been extracted from the reviews of wet and dirty phone model Motorola Tundra.

Link to the selected mobile model reviews:

http://www.amazon.com/Motorola-Tundra-Phone-Black-AT/product-reviews/B001PKTPBY/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

1.By JimBob911,January 11,2012

{reception,poor}

2.By Book Hound,December 28,2011

{3G}{good reception}{battery,good}{camera,ok}{sim card}

3.By John H,October 5,2011

{Bluetooth}{internet browser}

4.By Chris Anderson,August 11,2011

{phone dropped,recovered}{speakerphone,good}{volume,good}{camera,mediocre}
{battery}{speaker}

5.By Wdeady,June 14,2011

{phone droped,still works}{battery life,ok}{voice strength,great}

6.By Bcsuka, February 25,2011

{phone,junk}{{screen,went black}

7.Bt Phoenix rising,January 25,2011

{reception,good}

8.By dragonlady,January 21,2011

{phone,heavy duty}{easy to use}{keys,good}{volume,poor}{ring tones}

9.By Costa,December 12,2010

{phone,problem}

10.By Anton,November 13,2010

No phone features discussed in review

11.By Hiflier,October 4,2010

{software, not impressed}

12.By Joachim Kohn,August 6,2010

{phone,great}{speaker,excellent}{reception,great}{software,like}{screen,sharp&bright}

{phone memory}{buttons, comfortable}{blue tooth}{battery}{external speaker}

13.By Mindracer,August 3,2010

{reception, good}

14.By unimpressed,July 6,2010

{reception,mediocre}{battery}

15.By Dan O,June 26,2010

{reception,best}{phone,sturdy}{camera,garbage}

16.By Gumby,June 9,2010

{phone,tough&rugged}{reception,good}{battery life,above average}{screen,clear}{call quality,decent}{software}

17.By E,June 07,2010

{voice quality,good}{reception,good}{battery life ,fair}{screen}

18.By Michael J.Chestnut,June 6,2010

{phone,good}

19.By k:Jones,may 21,2010

{reception,good}{blue tooth}

20.By Woodrow Allen,may 11,2010

{phone,does not perform well}

21.By O´Dennehy,May 08,2010

{memeory}{text messages}

22.By Cheistopher A .Linck,April 19,2010

{phone,tuff}{ringer}{Vibrator}

23.By GMCM West,February 19,2010

{design}{durability}{sound}{camera}{blue tooth}{camera}{phone, beefy}

24.By K.C,January 30,2010

{phone,not reliable}

25.By John W.Bowman,Janauary 12,2012

{durability}{sim card}{battery}{MP3}

26.By Jim In Alaska,December 24,2009

{belt carrying case}{PDA case}

27.By Dee Willams,Novemeber 4,2009

{software}

28.By A.B.Gilbert,October 29,2009

{phone}{rubber shell}{keypad,large}{screen,beautiful}{durable}{camera}

29.By JohnP.Hans,October 29,2009

{phone}{jack for head phones}{USB adopter}{bluetooth}{mp3 player}{battery}{phone durable}

30.By Darek C. Doublin,October 24,2009

{phone,durable}{good reception}{ear piece}{{software}{text message}{voice mail}

{battery life ,abysmal}{button}{case}{durability}

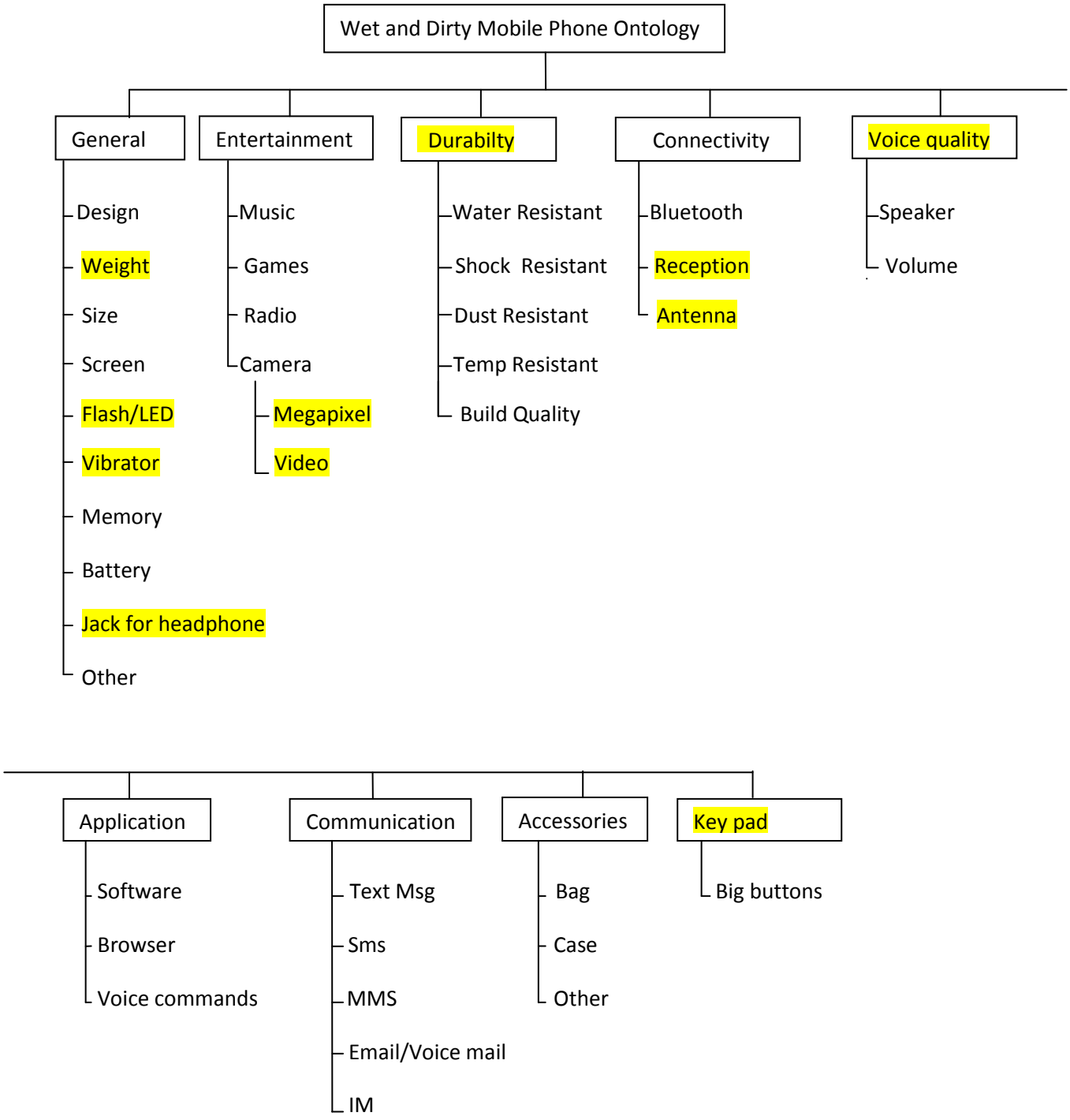


Figure:5 Refined ontology for wet &dirty mobile phone(based on Amazon reviews)

Figure 5 represents the refined ontology for the wet and dirty mobile phone which has been developed after analyzing the reviews present on website, www.amazon.com. The yellow color in the diagram depicts those features and sub categories of features that have been identified after analyzing the selected reviews. All highlighted features and subcategories of features were missing from the proposed ontology by Yaakub et, al.(2011) and have been added into the newly refined ontology for wet and dirty mobile phone.

After developing refined ontology for wet and dirty mobile phone, a refined ontology for simple mobile phone was developed. All features and attributes related to simple mobile phone were extracted manually.

The two chosen simple mobile sets were:

1.Nokia 1661 X 25 Reviews

2.Samsung A 107 X 30 Reviews

1.Nokia 1661 X 25 Reviews

Below are the features that have been extracted from the reviews of simple mobile phone model Nokia 1661.

Link to the selected mobile model reviews:

http://www.amazon.com/Nokia-1661-Prepaid-Phone-T-Mobile/product-reviews/B0027CSIYE/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

1.By Damers,May 23,2012

{phone}{sound,terrible}

2.By Hung Tran,April 20,2012

{phone}{design}{hard to break}

3.By V,March 15,2012

{phone}

4.By Henthom,September 21,2011

{phone}{headset}

5.By The New Yorker,June 29,2011

{phone}{comes with light}{radio}

6.By M.bernhagen,February 22,2011

{phone}{battery}{call quality}{very light}{display, decent}{FM radio}{text messages}

{buttons not elevated}{text}{sim}

7.By Tucson,February,13,2011

{phone}

8.By Clinton D.Gomes,December 5,2010

No feature discussed

9.By Isabella carasco,Novemebr 23,2010

No feature discussed

10.By Kenneth Sandberg,June,2010

No feature discussed

11.By Joy of Cooking,April 27,2010

{phone}{sim}{use only on GSM 850&GSM 1900 MHz}

12.{headphone}{battery}{screen}{flashlight}{alarm}{calendar}{date}{time }{easy to use}

{Screen}{battery life}{keys}{signal strength}{call quality}{ring volume}{message}

13.By RobertC,March 7,2010

{signal}{phone}

14.Clunymph.January 8,2010

{phone}{volume}{loudspeaker}{charger}

15.By Culip,December 31,2009

{telephone}{text fuction}{antenna,poor}{signal}

16.By Hugh E.Hauenstein,December15,2009

{phone}{sim}

17.By S.Willams,October 17,2009

{phone}

18.Ms Fluff,October,2009

{phone}{sim card}{keys,hard}{head set}{FM radio}{flash light}

19.By Ashley White,October 10,2009

{phone}{charger}{headset}{tough}{sleek screen}{back cover}

20.By Sergio R Schubert,October 7,2007

Wrong Review(Discussing another mobile model)

21.By Vishnu Vijayaraghavan,September 28,2009

{phone}

22.By Low Tech Grandmom,September 9,2009

{phone}{message}{vibration feature}{volume}

23.By Jimmyfergus,August 28,2009

{phone}{phone,stylish}{{high resolution screen}{keys, not perfect} {slim}{radio} {speaker}

{battery}

24.The Seeker,July 18,2009

{phone,like}

25.By Peace Lover"Alex",July 17,2009

{mobile}{sim}{cell,small}{cell,cute}{cell,light}{volume}{reception}{keypad}{message}
{charger}{headphone}{USB port}

26.By Rom,June 25,2009

{phone}{sim}{slim}{flashlight}{FM radio}{keys, slippery}{Fm radio}

2.Samsung A107 X 30 Reviews

Below are the features that have been extracted from the reviews of simple mobile phone model Samsung A107.

Link to the selected mobile model reviews:

http://www.amazon.com/Samsung-A107-Unlocked-Organizer-Unlocked/product-reviews/B004HIN7HO/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

1.By Keowee TR6 Owner,May 7,2012

{phone}

2.By C.Taylor,April 28,2012

{phone}{sim}

3.An Ikearat's Brain"Tom",April 24,2012

{phone,happy}{camera}{pouch}{buttons}{numeric pad}{joy pad}{charging port}

{phone survived}{software}

4.By Emma,April 24,2012

{phone}

5.By Paul,April 19,2012

{phone}

6.By Russel L.Casement "Russ",April 10,2012

{phone}{design}

7.By Mcneri,April 5,2012

{phone}

8.By Tobeerius,march 30,2012

{phone}

9.By This guy,March 21,2012

{text}{buttons}

10.By fof1060,March 17,2012

{phone}{sim}

11.By Lance213,march,2012

{phone}{phone, break easily}{reception, horrible}{speaker phone} {calendar, stopwatch, Calculator}{music player}{screen}{headphone}

12.By Claudia Kinsey,February 26,2012

{phone}{screen,small}{sim}{lightweight}{use,easy}{disply,colour}{sms}

13.By Krishna,February,18,2012

{phone, nice}{sim}

14.By Soundman,February 18,2012

{big numbers}

15.By Omar L “Omar”,February 11,2011

{phone}{dual band}{sim}{charger}

16.By Christina Allard,January 20,2012

{phone}

17.By Master of the drones,January 12,2012

{phone}{charger}{battery}

18.By Cooker Jean,December 22,2011

{pone}{battery}{camera}{text message}

19.By Shimon,December 19,2011

{phone}{sim}

20.By cat,November 28,2011

{phone}

21.By Y 2shakil,November 11,2011

{phone}

22.By C.K.Wong,November 10,2011

{phone}

23.By Joretta Fullington,November 2,2011

{phone}

24.By Nozama,October 11,2011

{phone}{message}{call quality}{speakerphone}{reception}{battery life, excellent}

25.By petesura,October 6,2011

{phone}

26.By Ha Globetotter,October 6,2011

{phone}{battery,good}{easy to carry}{lightweight}{sleek}

27.By Blossom,October 3,2011

{phone}

28.By Kat,August 7,2011

{phone}

29.{phone,great}

30.By Dorothea Casaubon,April 19,2011

{phone}{sound quality, not good}{cover}{software

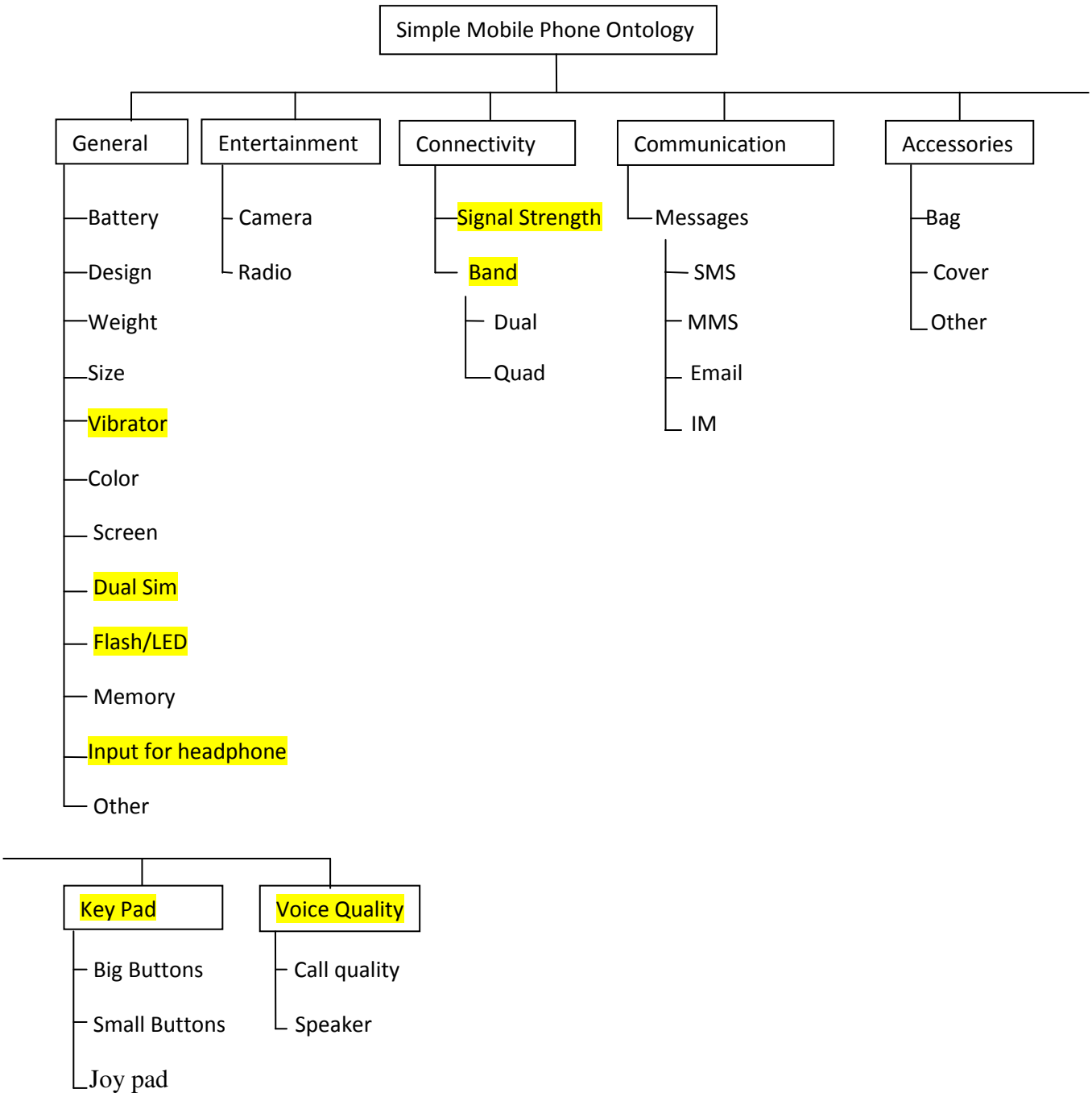


Figure:6 Refined ontology for simple mobile phone (based on Amazon reviews)

Figure 6 represents the refined ontology for the simple mobile phone which has been developed after analyzing the reviews present on www.amazon.com. The yellow color in the diagram depicts those features and sub categories of features that have been identified after analyzing the selected reviews. All highlighted features and subcategories of features were missing from the proposed ontology by Yaakub et, al.(2011) and have been added into the newly refined ontology for simple mobile phone.

4.1.2. To evaluate and verify the refined version of the ontologies

In order to verify the refined versions of the ontologies, same number of reviews (25-30 approx) i.e. from another famous website www.ebay.com were chosen. Same mobile models were chosen in order to verify the refined ontology for mobiles that were used in first objective.

The three chosen smart mobile phone sets were:

1.Samsung Galaxy SII G-19100 *X 29 Reviews*

2.Sprint HTC Evo 4G *X 30 Reviews*

3.Nokia N8 X 30 Reviews

1.Samsung Galaxy SII G-19100 *X 30 Reviews*

Below are the features that have been extracted from the reviews of smart phone model, Samsung Galaxy SII G-1900.

Link to the selected mobile model reviews:

http://www.ebay.com/ctg/samsung-galaxy-s-ii-gt-i9100-16gb-ceramic-white-unlocked-smartphone-/109611648#pbe-rvws

1.ByPliskoigori,03/10/2012

{phone}{stylish}{screen,good}{phone,expensive}{phone,works,well}

2.By Johannita, 03/07/12

{screen,perfect}{size,perfect}{google applications}

3.By Gmmiangious,03/07/2012

{phone,amazing}{screen,perfect} {size}{resolution}

4.By tbab9297,03/05/2012

{phone,amazing}

5.By Cellanos,03/05/2012

Language other than English used.

6.By Leedutcher, 02/17/2012

{phone,awesome}{sleek}{thin}{powerful processor}{screen,superb}

7.By V_Sokol2011,02/13/2012

{display,best}{cpu,best}{battery}

8.By elgantandgraceful,02/06/2012

{phone,awesome}{touch screen}{battery life}

9.By Hanod1,02/05/2012

{phone,best}{batterylife}{usb connection}

10.By Marcovichilan,02/05/2012

{product,great}{use,easy}

11.By Hmakhlouq, 02/03/12

{smart phone ,best} {applications,work great}

12.By jack9060804,01/16/2012

{phone,great}

13.By daveebianmasm,01/11/2012

{smartphone,best}

14.By Rifaau,01/08/2012

{display,gorgeous}

15.By Omarabali89,01/08/2012

{phone,best}{thin}{light weight} {stylish}

16.By Moinet0242, 01/05/12

Language other than English used.

17.By Hmvzla16,01/03/2012

{touchscreen,love}{applications,outstanding}

18.Ocap2009,01/03/2012

{phone,good}{battery,sucks}

19.By Vitorjf,01/03/12

{smartphone,best}{beautiful}{tough}{screen}

20.By Powerglide5949,12/24/2011

{phone,superfast}{battery,good}{charger}{4.3 inch screen,super bright}{touch keypad}{e-mail}{message}{speaker volume}{you tube}{Polaris office software}{sim card}{memory card}{WiFi}{(8MP camera}

21.By 2late4bed, 12/12/11

{phone,faster}{battery life,long} {8MP camera}

22.By brandonlvm,12/10/2011

{smart phone,best}

23.By sd0777denis,12/08/2011

{phone,best}{processor,powerful}{screen,super bright}

24.By abonaif2009,12/05/2011

{phone,awesome}{battery life,long}

25.By paul260475,12/05/2011

{colour,like}{size,dislike}

26.By Sonyvo, 12/04/11

{phone,love}

27.By Omniiiiii, 12/02/11

{phone,excellent}{lighweight}{powerful}{battery}

28.By Oscachu,12/01/2011

{phone,best}

29.By Puiusor,11/26/2011

{volume}

30.By Slubyanov,11/25/2011

{performance,excellent}{screen,sharp&bright}{applications for Android}{screen size}{weight}{image quality}{battery}

2.Sprint HTC Evo 4G ***X 30 Reviews***

Below are the features that have been extracted from the reviews of smart phone model, Sprint HTC EVO 4G.

Link to the selected mobile model reviews:

http://www.ebay.com/ctg/htc-evo-4g-1gb-black-sprint-smartphone-/102331090#pbe-rvws

1.By Johnson28311, 3/11/2012

{phone,good}

2.By Ghup5522,03/10/2012

3.{phone,great}

4.By Nascarkimmie,03/09/2012

{phone,fantastic}{battery,sucks}

5.Cortez1221,03/09/2012

Language other than English used.

6.By Propertymaximo,03/08/2012

{phone,good}

7.By 12dmitrii21,03/07/2012

{device, pleasant}

8.By Celeoliane1,03/07/2012

{battery, horrible}{4G}

9.By 441-Cell,03/06/2012

{SD card}

10.By Bsmi2984,03706/2012

{application}{touch keys}{email}{facebook}{battery}

11.By Cpm8834,03/06/2012

{screen size,like}{WiFi}

12.By Curtisj445

{phone use,easy}{battery}{applications}

13.By mrcleaneu,03/06/2012

{phone,love}{screen,large}{features,unique}

14.By arehankru2012

This not a review !

15.ByLong865,03/05/2012

{phone,love}{screen,huge}

16.By Dwnewt,03/05/2012

{phone,like}{use,easy}{durable}{charger}{battery life,low}

17.By supersupe94.03/05/2012

{phone,like}

18.By dkw416,03/04/2012

Nothing written except the word”good”

19.By audiobahnmaster,03/04/2012

{phone,best}

20.By Soberstudent28,03/04/2012

{phone,best}{battery life,amazing}

21.By Lizlovezpink,03/03/2012

{phone,great}{battery}

22.By 85lt1z28mex,03/03/2012

{phone, awesome}{4G}

23.By Mikkollg69,03/02/2012

{phone}{touch screen}{battery}

24,By Vidragmongoose,03/01/2012

{phone, best}

25.By Saul,03/01/2012

{phone, love}{Android applications}{battery, bad}

26.By Tqfin,03/01/2012

{weight, dislike}{application speed, like}

27,By exceptional,03/01/2012

{phone, great}{features, awesome}{screen resolution}

28.By Laciannoble1,02/29/2012

{phone, amazing}{feature, wonderful}{battery, best}

29.By Ytianbuys,02/29/2012

Not a review!!!

30.By danithasall,02/25/2012

{phone, love}{battery}{applications}

3.Nokia N8 X 30 Reviews

Below are the features that have been extracted from the reviews of smart phone model, Nokia N8.

Link to the selected mobile model reviews:

http://www.ebay.com/ctg/nokia-n-series-n8-16gb-silver-white-unlocked-smartphone-/101832891#pbe-rvws

1.By Karyvero,05/06/2012

{smartphone, excellent}{camera resolution}{social networks}

2. By Varune.m,04/16/2012

{phone,fantastic}{camera,best}{user interface,smooth}{durable}{symbian operating system}

3. By K50.serg,04/02/2012

{phone}

4.By Edwincitox,02/04/2012

{symbian OS,excellent}{touch screen}{video}{camera}{volume,high}

5.By Alialomary,01/23/2012

{symbian}{phone, best}{camera, best}{HDMI cable}{Fm radio}{flash drive}

{sound,high quality} {design,nice}

6.By Percel7,12/20/2011

{camera, good}{shape, nice}{looks, good}{handling, easy}

7.By Rde-2836,12/09/2011

{product, excellent}{camera}{GPS}{HD sound quality}{software}{symbian}

8.By Salfaroictech,11/14/2011

{smart phone, best}{camera, best}

9.ByXiaozhenmai,

{phone}{Android}

10.By Galosantj,09/13/2011

{smart phone}

11.Gihawaii2010,08/25/2011

{battery life, excellent}{ease of use, excellent}{battery life, excellent}{camera}

12.By Kauphy007,08/01/2011

{phone, nice}{call quality, nice}{symbian OS}

13.By bberniette2010,07/23/2011

{smart phone, best}{applications}{GPS}

14.Chinomixdijey,07/21/2011

Language other than English used.

15.By Asamimorita,07/13/2011

{Nokia N8,amazing}{camera, high quality}{GPS}{games}

16.By Sarsen65,06/20/2011

{smart phone, good}{12 MP camera, awesome}{16GB internal storage}{micro SD card}

{USB connectivity}{HDMI connectivity}{HD videos}{music player}

17.By parsnet09,06/09/2011

{smartphone,great}{GPS}{micro SD}

18.ByDinka_tu,06/02/2011

{screen}{touchscreen,good}

19.By Mechwiz,05/06/2011

{phone}{operating system}{16 GB storage}{camera, world class}{{display, crystal clear}{cables}{HDMI}{battery, excellent}{FM radio}{battry life, excellent}

20.By 10leno,06/05/2011

{cell phone,great}{colour}

21.By Lobeinvestments,04/30/2011

{product,great}{phone}{storage space,good}{camera,powerful}{GPS}

22.By Cniland,04/09/2011

{symbian OS}{phone,good}{size,comfortable}{durable}{camera,amazing}{call quality,wonderful}{screen,bright}{keyboard,qwerty}{phone,freezes}{screen,freeze}{software}

23.By pepi241511,04/05/2011

{12 MP camera, awesome}{16 GB storage}{micro SD card}{USB connectivity}{HDMI connectivity}{music player, good} {interface, easy}{HD videos}{phone, good} {processor, slow}{dual core smart phone}{single core smart phone}

24.By Eguez33,04/05/2011

Language other than English is used.

25.By Sujan maharjan,04/05/2011

{phone,good}

26,By minister77,04/05/2011

{software}

27.By Juansantana-123,04/03/2011

Language other than English used.

28.By anantharaj2006,04/02/2011

{phone,great}

29.By Abocroc,03/31/2011

{phone}{Android}{applications}

30.{phone, great}{12 MP camera, best}

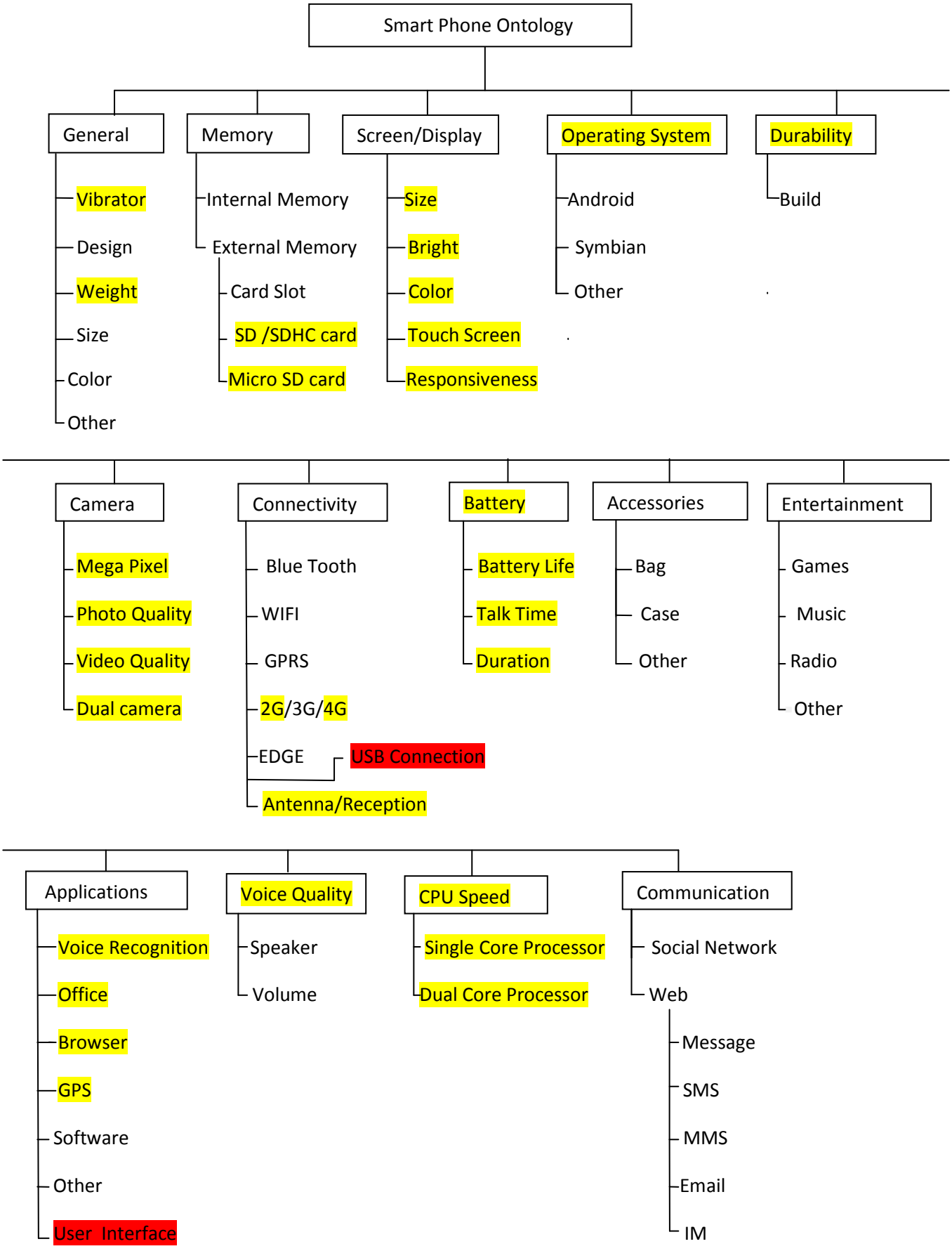


Figure.7 Refined ontology for smart mobile phone (Verified by eBay reviews)

Figure 7 represents the refined ontology for the smart mobile phone which has been verified after analyzing the reviews present on website, www.ebay.com. The red color in the diagram depicts those sub categories of features that were missing from the ontology that was developed in first objective by using the reviews present on website, www.amazon.com. This verified version of refined ontology will be used in the third and final objective.

After evaluating and verifying refined ontology for smart mobile phone, the refined ontology for wet and dirty mobile phone will be evaluated and verified. All features and attributes related to mobile phone were extracted manually.

The two chosen wet and dirty mobile sets were:

1.Casio G´zOne *X 29 Reviews*

2.Motorola Tundra *X 30 Reviews*

1.Casio G´zOne *X 30 Reviews*

Below are the features that have been extracted from the reviews of wet & dirty mobile phone model

Link to the selected mobile model reviews:

http://www.ebay.com/ctg/casio-gzone-commando-1gb-black-verizon-smartphone-/102536985#pbe-rvws

1.ByBbowman2002,03/11/2012

{phone,nice}{battery, doesn't last long}

2.By parkranger10,03/09/2012

{phone,rugged}{battery,doesn't last long}{phone,good}

3.By qrodrigu,03/08/2012

{tough}{high quality}{water resistant}{screen protector}

4.By Raiderbasebalip,02/10/2012

{phone,love}{fastest}{battery,good}

5.By Ucateacher,02707/2012

{phone,great}{dropped,nothing happened}

6.By Sucks,02/04/2012

{phone}

7.By Zoeannd,03/03/2012

{games,loves}

8.By matthewb1313,01/29/2012

{phone}

9.By stillmojoin,01/09/2012

{phone}

10.By 98lina78,01/03/2012

{phone}

11.By Ajsroom,01/03/2012

{phone,great}

12.By sadarr53,12/26/2011

{signal straength,poor}{phone}{touch screen}

13.By Rovingrambler,12/16/2011

{android}{phone, good}{battery life, decent}{tough}

14.By Thetimexchange,12/03/2011

{rough & tough}{battery life, long}

15.By smlbarker947,11/13/2011

{{phone}{communication}

16.By Thrashmastr,11/10/2011

{phone, best}

17.By Fjauregui,11/08/2011

{phone, nice}{durable}{water resistant}{phone, great}

18.By Tigraja,11/0672011

{product, good}

19.By Brother.thew,10/0772011

{android}{phone}{screen}{battery life, poor}{talk time}{music}{cable}

20.By Rohan8me,10/06/2011

{phone works,harsh conditions}

21.By Emmettottermomma,08/30/2011

{phone,awesome}

22.By tracyjeffares,08/16/2011

{phone dropped in ocean, worked perfectly}

23.By nmfirefighter,08/13/2011

{phone,love}{submerged in river}{covered in sand}{scratch}{dropped}{browser}

{speaker}{bluetooth}{screen protector}{battery life}{touchscreen}{slim}{small}

24.By tryme43123

{phone, great}{battery,short}{Bluetooth}{touch screen}

25.By painsufferit,08/06/2011

{phone, great}{use, easy}{battery life, short}{android}

26.By 123minniear,08/05/2011

{phone,good}{weight,light}

27.By jorgeluisparramunoz,07/24/2011

{water resistant}{gorilla glass screen}{android}{touch screen}

28.By narntek,07/06/2011

{android system}{screen}{tough &durable}

29.By Jonlancaster1990,06/05/2011

{product, awesome}

2.Motorola Tundra *X 30 Reviews*

Below are the features that have been extracted from the reviews of wet and dirty phone model

Link to the selected mobile model reviews:

http://www.ebay.com/ctg/motorola-tundra-va76r-black-at-t-cellular-phone-/99979469#pbe-rvws

1.By tony:meyer76,03/05/2012

{phone,works good}

2.By Bezmar_kanduritz,03/02/2012

It is not a review

3.By Busysales,02/22/2012

{phone, great}{worked,in all kinds of weather}{ring tones, loud}

4.By Ronblachman,02/09/2012

{phone}{signal}{phone,durable}{communication}{interface,chunkier}{volume}{sound}

{speaker}

5.By Myrna1107,01/07/2012

{phone}

6.By Stevecnly,12/28/2011

{phone, tough}

7.By Ron-the-hunter,12/2772011

{phone}{antenna}{speaker phone}{bluetooth}

8.By Lucky ark,

{phone, great}{battery}

9.By tedo830,11/13/2011

{phone}{messaging}

10.By Teo-moli,11/04/2011

{phone,very good}{reception}

11.By ppal1010,10/08/2011

{phones}{antenna}

12.By Solitaire812010,10/05/2011

{durable}{buttons}{camera}

13.By rcox649180,09/10/2011

{screen}

14.By derekb_gsu,08/25/2011

{phone, good}{battery, horrible}

15.By Rojniles,08/21/2011

{phone, good}{volume}{ring tones}

16.By Harris498,08/17/2011

{phone, great}{phone, rugged}{use, easy}{battery, good}{camera}

17.By freemanfarms,08/09/2011

{reception}

18.By Sjrcichey

{phone}

19.By Bjking66,07/15/2011

{phone, great}{battery life, great}{phone, sturdy}{sound, good}{ringer, loud}{signal,good}

20.By dandj0404,07/13/2011

{phone, easy to use}{Water proof}

21.By Joetrussell,07711/2011

{phone, great}

22.By Jeffrojda81qx,07/05/2011

{love, phone}{use, easy}{sound, clear}{durable}

23.By Poole7746,06/30/2011

{phone}

24.By Debpeb,06717/2011

{rugged}{phone}

25.By Slickrick135,06/09/2011

{software}{sound quality, ok}

26.By Peloni,06/01/2011

{phone, rugged}{phone, great}

27.ByLifter49,05/29/2011

{phone, durable}{reception, unmatched}{sound quality, clear}{texting}

28.By Dgap3876,05/12/2011

{phone, rugged}

29.By Jethro7709,05/04/2011

{product, great}{rugged}{solid}{phone}

30.By Jimmie,05/04/2011

{phone,pleased

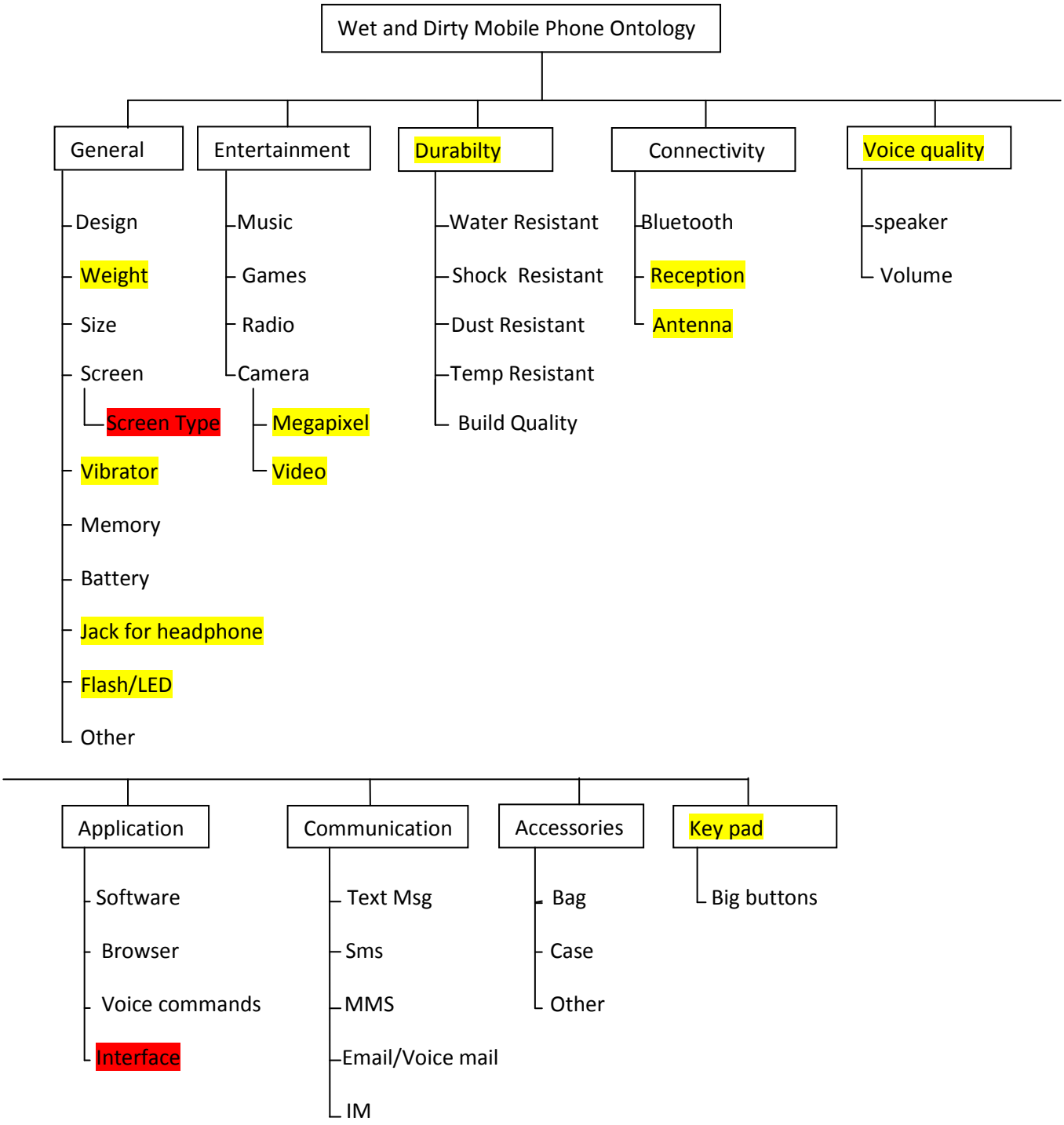


Figure:8 Refined ontology for wet &dirty mobile phone(verified by eBay reviews)

Figure 8 represents the refined ontology for the wet and dirty mobile phone which has been verified after analyzing the reviews present on website, www.ebay.com. The red color in the diagram depicts those sub categories of features that were missing from the ontology that was developed in first objective by using the reviews present on website, www.amazon.com. This verified version of refined ontology will be used in the third and final objective.

After evaluating and verifying refined ontology for wet and dirty mobile phone, the refined ontology for simple mobile phones will be evaluated and verified. All features and attributes related to mobile phone were extracted manually.

The two chosen simple mobile sets were:

1.Nokia 1661 X 25 Reviews

2.Samsung A 107 X 30 Reviews

1. Nokia 1661 X 28 Reviews

Below are the features that have been extracted from the reviews of simple phone model,

Nokia 1661.

Link to the selected mobile model reviews:

http://www.ebay.com/ctg/Nokia-1661-Black-T-Mobile-Cellular-Phone-/99985445#pbe-rvws

1. By Welder314,11/19/10

{phone}{color display, large}{battery life, good}{FM radio}{headphones}{sound quality, good}{reception ,good}{buttons,not good}{keypad}{low res screen}{sim}{flashlight}

2.By Ohfosho04,12/12/09

{phone}{sim}{FM radio}{flashlight}{color screen,great}{slim design}{small}{light weight}

{camera}{mms}{blutooth,absent}{buttons,small}

3.By Cordero7740,06/07/10

{text message}{{light weight}{flash light}

4.By ryanjones102,05/27/11

{cell phone}{sim}{text message}{flashlight}

5.By VH_Cuty,10/07/09

{sound}

6.By Phanonad,05/22/10

{phone}{flashlight}{FM radio}

7.By Compound925,11/09/09

{cell phone}{battery time, good}{text}{sim}

8.Indiran1129ksp,07/09/09

{design, slim}{Fm radio}{size, perfect}{battery, good}

9.ByBoeskool,05/10/10

{size, like}{display, fine}{keypad, small}{speakerphone}{phone volume}{band}

10.By Kokokrisp1106,07/30/10

{phone}{flash light}

{Fm radio}{ringer volume}{display}

11.By Less30,12/05/09

{phone}{radio}{flashlight}{battery}

12.By Bhmishra12,11/08/09

No feature discussed in the review

13.By ECR1320,08/28/10

No feature discussed in the review

14.By 88ambush,12/07/09

{phone}

15.By Belowsale,04/19/10

{phone}{flash light}{dual band}{battery ,great}

16.By 5traxx,07/09/10

{battery, excellent}7radio}{size, small}{ringer, loud speaker}

17.By Cecetay,03/02/10

{phone}{phone}{call quality}{text}

18.By vargha-samadani,08/18/10

Not a review

19.By Yesbergerman,12/03/10

{message}

20.{sound quality}{flashlight}{phone, light}{battery, great}

21.By Narntek,04/23/11

{phone}{Fm radio}

22.By Aswiter25,10/04/10

{phone}{look, sleek}

23.By 6900thor,10/20/09

{camera}{radio}

24.By Jnapoleon,12/05/09

{phone}

25.By rashedtex,12/14/09

{phone}{flashlight}{design}{software app}{lightweight}{volume}

26.By Roj99,11/09/09

{phone,great}

27.By dasherguy,27/02/12

{phone}

28.By Chicana,10/05/10

{phone}{volume}{ringtone}

2.Samsung A 107 X 30 Reviews

Below are the features that have been extracted from the reviews of simple phone model Samsung A 107.

Link to the selected mobile model reviews:

http://www.ebay.com/ctg/motorola-tundra-va76r-black-at-t-cellular-phone-/99979469#pbe-rvws

1.ByJimanddot631,29/02/2012

{text}{{screen, small}{ringer}

2.By sashaleiwalker,04/25/12

{phone}{screen}{battery}{text}{sim}

3.By Meerkatj,12/08/11

{phone}{call quality}

4.By 2010pensionado,03/09/11

{size, dislike}{screen}

5.By Msfancy73,04/18/11

{phone}{sim}

6.By smags123,

{phone}

7.2636edie,03/02/12

{phone}

8.By tempesttower1,05/27/11

{phone}

9.By Wtl777wtl,03/04/11

{phone}

10.Trishaschaffer2009,09/13/11

{phone}

11.Bearvalleydave661

{battery}

12.By Barr9732,12/03/11

{phone}{message}

13.by Harley5769

{phone}{batteries}{charger}

14.By Pinhirilo2007,02/23/12

{phone}

15.ByTvan7995,01/09/12

{phone}{screen}

16.iph86,

{phone}

17.By Gdy1961car,11/09/11

{phone}{buttons}{volume}{ringer}

18.By Drotger,02/07/11

{phone}

19.By ladypj56,03/10/12

{phone}{battery}

20.By Humberto3931,04/14/12

{phone}

21.By roro43,

{phone}

22.By 108-2jon,07/07/11

{screen}

23.Mr.Welder,09/01/11

{clock}

24.By Mack4067 ,07/29/11

{phone}{battery}

25.By Investigationpr,08/31/11

{phone}

26.By Tripgirl-half,

{phone}

27.By Vilgab01,06/03/11

No feature discussed in the review

28.By kaboink60,12/10/11

{phone}

29.By Orlando13orlando,04/02/12

{phone, great}{battery}

30.By Andrewjscott88,10/14/10

{phone}{slim}

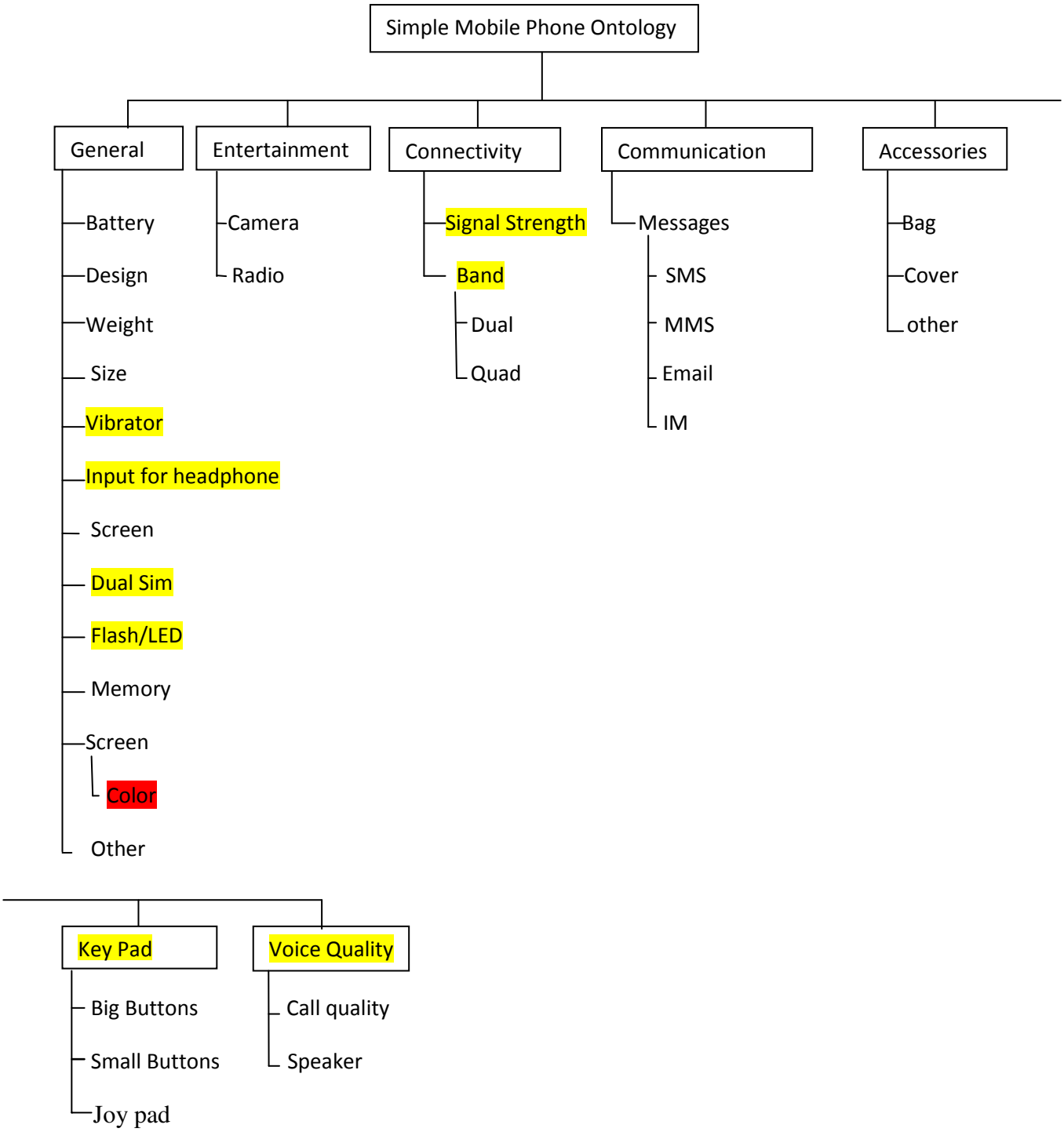


Figure:9 Refined ontology for simple mobile phone (verified by eBay reviews)

Figure 9 represents the refined ontology for the simple mobile phone which has been verified after analyzing the sentiments present on www.ebay.com. The red color in the diagram depicts those sub categories of features that were missing from the ontology that was developed in first objective by using the reviews present on www.amazon.com. This verified version of refined ontology will be used in the third and final objective.

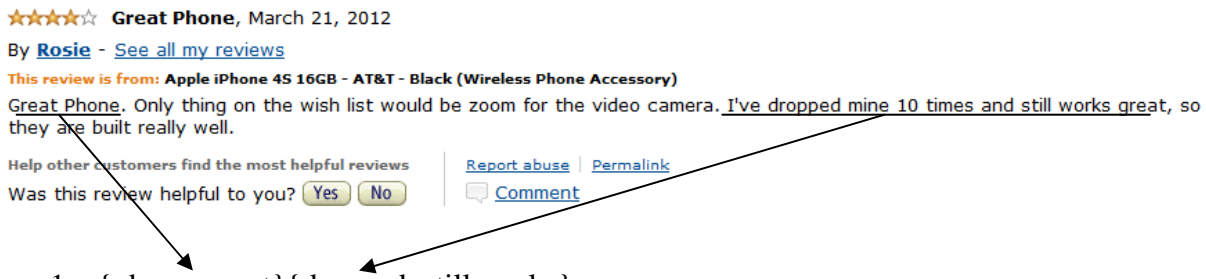
While evaluating and verifying the newly refined ontologies, the quality of reviews present on www.ebay was found to be of low quality i.e. a lot of spelling errors were found. The spelling mistakes were ignored as our main objective was to evaluate and verify the refined ontologies. It was also noted while investigation that people used dual languages to express their opinions. Some fake reviews were also been identified during the investigation of reviews, which was a deliberate attempt to make the product popular into the eyes of the customer.

4.1.3. To compare the verified ontologies with the ontology proposed by Yaakub et,al. (2011) by doing sentiment analysis

The last objective is to conduct sentiment analysis by using the verified ontologies and to calculate and compare the opinion polarities with the results of the sentiment analysis conducted by using the ontology proposed by Yaakub et,al. (2011).

In order to achieve this objective, the verified refined ontology for the smart mobile phone was selected first and the opinion polarities were calculated by extracting the features from the reviews related to smart phone model " iphone 4GS 16 GB". Only those features will be extracted for which an opinion or sentiment has been expressed by the reviewer. Further same features will be used for calculating the opinion polarities by using the ontology proposed by Yaakub et,al. (2011). According to Yaakub et,al.(2011), the opinion polarity (OGC) from comments present in the reviews is calculated in the following steps:

Step 1: Features and their attributes were extracted from the reviews (From March 21,2012) http://www.amazon.com/Apple-iPhone-4S-16GB-Black/product-reviews/B005VGFQXE/ref=cm_cr_pr_top_link_3?ie=UTF8&pageNumber=3&showViewpoints=0&sortBy=bySubmissionDateDescending



1. {phone, great}{dropped, still works}

<u>Rest of the features for which an opinion has been expressed in the review were extracted in the same way as depicted in the first review.</u>

2. {phone, great}
3. {battery, bad} {screen, beautiful}{application, vast}

   {speaker, loud}
4. {phone, good}{battery, not bad}
5. {camera, improved}{battery life, bad}
6. {dropped, worked fine}

7. {blue tooth, does not work on other devices}
8. {phone, greatest}{vibration reduction, remarkable}
   {retina screen with 960 by 640 resolution ,wide}
9. {8MP camera with IS, improved} {CPU speed, excellent}{connectivity, good}
10. {waterproofing, poor}{connectivity, good}{camera, excellent}{icloud, excellent}
    {battery, poor}{voice recognition, good}
11. {phone, excellent}{user interface, excellent}{entertainment, great}
12. {battery ,poor}{vibration reduction, good}{connectivity, excellent}
13. {phone, excellent}{camera, awesome}{design, beautiful}{connectivity, excellent}
14. {phone, high quality}{battery life, amazing}{voice recognition, great}
15. {digital camera, good results} {icloud, needs to mature} {design, ergonomic}
16. {siri, helpful}
17. {battery life, much shorter}{vibrator, not good}{screen, superb}{camera, superb}
    {voice quality, pretty good}
18. {Siri, annoying}
19. {camera, better}
20. {phone dropped, shattered}
21. {battery life, sucks}
22. No opinions expressed
23. {camera with flash, great}
24. {iphone 4S, greatest} {3.5 inch screen multi touch display with 960 by 640, wide}
25. No opinion expressed
26. {phone, best}
27. {phone, amazing}
28. No opinions expressed
29. {phone, fragile}
30. {phone, best}

Step 2: The features were then mapped into the verified refined ontology for smart mobile phones and a table with attributes polarity(AP) was formed. The sentiments present in the customer reviews were transformed into an attribute table by using a 7 point polarity system (-3 to 3). Where -3 represents poor, -2 represent reject, -1 represent weak reject, 0 represent neutral opinion, +3 represent excellent, +2 represent distinguish, +1 represent accept.

Comment	Attributes Polarity (AP)
1	(general, +3) (durability,+2)
2	(general, +3)
3	(battery, -3) (display, +3) (application, +3) (voice quality,+2)
4	(general, +3) (battery, -1)
5	(camera, +1) (battery, -3)
6	(durability, +2)
7	(connectivity, -2)
8	(general, +3) (camera, +3) (display, +3)
9	(camera, +2) (cpu, +3) (connectivity, +2)
10	(durability, -3) (connectivity, +2) (camera, +3) (application, +3) (battery, -3) (application, +2)
11	(general, +3) (application +3) (entertainment +2)
12	(battery, -3) (camera, +2) (connectivity, +3)
13	(general, +3) (camera, +3) (general, +3) (connectivity, +3)
14	(general, +3) (battery, +3) (application, +3)
15	(camera, +3) (application, -1) (general, +3)
16	(application, +2)
17	(battery, -3) (general, -3) (display, +3) (camera, +3) (voice quality, +2)
18	(application ,-3)
19	(camera, +1)

20	(durability, -3)
21	(battery, -3)
22	
23	(camera, +3)
24	(general, +3) (display, +3)
25	
26	(general, +3)
27	(general, +3)
28	
29	(durability, -3)
30	(general, +3)

Table 2 *Attributes Polarity Table for smart mobile phone by using verified and refined ontology for smart phone*

Step 3:By using the formula, opinion polarity (ogc) will be calculated by using the attributes polarities(AP) from attribute polarity table.

$$\text{where } \text{ogc}(g, c) = \sum_{z=-3}^{3} (z * polarity(c, g, z))$$

Attributes	Polarity							OGC	Orientations
	3	2	1	0	-1	-2	-3		
General	13	0	0	0	0	0	1	36	Positive
Durability	0	2	0	0	0	0	3	-5	Negative
Battery	1	0	0	0	1	0	6	-18	Negative
Display	4	0	0	0	0	0	0	12	Positive
Voice Quality	0	2	0	0	0	0	0	4	Positive
Camera	6	2	2	0	0	0	0	24	Positive
Connectivity	2	2	0	0	0	1	0	10	Positive
CPU	1	0	0	0	0	0	0	3	Positive
application	4	2	0	0	1	0	1	10	Positive
Entertainment	0	1	0	0	0	0	0	2	Positive

Table 3 *Opinion Polarity Table for smart mobile phone by using verified and refined ontology for smart phone*

After calculating the opinion polarity (ogc), the user's orientation towards the product is clearly visible. This table shows the features of the product that have a positive orientation and also those features that have negative orientation. For our chosen product iphone "4S 16 GB", the durability and battery features were not liked by most of the users that's why the both features have a negative opinion polarity.

Further opinion polarities were calculated by from the reviews that are related to smart mobile phone model "iphone 4GS 16 GB" by using the ontology proposed by Yaakub et,al.(2011).

Accroding to Yaakub et,al.(2011), the opinion polarity (OGC) from comments present in the reviews is calculated in the following steps:

Step 1: Features and their attributes were extracted from the same reviews, that were used for evaluating the refined ontology for smart mobile phones on page (68).

Step 2: The features were then mapped into the ontology proposed by Yaakub et,al.(2011) and a table with attributes polarity(AP) was formed. The sentiments present in the customer reviews were transformed into an attribute table by using a 7 point polarity system (-3 to 3). Where -3 represents poor, -2 represent reject, -1 represent weak reject, 0 represent neutral opinion, +3 represent excellent, +2 represent distinguish, +1 represent accept.

Comment	Attributes Polarity (AP)
1	(general, +3) (other,+2)
2	(general, +3)
3	(general, -3) (general, +3) (application, +3) (other,+2)
4	(general, +3) (general, -1)
5	(entertainment, +1) (general, -3)
6	(other, +2)
7	(connectivity, -2)
8	(general, +3) (entertainment, +3) (general, +3)
9	(entertainment, +2) (other, +3) (connectivity, +2)
10	(other, -3) (connectivity, +2) (entertainment, +3) (application, +3) (general, -3) (application, +2)
11	(general, +3) (application +3) (entertainment, +2)
12	(general, -3) (entertainment, +2) (connectivity, +3)
13	(general, +3) (entertainment, +3) (general, +3) (connectivity, +3)
14	(general, +3) (general, +3) (application, +3)
15	(entertainment, +3) (application, -1) (general, +3)
16	(application, +2)
17	(general, -3) (general, -3) (general, +3) (entertainment, +3) (other, +2)
18	(application ,-3)
19	(entertainment, +1)
20	(other, -3)

21	(general, -3)
22	
23	(entertainment, +3)
24	(general, +3) (general, +3)
25	
26	(general, +3)
27	(general, +3)
28	
29	(other, -3)
30	(general, +3)

Table 4 *Attributes Polarity Table for smart mobile phone by using ontology proposed by Yaakub et, al.(2011)*

Step 3:By using the formula, opinion polarity (ogc) will be calculated by using the attributes polarities(AP) from attribute polarity table.

$$\text{where } \text{ogc}(g, c) = \sum_{z=-3}^{3} (z * polarity(c, g, z))$$

Attributes	Polarity							OGC	Orientations
	3	2	1	0	-1	-2	-3		
general	18	0	0	0	1	0	7	32	Positive
other	1	4	0	0	0	0	3	2	Positive
entertainment	6	3	2	0	0	0	1	23	Positive
connectivity	2	1	1	0	0	1	0	7	Positive
application	4	2	0	0	1	0	1	12	Positive

Table 5 *Opinion Polarity Table for smart mobile phone by using ontology proposed by Yaaqub et,al.(2011)*

After calculating opinion polarity (ogc) by using the ontology proposed by Yaakub et,al.(2011), we can clearly see that all orientations are positive.

Further opinion polarities were calculated for the wet and dirty mobile phone by using mobile phone model "Samsung B2100" by using verified and refined ontology for wet & dirty mobile phone . Thirty latest reviews were selected for feature extraction and those features were selected for which the reviewer has expressed an opinion.

According to Yaakub et,al.(2011), the opinion polarity (ogc) from comments present in the reviews is calculated in the following steps:

Step 1: Features and their attributes were extracted from the reviews (From February 13,2012)

http://www.amazon.com/Samsung-B2100-Anti-Shock-Bluetooth-International-Version-Black/product

reviews/B003ICWA7I/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

1. {phone, solid}{use, easy}{battery life, great}{speaker phone, not good}
2. {phone, simple}{signal, ok}{volume, ok}{alarm, ok}
3. {phone, nice}{battery, does not charge}
4. {phone, rough}{phone dropped in water, still works}
5. {sound quality, great}{speaker, excellent}{flash light, bright}
6. Not a review
7. {phone, rugged}
8. {Fm radio, fantastic}{battery life, outstanding}
9. {phone, ok}
10. {waterproofing, excellent}{ring tones and speaker, loud}
11. {phone, durable}
12. {signal reception, decreased}
13. No opinion expressed
14. {sound, great}{battery good}

15. {design, strong}

16. {phone, tough}{use, easy}

17. {ring tone volume, very low}

18. No opinion expressed

19. {phone, waterproof}

20. {phone, great}{sound quality, better}

21. {phone, survived crash}

22. No features in review

23. {phone, can resist nuclear attack}

24. Reviewer complaining that he has received wrong product

25. {phone, not sophisticated }

26. No opinion expressed

27. {phone, anti shock-waterproof}

28. {buttons, small}{phone, bulky}{voice, muffled}

29. {phone, rugged}{music, loud}

30. {phone, tuff}

Step 2: The features were then mapped into the verified refined ontology for wet and dirty mobile phones and a table with attributes polarity(AP) was formed. The sentiments present in the customer reviews were transformed into an attribute table by using a 7 point polarity system (-3 to 3). Where -3 represents poor, -2 represent reject, -1 represent weak reject, 0 represent neutral opinion, +3 represent excellent, +2 represent distinguish, +1 represent accept.

Comment	Attributes Polarity (AP)
1	(durability,+3) (general,+2)(general,+3)(voice quality,-2)
2	(general,+2)(connectivity,+2)(voice quality,0)(general,0)
3	(general,+2) (general, -3)

4	(durability, +2) (durability,+3)
5	(voice quality,+3) (voice quality,+3 (general,+2)
6	
7	(durability,+3)
8	(entertainment, +3) (general,+3)
9	(general,+1)
10	(durability, +3) (voice quality, +2)
11	(durability,+3)
12	(connectivity,-2)
13	
14	(voice quality,+3) (general,+1)
15	(durability,+2)
16	(durability,+2)(general,+1)
17	(voice quality, -3)
18	
19	(durability,+2)
20	(general,+3)(voice quality,+2)
21	(durability,+3)
22	
23	(durability,+3)
24	
25	(general,-2)
26	
27	(durability,+3)
28	(keypad,-1)(general,-1)(voice quality,-1)

29	(durability, +2)(voice quality,+2)
30	(durability, +2)

Table 6 *Attributes Polarity Table for wet & dirty mobile phone by using verified and refined ontology for wet & dirty mobile phone*

Step 3:By using the formula, opinion polarity (ogc) will be calculated by using the attributes polarities(AP) from attribute polarity table.

$$\text{where } ogc(g,c) = \sum_{z=-3}^{3} (z * polarity(c,g,z))$$

Attributes	Polarity							OGC	Orientations
	3	2	1	0	-1	-2	-3		
General	3	4	3	1	1	1	1	14	Positive
Durability	8	6	0	0	0	0	0	36	Positive
Voice Quality	3	3	0	1	1	1	1	9	Positive
Keypad	0	0	0	0	1	0	0	-1	Negative
Connectivity	0	1	0	0	0	1	0	0	Positive
Entertainment	1	0	0	0	0	0	0	3	Positive

Table 7 *Opinion Polarity Table for wet & dirty mobile phone by using verified and refined ontology for wet & dirty mobile phone*

Further opinion polarities were calculate from the reviews that were related to wet and dirty phone model "Samsung B2100" by using the ontology proposed by Yaakub et,al.(2011).

Accroding to Yaakub et,al.(2011), the opinion polarity (OGC) from comments present in the reviews is calculated in the following steps:

Step 1: Features and their attributes were extracted from the same reviews, that were used for evaluating the refined ontology for wet and dirty mobile phone model "Samsung B2100" on pg (75).

Step 2: The features were then mapped into the extended ontology and a table with attributes polarity(AP) was formed. The sentiments present in the customer reviews were transformed into an attribute table by using a 7 point polarity system (-3 to 3). Where -3 represents poor, -2 represent reject, -1 represent weak reject, 0 represent neutral opinion, +3 represent excellent, +2 represent distinguish, +1 represent accept.

Comment	Attributes Polarity (AP)
1	(other,+3) (general,+2)(general,+3)(other,-2)
2	(general,+2)(connectivity,+2)(other,0)(general,0)
3	(general,+2) (general, -3)
4	(other, +2) (other,+3)
5	(other,+3) (other,+3 (other,+2)
6	
7	(other,+3)
8	(entertainment, +3) (general,+3)
9	(general,+1)
10	(other, +3) (other, +2)
11	(other,+3)
12	(connectivity,-2)
13	
14	(other,+3) (general,+1)
15	(other,+2)
16	(other,+2)(general,+1)

17	(other, -3)
18	
19	(other,+2)
20	(general,+3)(other,+2)
21	(other,+3)
22	
23	(other,+3)
24	
25	(general,-2)
26	
27	(other,+3)
28	(other,-1)(general,-1)(other,-1)
29	(other, +2)(other,+2)
30	(other,+2)

Table 8 *Attributes Polarity Table for wet & dirty mobile phone by using ontology proposed by Yaaqub at,al.(2011)*

Step 3:By using the formula, opinion polarity (ogc) will be calculated by using the attributes polarities(AP) from attribute polarity table.

$$\text{where } ogc(g,c) = \sum_{z=-3}^{3} (z * polarity(c,g,z))$$

Attributes	Polarity							OGC	Orientations
	3	2	1	0	-1	-2	-3		
General	3	3	3	1	1	1	1	12	Positive
Other	10	10	0	1	2	1	1	43	Positive
Entertainment	1	0	0	0	0	0	0	3	Positive

Connectivity	0	1	0	0	0	1	0	0	Positive

Table 9 *Opinion Polarity Table for wet & dirty mobile phone by using ontology proposed by Yaaqub et,al.(2011)*

At last, opinion polarities were calculated for the simple mobile phone by using mobile phone model "Nokia C1-01 GSM" by using verified and refined ontology for simple mobile phone. Thirty latest reviews were selected for feature extraction and those features were extracted for which the reviewer has expressed an opinion.

According to Yaakub et,al.(2011), the opinion polarity (OGC) from comments present in the reviews is calculated in the following steps:

Step 1: Features and their attributes are extracted from the reviews(From March 2,2012)

http://www.amazon.com/Nokia-C1-01-Unlocked-GSM-Phone/product-reviews/B0047DVF00/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

{Nokia C1-01,happy with choice} {battery life, more than acceptable}

1. Many spelling errors, reviewer asked for help instead of reviewing the product.
2. {display, hurt eyes}
3. Reviewer asking for help
4. Reviewer asking for help
5. {survived, countless drops}
6. {phone, costly}
7. Language other than English used.
8. {phone, loved}
9. Phone is unable to connect in Costa rica
10. {phone, excellent}{operation, simple}{keys, large}{sound, clear}
11. No Opinion expressed
12. {reception, good}{call quality, good}{body, small & lightweight}{screen, nice & bright}{texting, easy}{battery life, extremely good}{buttons, easy navigation}

13. Language changed

14. {battery life, 6-7 days}

15. No opinion expressed

16. {size, small}{use, easy}{voice, excellent}

17. {phone, compact & simple}

18. {phone, like}{audio quality, good}

19. No opinion expressed

20. No opinion expressed

21. {phone, great}{camera, mediocre}{phone dropped, no problems}

22. In Costa Rica the cell phone cannot catch signal

23. {phone, like}{phone, recommend}

24. {phone, amazing}{use, easy}{phone, light}

25. {phone, good}

26. Reviewer complaining after receiving the wrong product

27. {phone, like}

28. No comment expressed

29. Reviewer complaining that this phone did not work outside USA.

Step 2: The features were then mapped into the refined ontology for simple mobile phone and a table with attributes polarity(AP) was formed. The sentiments present in the customer reviews were transformed into an attribute table by using a 7 point polarity system (-3 to 3). Where -3 represents poor, -2 represent reject, -1 represent weak reject, 0 represent neutral opinion, +3 represent excellent, +2 represent distinguish, +1 represent accept.

Comment	Attributes Polarity (AP)
1	(general, +2) (general,+2)
2	
3	(general,-3)

4	
5	
6	(durability,+3)
7	(general,-1)
8	
9	(general,+3)
10	
11	(general, +3) (general,+1) (keypad,+2)(voice quality,+1)
12	
13	(connectivity, +3) (voice quality,+2) (general, +3) (general, +3)(communication,+2)(general,+3)(keypad,+2)
14	
15	(general,+3)
16	(application, +2)
17	(general, +2) (general, +2) (voice quality,+3)
18	(general,+3)
19	(general,+1)(voice quality,+2)
20	
21	
22	(general.+3)(general,0)(durability,+2)
23	
24	(general, +2) (general, +2)
25	(general,+3)(general,+3)(general,+2)
26	(general, +2)
27	
28	(general,+2)

29	
30	

Table 10 *Attributes Polarity Table for simple mobile phone by using verified & refined ontology for simple mobile phone*

Step 3:By using the formula, opinion polarity (ogc) will be calculated by using the attributes polarities(AP) from attribute polarity table.

$$\text{where } ogc(g,c) = \sum_{z=-3}^{3} (z * polarity(c,g,z))$$

Attributes	Polarity							OGC	Orientations
	3	2	1	0	-1	-2	-3		
General	10	9	2	0	1	0	1	49	Positive
Durability	1	1	0	1	0	0	0	5	Positive
Communication	0	1	0	0	0	0	0	2	Positive
Keypad	0	2	0	0	0	0	0	4	Positive
Voice quality	1	2	1	0	0	0	0	8	Positive
Connectivity	1	0	0	0	0	0	0	3	Positive
Application	0	1	0	0	0	0	0	2	Positive

Table 11 *Opinion Polarity Table for simple mobile phone by using verified & refined ontology for simple mobile phones*

Then opinion polarities were calculated from the reviews that are related to simple phone model " Nokia C1-01" by using the ontology proposed by Yaakub et,al.(2011).

According to Yaakub et,al.(2011), the opinion polarity (OGC) from comments present in the reviews is calculated in the following steps:

Step 1: Features and their attributes were extracted from the same reviews ,that were used for evaluating the specialized ontology for simple phone on page (81).

Step 2: The features were then mapped into the extended ontology and a table with attributes polarity(AP) was formed. The sentiments present in the customer reviews were transformed into an attribute table by using a 7 point polarity system (-3 to 3). Where -3 represents poor, -2 represent reject, -1 represent weak reject, 0 represent neutral opinion, +3 represent excellent, +2 represent distinguish, +1 represent accept.

Comment	Attributes Polarity (AP)
1	(general, +2) (general,+2)
2	
3	(general,-3)
4	
5	
6	(other,+3)
7	(general,-1)
8	
9	(general,+3)
10	
11	(general, +3) (general,+1) (other,+2)(other,+1)
12	
13	(connnectivity,+3)(other,+2)(general,+3)(general,+3) (communication,+2) (general,+3) (other,+2)
14	
15	(general,+3)
16	(application, +2)
17	(general, +2) (general, +2) (other,+3)
18	(general,+3)

19	(general,+1)(other,+2)
20	
21	
22	(general.+3)(general,0)(other,+2)
23	
24	(general, +2) (general, +2)
25	(general,+3)(general,+3)(general,+29)
26	(general, +2)
27	
28	(general,+2)
29	
30	

Table 12 *Attributes polarity Table (AP) for simple mobile phone by using proposed ontology by Yaaqub et,al.(2011)*

Step 3:By using the formula, opinion polarity (ogc) will be calculated by using the attributes polarities(AP) from attribute polarity table.

$$\text{where } \text{ogc}(g, c) = \sum_{z=-3}^{3} (z * polarity(c, g, z))$$

Attributes	Polarity							OGC	Orientations
	3	2	1	0	-1	-2	-3		
General	10	9	2	1	1	0	1	49	Positive
Other	2	5	1	0	0	0	0	17	Positive

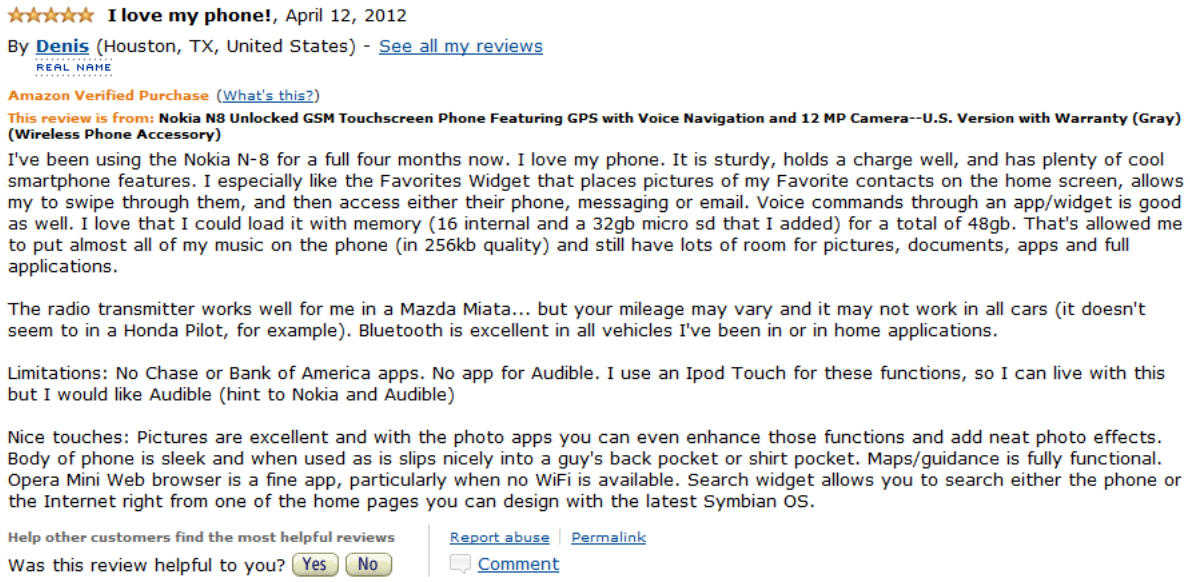
Communication	0	1	0	0	0	0	0	2	Positive
connectivity	1	0	0	0	0	0	0	3	Positive
application	0	1	0	0	0	0	0	2	Positive

Table 13 *Opinion Polarity Table for simple mobile phone by using ontology proposed by Yaaqub et.al(2011)*

5. Analysis:

After refining the ontology proposed by Yaakub et,al. (2011) for smart mobile phone category by using the customer reviews present on the website www.Amazon.com, following are the observations: The main objective was to develop an ontology that contains features and their attributes and components which have been mostly been discussed by the reviewers. The ontology proposed by Yaakub et,al. (2011) was unable to accommodate all the features that have been discussed into the review related to our three selected mobile phones i.e. ***Samsung Galaxy SII G-19100,Sprint HTC Evo 4G*** *and* ***Nokia N8.***

For instance following is the review:



★★★★★ **I love my phone!**, April 12, 2012

By **Denis** (Houston, TX, United States) - See all my reviews

REAL NAME

Amazon Verified Purchase (What's this?)

This review is from: **Nokia N8 Unlocked GSM Touchscreen Phone Featuring GPS with Voice Navigation and 12 MP Camera--U.S. Version with Warranty (Gray) (Wireless Phone Accessory)**

I've been using the Nokia N-8 for a full four months now. I love my phone. It is sturdy, holds a charge well, and has plenty of cool smartphone features. I especially like the Favorites Widget that places pictures of my Favorite contacts on the home screen, allows my to swipe through them, and then access either their phone, messaging or email. Voice commands through an app/widget is good as well. I love that I could load it with memory (16 internal and a 32gb micro sd that I added) for a total of 48gb. That's allowed me to put almost all of my music on the phone (in 256kb quality) and still have lots of room for pictures, documents, apps and full applications.

The radio transmitter works well for me in a Mazda Miata... but your mileage may vary and it may not work in all cars (it doesn't seem to in a Honda Pilot, for example). Bluetooth is excellent in all vehicles I've been in or in home applications.

Limitations: No Chase or Bank of America apps. No app for Audible. I use an Ipod Touch for these functions, so I can live with this but I would like Audible (hint to Nokia and Audible)

Nice touches: Pictures are excellent and with the photo apps you can even enhance those functions and add neat photo effects. Body of phone is sleek and when used as is slips nicely into a guy's back pocket or shirt pocket. Maps/guidance is fully functional. Opera Mini Web browser is a fine app, particularly when no WiFi is available. Search widget allows you to search either the phone or the Internet right from one of the home pages you can design with the latest Symbian OS.

Help other customers find the most helpful reviews

Was this review helpful to you? Yes No

Report abuse | Permalink

Comment

Below are the features that have been extracted from the above review that are about smart phone model, " Nokia N8".

By **Denis** April 12, 2012

{Phone,love}{phone,sturdy}{charge hold,well}{messaging or email}

{voice commands,good}{memory,internal 16GB:external,32GB micro SD} {screen} {radio,well}{music}{radio}{blue tooth,excellent}{body,sleek}{opera mini browser} {WiFi}{symbian OS}

It can be seen that the highlighted features and attributes of the item "phone" were not covered by the ontology proposed by Yaakub et,al. (2011). Here reviewer has tried to express that the phone is durable by expressing it as "sturdy". This feature is absent in the ontology

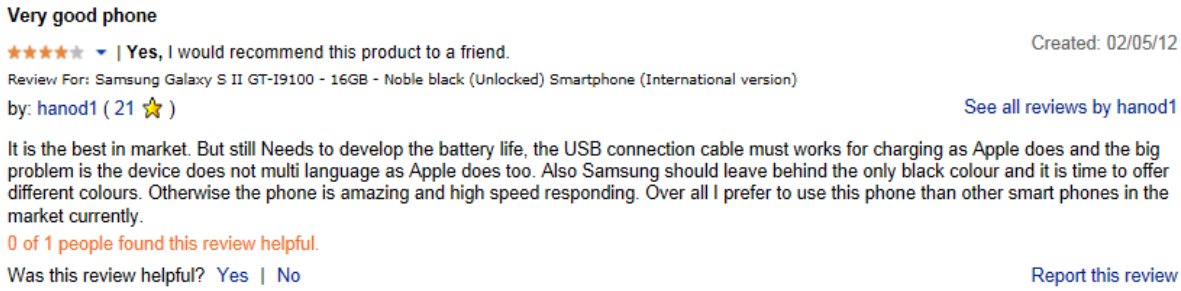
proposed by Yaakub et,al. (2011). Further the battery duration has been discussed. It has been noted that users of smart phones are very much concerned about their battery that is a vital component. So when developing the ontology battery was considered as a separate feature rather than using it as a subcategory of general feature. "Voice commands" here refers the speech recognition feature which is used for voice dialing that has been added into the application feature of the new refined ontology. Yaakub et,al. (2011) have used memory as a general feature in their ontology. Since various new applications are continuously been designed by companies in order to attract the mobile users attention, and those applications need considerable amount of memory. So that's why, this research has used memory as a separate feature in the new ontology. In the same way different users prefer to have the operating system of their interest. This feature is very important for smart phone that was missing from the ontology proposed by Yaakub et,al. (2011) and now it has been added in our new ontology. The features and their attributes have been highlighted in the extracted reviews and in the newly formed ontology so that it is easier to map them. Durability, Battery, Operating system, Voice quality and CPU speed are the features that have been added into the refined ontology for smart mobile phones.

In the refined ontology for the wet and dirty mobile phones, durability feature has been added along with voice quality and keypad. Since people related to construction business, fire fighters, people who work in coal mines and people who work in remote areas use these kind of mobiles. Durability feature was found mostly been discussed by the users along with connectivity and reception. This missing feature and other important attributes have been added into the ontology and been highlighted so they can be mapped easily.

The ontology proposed by Yaakub et,al. (2011) covered most of the features and attributes related to simple mobile phone. The reason is that the simple mobile phone has less features as compared to the other category of phones, i.e. smart phone and wet and dirty mobile phones. In the refined ontology for simple mobile phone attributes like WiFi and Blue tooth has been removed. A new attribute "Dual sim" has been added into the connectivity feature. In the communication feature Social networking and web have been removed since simple phone does not have such kind of features but these features were present into the ontology that was proposed by yaakub et,al, (2011). And another important observation that came to notice was that the reviews that were used to evaluate and refine the ontologies for the mobile phones were written by people of different ages, having different technological backgrounds . Few reviews discussed the mobile features comprehensively and few just gave an overall general opinion about the product.

In order to fulfill the second objective, the refined ontologies were evaluated and verified. All the main features related to the mobiles that were extracted for this purpose from the reviews present on website www.ebay.com were covered by the ontologies. Only some components and attributes were added in to the ontology after evaluation that were missing from the refined ontology that was developed by using reviews on www.amazon.com. Since random reviews have been chosen in order to extract the features and there are various mobile models available in the market, it is obvious that every new set of reviews written for another smart mobile phone, would likely to add some new components and attributes to the ontology. This

is because a reviewer who has used the product for a longer period of time and having a more technological background tends to discuss the product features and their attributes in more details. For instance following is the review:



Very good phone

★★★★☆ ▾ | **Yes,** I would recommend this product to a friend. Created: 02/05/12

Review For: Samsung Galaxy S II GT-I9100 - 16GB - Noble black (Unlocked) Smartphone (International version)

by: hanod1 (21 ☆) See all reviews by hanod1

It is the best in market. But still Needs to develop the battery life, the USB connection cable must works for charging as Apple does and the big problem is the device does not multi language as Apple does too. Also Samsung should leave behind the only black colour and it is time to offer different colours. Otherwise the phone is amazing and high speed responding. Over all I prefer to use this phone than other smart phones in the market currently.

0 of 1 people found this review helpful.

Was this review helpful? Yes | No Report this review

Below are the features that have been extracted from the above review that are about smart phone model,"Samsung SII GT-19100".

{phone,best}{batterylife}{usb connection}

Here it can be seen that the attribute (component) USB connection has been discussed by the reviewer which falls in the subcategory of feature "connectivity" and was missing from the new refined ontology for smart phones that was developed in order to fulfill the first objective of this project.USB Connection has been added to the refined and specialized ontology for smart phones. Few other attributes like "user interface", "HDMI cable" were also found and will come under the feature "accessories" automatically. After the fulfillment of the second objective, the verified refined ontologies have the capability to cover those features and their components and attributes that have been frequently been discussed by the reviewers and for which they have expressed their opinions.

The last objective was to conduct sentiment analysis by using the refined ontologies and to calculate and compare the opinion polarities with the results of the sentiment analysis conducted by using the ontology proposed by Yaakub et,al. (2011). After calculating opinion polarity (ogc) by using our refined ontologies and the ontology proposed by Yaakub et,al.(2011),following were the observations.

After calculating the opinion polarity (ogc), by using refined ontology for the model "iphone 4GS",in the smart phone category, the result shows the user's orientation towards the product features, the "durability" and "battery" features were not liked by most of the users that's why both features have a negative opinion polarity. The rest of the features showed positive orientation. Whereas opinion polarity calculated by using the ontology proposed by Yaakub et,al(2011) for the same model of mobile showed positive orientations for all features. The reason behind this is that the proposed ontolology by Yaakub et,al.(2011) is too general. Since smart phone has extra additional feature and attributes, the ontology proposed by Yaakub et,al.(2011) was unable to accommodate them and was unable to provide a clear depiction of the features having negative orientation. While calculating opinion polarity (ogc)

by using the ontology proposed by Yaakub et,al. (2011),battery was selected as a “General” feature, where as durability fell into the “Other” features category. Thus the formula used to calculate the opinion polarity gave an overall positive rating to the “General” feature as well as to the “Other” feature. The buyer will still remain unaware of those features that have been disliked by the reviewers. Thus our newly extended ontology for the chosen smart phone has shown both positive and negative orientation of customers opinions about a product i.e.it is more explicit in case of smart phone category.

For the wet and dirty phone category the opinion polarities calculated by using the refined ontology for the wet and dirty phone showed only one negative orientations for the “keypad” feature. Whereas the opinion polarities calculated by using the ontology proposed by Yaakub et,al. (2011) showed all positive orientations.

The opinion polarities calculated by using refined ontology for simple mobile phone and by using ontology proposed by Yaakub et,al. (2011) showed almost same results, since the new refined ontology for simple phone is very much similar like the ontology proposed by Yaakub et,al. (2011).The reason behind this is that simple mobile phone has very few features as compared to the other two categories of mobile phones. That is the reason that he ontology proposed by Yaakub et,al. (2011) covered all the features of a simple mobile phone.

6. Discussion:

6.1. Results in Relation to the Aim

As indicated in Chapter 1, the aim of this work was to:

To refine Yaakub et,al's proposed ontology for examining customer sentiments present in reviews published on the web

In order to fulfill the aim, the following three sequential objectives were set up for achievement.

1. To refine the ontology proposed by Yaakub et,al. (2011) for different types of mobile phones i.e. simple mobile phone, wet and dirty mobile phone and smart phone

2. To evaluate and verify the refined version of the ontologies

3. To compare the verified ontologies with the ontology proposed by Yaakub et,al. (2011) by performing sentiment analysis

Below, the results for each objective will be discussed along with an argumentation for why the objective should be considered as achieved.

Objective.1: The results of this work includes a set of refined ontologies, which all take their stand in the ontology proposed by Yaakub et al. (2011), but where the original ontology has been divided into three specialized ontologies for different types of mobile phones, i.e. simple phone, wet and dirty phone and smart phone. The specialized ontologies were developed based on an extensive review of sentiments from world's largest online retailer and multinational electronic commerce company, i.e. Amazon.com. The extensive review of sentiment contributed in capturing the uniqueness of each type of mobile, when it comes to their features. Thereby, this objective should be considered as achieved.

Objective.2: After the ontology proposed by Yaakub et at.(2001) was refined and first objective was achieved, the new refined ontologies were evaluated and verified by extensively reviewing the sentiments from another source of reviews of an online auction and shopping website, i.e. e-bay.com. The extensive review of sentiment contributed in evaluating and verifying the newly refined ontologies for the three types of mobile phones. Thereby, this objective should be considered as achieved.

Objective.3:After the second objective has been achieved the verified refined ontologies were compared with the ontology proposed by Yaakub et,al. (2011). In order to achieve this objective sentiment analysis was done and the results of this analysis contributed by showing results at a higher degree of precision. The sentiment analysis conducted by using the refined ontologies showed negative polarities for some features related to the smart phone and wet and dirty mobile phone. Whereas, sentiment analysis conducted by using the ontology

proposed by Yaakub et at.(2001) showed no negative polarities for the features that were related to the three types of mobile phone. Thereby, this objective should be considered as achieved.

6.2.Methodological Considerations: This research is based on a case study that was conducted on websites www.amazon.com and www.ebay.com . Case study was the most appropriate method if we consider other options that could have been chosen. At the initial stages of the project, interviewing the mobile consumers was also an option. But the amount of data that could have been gathered by conducting interviews would not have been sufficient to fulfill the requirements of the project. A case study as the chosen method in contrast to interview provided huge amount of data that was related to a particular mobile set. Thus data related to different types of mobiles were easily gathered by using case study as the chosen method. The case study provided data that was very much helpful for the analysis and results that were generated by mathematical calculations. The data was in the form of opinions that were extracted from the reviews and then transformed into opinion polarities. The reviews were the source of opinions of the consumers about the product that played pivotal role in this research. Around five hundred reviews were used in order to collect the data for this research. The reviews were written by users from all over the world and during the analysis multilingual reviews were encountered. Reviews that have been written in English were considered. Also during analysis, a lot of grammatical and spelling mistakes were found in the reviews but were ignored since main objective was to extract opinions related to the features of mobile phones. The reason behind choosing three models of smart mobile phones and two models of simple and wet & dirty mobile phones for analysis in this research is that the smart phone technology has been progressing recently. Every company is introducing new features in to their wide range of smart phones in order to make their product attractive and worthy in the eyes of a new customer. Since this research is about extracting opinions of the reviewers about mobile's features and components and then refining the ontology for every particular type of mobile. That was the main reason for choosing three models of smart phone in order to develop and then verify the refined ontology for smart phones that could cover maximum features and attributes that a smart mobile have. Since simple and wet & dirty mobile phone have less features as compared to a smart mobile phone, the two models used for simple and wet & dirty mobile phone in this research for analysis covered almost all features.

6.3.Results in Wider Context:

6.3.1.Scientific Point of View: This research has been connected to the work done by Yakub et,al's research and has been an extension of their work and has fulfilled their desire of the need of conducting experiments for a larger group of products. The ontology proposed by Yaakub et,al.(2011) has been refined for three types of mobile phones. The refined ontologies are based on attributes and features that have been discussed by the reviewers in their comments. Also the comments used in Yakub et,al's research for the extraction of sentiments were very much simple. In this research sentiments have been extracted from the comments that have been written by the reviewers on websites www.amazon.com and

www.ebay.com .These comments were complex and not as simple as comments that were used by Yakub et,al(2011) in their research. Thereby the results of this work assist in bringing forward the work done by Yakub et,al(2011) by refining the ontology proposed by them and also show that there is a need to develop more ontologies for other products. In addition the results contributes to current research by calculating opinion polarities (ogc) by using attribute polarities which decides the positive or negative orientation of consumer of the product's features. The results on the basis of opinion analysis will provide valuable insights and information about that product. This research will also make the decision making process efficient not only for the user of the products but also for the manufacturers of the product. It is also important to discuss when is the need to adjust the ontology. As soon as any manufacturer introduce a new feature into their mobile, the ontology needs to be adjusted for that particular feature accordingly so as to provide precise results in the form of opinion polarities(ogc).

6.3.2.Practitioners Point of View: Mobile phone has been an integral commodity in the electronics market and is one of the most popular device that is used for communication worldwide. Mobile companies are introducing latest technologies and are constantly adding new features into their latest mobile models in order to attract the consumers and to be competitive in to the market. Also, the new users want to be aware of all the new features and the overall performance of the mobile products when there are many options available to the consumer in the market. The motive behind this research is to provide a platform for the future research which will facilitate the readers of the reviews that have been written for a particular product. For the consumer of the product it will provide insights and valuable information about the 'pros' and 'cons' of the product they are interested in buying . This information has been extracted from the comments written by the existing users of the product, thus would help them in making decisions before buying any particular product of their interest. Companies and product manufactures will also get the benefit from this research in the future and it would be very easy for them to track the popularity of their product when there are a number of competitors selling similar products in the market. Also they will be able to judge what features of the product are liked and what features are disliked by the consumer. After conducting sentiment analysis, the companies would be also be able to identify the problems or any bugs in the operating system that have been encountered by the users after purchasing the product. This would help them to increase the overall quality of the product before they launch new model into the market.

6.3.3.Ethical Consideration: Due to the immense popularity of social media and e-business based on the reviews written by the reviewers on the e-commerce websites, some companies post fake positive reviews about their products in order to gain advantage in the market. Also, in order to decrease the popularity of the competitor, another manufacturer of the product can post a fake negative review.

6.4.Future Work: In this research, the extraction of opinions from the reviews were done manually which made the process time consuming. On the other hand after analysis and

calculating the opinion polarities (ogc) the results provided valuable information about the attributes and components of the product. The automated process of extracting features and attributes for which a sentiment has been expressed by a reviewer and an automatic generation of ontologies for other electronic products will be helpful for both the reviewers and readers of the reviews of those products. Thus will make the process efficient. Other electronic products include items like digital cameras, computers, laptops, television sets etc. For all such kind of electronic products the consumer is always concerned about the overall quality and features of the product before buying. After implementation of this research, the readers of reviews will not have to search large number of reviews in order to gain knowledge about the features of a particular product. Also it will be easy to compare the features of the products after the opinion polarity (ogc) will be calculated automatically. Other researchers in future can use the results of this research i.e. the opinion polarities (ogc) that have been calculated to show consumer's opinion about products features. These opinion polarities (ogc) can be used to display an overall rating of the product. This will help the consumer to compare the product in the market with other competitors and will also get an overall rating of the product. These refined ontologies can also replace the option of writing reviews on electronic business websites and instead of writing the reviews the reviewer can be provided a form which has been pre designed on the basis of the features and attributes of a particular product. More information can be extracted from the reviews in the form of opinions by using forms based on these ontologies. This would result in better opinion analysis. According to Meersman (2005), in near future these ontologies will act as a semantic domain for the information systems and will be very useful in e-commerce. Also, there is a need to develop algorithms and software that could detect fake reviews and has the ability to discard them. This would make the process of opinion mining more transparent and reliable for the users.

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Appendix:

Web links of reviews used in objective 1:

Reviews of smart phone model Nokia N8. http://www.amazon.com/Nokia-Touchscreen-Featuring-Navigation-Camera-U-S/product-reviews/B003ZX7RL4/ref=cm_cr_pr_btm_link_2?ie=UTF8&pageNumber=2&showViewpoints=0&sortBy=bySubmissionDateDescending

Reviews of smart phone model Sprint HTC Evo 4G. http://www.amazon.com/HTC-Android-Cell-Phone-Sprint/product-reviews/B004KFXTOA/ref=cm_cr_pr_btm_link_next_4?ie=UTF8&pageNumber=4&showViewpoints=0

Reviews of smart phone model Samsung galaxy SII G-19100

http://www.amazon.com/Samsung-i9100G-Unlocked-Smartphone-Touchscreen/product-reviews/B004QTBQ2C/ref=cm_cr_pr_btm_link_next_2?ie=UTF8&pageNumber=2&showViewpoints=0&sortBy=bySubmissionDateDescending

Reviews of wet and dirty phone model Casio G´zOne. Http://www.amazon.com/Casio-GzOne-Phone-Verizon-Wireless/product-reviews/B000LNFZ7E/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

Reviews of wet and dirty phone model Motorola Tundra.

http://www.amazon.com/Motorola-Tundra-Phone-Black-AT/product-reviews/B001PKTPBY/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

Reviews of simple mobile phone model Nokia 1661.

http://www.amazon.com/Nokia-1661-Prepaid-Phone-T-Mobile/product-reviews/B0027CSIYE/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

Web links of reviews used in objective 2:

Reviews of smart phone model Samsung Galaxy SII G-1900. http://www.ebay.com/ctg/samsung-galaxy-s-ii-gt-i9100-16gb-ceramic-white-unlocked-smartphone-/109611648#pbe-rvws

Reviews of wet and dirty phone model Sprint HTC EVO 4G. http://www.ebay.com/ctg/htc-evo-4g-1gb-black-sprint-smartphone-/102331090#pbe-rvws

Reviews of smart phone model

Nokia N8. http://www.ebay.com/ctg/nokia-n-series-n8-16gb-silver-white-unlocked-smartphone-/101832891#pbe-rvws

*R*eviews of wet and dirty phone model http://www.ebay.com/ctg/casio-gzone-commando-1gb-black-verizon-smartphone-/102536985#pbe-rvws

Reviews of wet and dirty phone model *http://www.ebay.com/ctg/motorola-tundra-va76r-black-at-t-cellular-phone-/99979469#pbe-rvws*

Reviews of simple phone model

Nokia 1661. http://www.ebay.com/ctg/Nokia-1661-Black-T-Mobile-Cellular-Phone-/99985445#pbe-rvws

Reviews of simple phone model

Samsung A 107. http://www.ebay.com/ctg/motorola-tundra-va76r-black-at-t-cellular-phone-/99979469#pbe-rvws

Weblinks of reviews used in objective 3:

iphone 4GS 16 GB

http://www.amazon.com/Apple-iPhone-4S-16GB-Black/product-reviews/B005VGFQXE/ref=cm_cr_pr_top_link_3?ie=UTF8&pageNumber=3&showViewpoints=0&sortBy=bySubmissionDateDescending

Samsung B2100

http://www.amazon.com/Samsung-B2100-Anti-Shock-Bluetooth-International-Version-Black/product reviews/B003ICWA7I/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

Nokia C1-01 GSM

http://www.amazon.com/Nokia-C1-01-Unlocked-GSM-Phone/product-reviews/B0047DVF00/ref=cm_cr_pr_top_recent?ie=UTF8&showViewpoints=0&sortBy=bySubmissionDateDescending

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