Bridging Gaps For Better & Smarter Mobile Applications

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Abstract: In recent years, there has been considerable research interest in mobile applications development, in particular on ontology and context-awareness. In this review paper, the aim is to understand current challenges in mobile applications development and find gaps to bridge for better and smarter mobile applications in the future. We believe the ideas suggested in opportunities will allow researchers to redesign related hardware and software technologies for greater functionalities and better user experiences, and application developers to make future applications that are more productive in the users' context.

Index Terms: Context-Aware, Mobile Applications, Smart Apps, Smartphone, Smart-Shopping

1 INTRODUCTION

MOBILE applications (mobile apps, or apps) are developed for various purposes. Some focus on Quality of Experience (QoE) [1], ontology, context-awareness and personalised life assistance while others are just for business and entertainment. Fig. 1 describes the app development process (http://x-tech.am/mobile-application-development/). In this paper, we have identified some limitations or gaps in mobile apps and have suggested improvements for smart app developments in the future. In section 2 of this paper, we provide an overview of related work, and in section 3, we present some innovative solutions as opportunities. Section 4 concludes with discussion of future works.

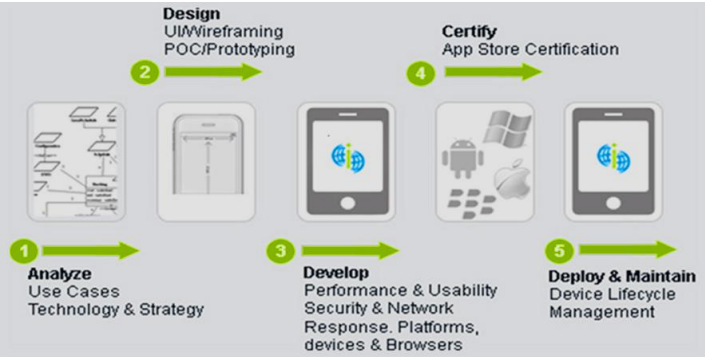

Fig.1 *Mobile App Development Process*

2 RELATED WORK

2.1 Ontology-based models

Ontology based models of context allow (a) representing complex context knowledge and (b) providing a formal semantics to context knowledge, which supports the sharing and/or integration of context information [1]. In [2], an ontology-based mobile app for vaccine information and education prototype was proposed. The application *Vaccine Helmsman* allows users to query the system using *Natural Language Interface* (NLF) to obtain vaccine information. This prototype offers to improve patient education of vaccines on timely basis. However, according to [2], it also has limitations; currently the NLF is limited with vocabularies, supports only two *Vaccine Information Statements* (VIS) documents and has technical constraints such as speech recognition and network latency.

2.2 Context-aware

Context is any information that can be used to characterize the situation of an entity [1]. Furthermore, an entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves. Context-aware assistive mobile applications have recently become popular in medical and health sciences. Medical condition such as *Dementia* is causing a threat to maintaining a mobile lifestyle. Assisting People with Dementia by providing personalized, context aware and user profile model to address outdoor mobility is an idea proposed in [3]. This smart phone driven mobile app will collect context data about the user and adapt to changing user behavior and provide tailored service suited to the user. By far, this app will only work in specific locality and users have to be *Smartphone* literate. Additionally, it has not been trialed out in real-life scenario, thus could lead to a dissimilar decision.

2.3 Short Message Service (SMS)

Short Message Service (SMS) apps in *Smartphones* have been a major information exchange tool for all mobile users. SMS for direct marketing by companies is currently at a rise, communicating all sorts of messages on phones. To control and proof legitimacy of SMS there has been several SMS managers developed [4], however the author proposes all in one ontology-based SMS controller which includes previous features with advancements and exciting new features like content based SMS detection, group chat, SMS text analysis and auto-reply.

2.4 Smart Apps

Next generation mobile apps should focus on the user needs and improve user's lives as in [5]. It should be able to adapt to different contexts, predict users' intentions and provide recommendations respectively and protect users' privacy and trust at the same time. Yet few issues are cumbersome as

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stated in [5] regards to the algorithm and techniques needed for better reasoning and processing of the vast amount and variety of information collected. The authors have suggested using a distributed architecture with external processing and data sources as well as improved processor capabilities, battery life and other capabilities. A challenge waits in the need for users' data and the requirements to preserve users' privacy and trust.

2.5 Smart-Shopping

Recently, shopping using mobile apps has been in rise. *Augmented Reality* based mobile apps have the ability to map real world environment with computer based virtual environments as in [6]. Smart-shopping mobile app matches the image taken through the embedded mobile camera in at a certain angle with the image in its database and output details about that fruit. This app is very handy for busy shoppers, however storing and retrieving image details is still a challenge. Using advanced image processing technology and web service app connected via internet made this challenge a possible. Today's mobile apps are used in many aspects of life. Apart from usual calls and SMS, business customers are using apps to improve customer satisfaction through smart shopping. However, many problems exists such as how to analyze the buying pattern/behavior of a specific customer and how can providers send up to-date information to customers [7]. Developing a system that uses NFC, mobile and web application to provide customers with up to-date information at the same time gather and analyze customer buying habits will assist in solving the problem [7]. This app is excellent; however it has some limitations and complexities. Customers' mobile phones must be NFC enabled Android Smartphone, works online only and lacks security and privacy. Latest trends in mobile usage have shown escalations in mobile marketing. A mobile app to provide customers with a smart shopping experience with the help of social vectors and RFID technology was proposed in [8]. Some of the challenges encountered in this development are; how to identify customers when they enter a shop and how customized marketing messages can be generated and sent to the customer. Meanwhile, [8] employs three approaches to counter these challenge; basic properties of social vectors, rule-based approach and comparison-based approach. Some limitations that accompany this app includes, apart from a Smartphone, customer needs to carry a smartcard, app needs to be downloaded on Smartphone and customer registered. Also the purchase record of the individual is stored on the servers may cause privacy issue.

2.6 Integrated Features

Improvements in Smartphone technology have redefined the usage of mobile phones in this world. Integrated features such as Wi-Fi, GPS navigation, HD camera, touch screen and internet access can be smartly used in cases of emergencies and personal safety [9]. They proposed a mobile app that will make decisions based on drivers heart beat rate, driver location and mobile phone sensor. However, some challenges such as how to measure and input heart beat rate, track user location and detect vehicle accident exist. This app uses *Zephyr* heart rate monitoring device which is worn around the chest by the driver to monitor and transfer beat rate via *Bluetooth* to the mobile device for decision making, use of GPS API to track user location and built in sensor to track accidents. Shortcomings to this app include; if the driver forgets to wear *Zephyr* device, emergency app would not initiate, and also there should be full time internet access available.

2.7 Resource Utilization and Performance

Resource utilization and performance of Mobile apps play an important role in terms of improving and maintaining the quality. Today there is little platform support for tracing app performance in the field. To measure the performance of mobile apps bottlenecks and failures [10] proposes *AppInsight*, a lightweight solution to track performance. The design of *AppInsight* was guided by three principles; low overhead, and zero-effort and immediately deployable. So far it was been tried out on 30 windows platform phones with positive results off course with varying network connectivity, phone hardware and changing environmental conditions.

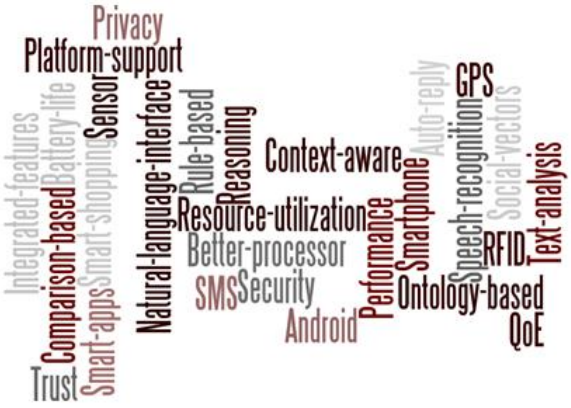

Fig.2 *Areas of opportunities for improvement*

3 OPPORTUNITIES

Better results could be attained if user *Quality of Experience* (QoE) is measured using *QoE Doctor*, a tool that supports accurate, systematic, and repeatable measurements and analysis of mobile app QoE [11]. QoE of real video-on-demand and VoIP apps was measured with over 80% accuracy in [12], which is close to or exceeds the accuracy of approaches suggested by domain experts. Using natural language for mobile app is in rise, in particular in medical field. Moreover, [13] presented open source *Natural Language Processing* (NLP) library for the Android platform that allows various applications to benefit from arbitrary NLP services through a comprehensive, service-oriented architecture. Context-aware applications and platforms have gained popularity in the medical field. [14] and [15] suggested better solutions to context-aware apps and its application. *SenSay* is a context-aware mobile phone that adapts to dynamically changing environmental and physiological states [14]. Similarly, *Prototyping Platform for Context-Aware Mobile Applications* is an open-source prototyping platform for context-aware mobile applications [15]. These devices and apps can also be used in emergencies and personal safety situations where the devices can be worn by drivers and it can perform sensory detection. Rise in mobile shopping has led to developments of many varieties of apps. Some use social vectors and RFID technology, while others use built in features such as cameras, Wi-Fi, NFC and web services to gather customer buying patterns and share information. Using a

combination of social vectors and RFID with NFC, GPS and high resolution cameras and web applications, a more realistic app can be designed for mobile shopping. Shopping outlets can put in their best prices in databases and apps can draw those prices and compare between other outlets and produce a report for the customer based on the context. Mobile application performance tracking used in [10] is a powerful app, however other commercial product such as *New Relic's mobile APM* (mAPM) toolset brings performance data to the surface to help teams focus on ensuring users are getting a great experience [16]. In addition, with *Logentries* [17], mobile app developers and providers can easily and securely log events directly from iOS, Android and HTML5 apps and quickly correlate that information with log events across backend applications, operating systems and infrastructure.

Ontology based SMS manager developed by [4] is a wonderful invention, however few additional features such as SMS archival in cloud based services will be an added advantage as suggested in [18]. Additionally SMS can be synchronized with phone, tablet and computer and entire SMS inbox can be exported to a single *.csv* file.

4 Conclusion

In this paper, we have studied various works towards understanding mobile apps current limitations and opportunities in gaps to bridge for its improved functionalities and performance in future app development. With the increasing power of smartphones, more can be expected. The literature review has revealed numerous studies on context-awareness and ontology based with embedded features and its focus today. In addition, smart shopping and app performance monitoring apps are also in demand. Our future work will focus on developing a smart shopping app based on context-awareness.

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