

# Proposed Profile Translation based Proactive Adaptation using Context Management (PTPACM) in Smartphones

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**Abstract**— Mobile technology and Internet is becoming an integral part of our daily life. Various transactions like shopping, ticket booking and banking transactions have been done on the fly. The technology like Smartphone adds portability for these activities. To manage information and applications on Smartphone, user must provide credentials or profiles to service provider with their details filled by logging onto different websites. To this purpose, user's profile resides in control of multiple service providers. Due to this, duplication of data occurs which will lead to a data inconsistency. To overcome these issues, this paper proposes Profile Translation based Proactive Adaptation using Context Management (PTPACM) in Smartphones which automatically generates user's profile according to the scenarios. Proposed system allows keeping user's full profile in user domain resulting into centralizing or exchanging the profile information with increase in the consistency of profile information. This paper presents the layered architecture for PTPACM with Context Awareness Layer, Proactive Analyzer Layer and Profile Translation in a system. This paper also presents probabilistic representation of PTPACM as well as pseudo codes for different operations in the functional blocks of presented architecture.

**Keywords**— Context, Context-Awareness, Mobile, Proactive system, Profile translation, Smartphone, User profile

## I. INTRODUCTION

Advances in mobile technologies and Internet access make users' life very comfortable and convenient to do the work very intelligently. Traditionally Internet uses client-server model. Client requests for some pages and server responds to client or client may give his information to server if required. This is a reactive model. To give more ease at the client end we can use concept of proactivity. Proactive service can be defined as giving response without explicit request. In proactive systems, user is provided with different suggestions according to the different situations. So proactivity means that the system pushes recommendations to the user when current situations seem appropriate [1]. To apply proactivity we should store user's information, situation or some rules (context) and to enhance proactivity, concept of context awareness is applied [2].

It has become common practice for retailers, banks, service providers, and just about everyone else to provide

customers with a way of shopping on the Web. So every service is being computerized and made available to users online. Many users are using these online services through their desktops or through the Smart phones. Due to the emerging of centralized markets, we have seen an explosion in the number of applications for Smartphone. So here, concept of context aware proactive system is applied on android Smart phones to provide information of user proactively to the service provider. In this paper, we discuss the properties which are required for designing framework for Context Aware Proactive System running on Android platform [3]. And also introduce an approach to improve the privacy and address consistency of information [4]. This proposed PTPACM work is extension of our previous work [5].

The rest of this paper is structured as follows: Section II highlights the motivation behind this research work. Section III reviews the related work. In section IV, proposed PTPACM and the workflow is presented. Implementation details are presented in section V. Section VI describes the probabilistic representation of PTPACM. Finally, section VII concludes the paper with future outlook.

## II. MOTIVATION

In current scenario, profile of user is stored at service providers. As one user uses various kinds of services, his profile is stored at different places. Each service provider uses their own personalization architecture. The credentials in user's profile keep on changing frequently as time, place, and interest areas of user changes. So, user needs to remember all different credentials that he has submitted at different places. User must update his information with all the service providers he is interacting with. This is a tedious task. In this way storage of profile database at service providers raises the issues concerning privacy and consistency of the information. This can be made easy if the profile is under user's control [4].

Context awareness is a potential technology for mobile devices as it can facilitate the device use in demanding situation by dynamically adapting the device behavior. Context awareness systems are also the component of ubiquitous environment and pervasive environment. Therefore, storing the profile at user domain and providing it

to the service provider can be made convenient using context aware proactivity.

### III. RELATED WORK

Wuest, Droegehorn and David proposes idea for profile translation which stores the profile at user domain and not at the service provider [4]. The Microsoft passport service [6] and the Liberty Alliance [7] are the efforts to keep a service independent user profile.

Passport uses the existing web technologies to the best of its abilities to store user credentials. Unfortunately, this poses several risks to the user [8]. David and Rubin examined the Passport single sign-on protocol, and identify several risks and attacks.

Schilit and Theimer [9] introduced the term ‘context aware’ first time. Context-aware computing was discussed by them in 1994 to be “software that adapts according to its location of use, the collection of nearby people and objects, as well as changes to those objects over time.” This definition is more specific claimed by Dey. Dey defines more general definition of context as “Context is any information that can be used to characterize the situation of an entity [10].” 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[11]. In other words, any piece of information that the system has is a part of the system’s context. The aspects of context include, but are not limited to, location, identity, activity, time. An author defines context aware system as “system is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user’s task [10].” Now many context aware systems are developed. Everyone uses different approach to make system context aware.

One such type of approach is intelligent system architecture for dealing with context-aware application services in pervasive computing environment [2]. In [12], the author proposed architecture and the Hydrogen Context-Framework which was extensible to consider all kinds of context information and comprises a layered architecture. Moving towards the context awareness on mobile / portable devices, in [13] ,a server-based middleware CASS (Context-awareness sub-structure) is presented. That supports context-aware applications on hand-held and other small computers describing how mobile applications can benefit from the ability to use high level context data. Context aware system has also shown its enhancement through android. The concept of *ContextDroid* which is an Expression-Based Context Framework for Android is explained in [3]. In [14] the terminal is enhanced by providing it with content information which is retrieved, ranked and formatted for specific user. Author proposed the Architecture for Context aware Proactive Recommender System in [15]. This recommender system provides recommendations proactively by using multi-agent technology. More specific solution of context aware proactive application on mobile can be PEMA [1]. The architecture with multiple agents for tourist guide application is referred in [16] which apply proactivity to the mobile.

A lot of work has been done on Context Aware Proactive System. With this, we analyzed the previous work and according to our context of research we have taken out the common parameters for evaluation. The evaluation Table 1 below shows state of art. So, we are addressing all the parameters in the proposed architecture which have not been paid attention in the literature.

TABLE I. EVALUATION OF THE RELATED WORK

Existing Solution	Context Quality	Portability	Extensibility	Data Personalization	Data Consistency
[1]	×	√	√	√	×
[2]	√	√	√	√	√
[3]	√	√	√	√	×
[4]	×	×	√	×	√
[12]	√	×	√	×	×
[13]	√	√	√	×	×
[14]	√	×	√	×	×
[15]	×	×	√	√	√
[16]	×	√	√	×	√

√: Corresponding parameter is present in that particular solution

×: Corresponding parameter is lagging in that solution

### IV. PROPOSED PTPACM SYSTEM

With the increasing use of web apps present in Smartphone it has become tedious job for the users to provide the detailed profile to service provider. In current scenario the user’s profile is maintained by service providers. When the particular website requires the information of user, whole profile is provided by the user. But this is actually not relevant because all the information is not needed. Accordingly, only the specified information of the usage should be provided. So here we propose a system which is android based and generates specific profile for specific website. As if the website relates to shopping, the profile would contain only the name, postal address and contact or online reservation will require name, age etc. So according to the requirements, different profiles of user are generated. These will be the abstract views of actual profile of user. And these abstract views are provided to the service provider.

Now to recognize what profile is needed by service provider we use the concept of context awareness. Context in our terms can be referred as all the web apps in a Smartphone also all different kinds of websites that user visits through these Apps. Recognizing which website/webapp or which action of user needs generation of such profiles is referred as context awareness. Being context aware, the system recognizes need of an abstract views of profile which is provided proactively i.e. before user requests. When user tries to open an app which

requires profile then this will be recognized and while that site loads, profile will be generated automatically. To generate these views proactively we should know the credentials needed for that website. Generating the profile according to the context determined is the foremost task of the application. The personalization of data is to be done at user side itself. The profile database is to be stored in the Smartphone.

This is android based context aware proactive system which manages user's whole profile information and gives abstract view of profile according to the current context requirements [4]. As whole profile information is stored at one place consistency of information will be maintained. Profile of user will be in user's control and not of service provider. In this way it becomes convenient for user to update his profile. He can update his profile stored in the database and next time when he visits different websites, this updated information will be made available to that website proactively.

This paper includes:

- Emphasis on the fact that for ease of generating user profile it is necessary to design framework which includes storage of user credentials, accepting the queries, fetching the requisite data to application with its needs.
- The structural designs that will give the clear and distinct idea about how each layer is interrelated to each other and equally contribute to all.
- The necessary requirements for Context Framework in Smartphone.

#### A. Proposed Architecture

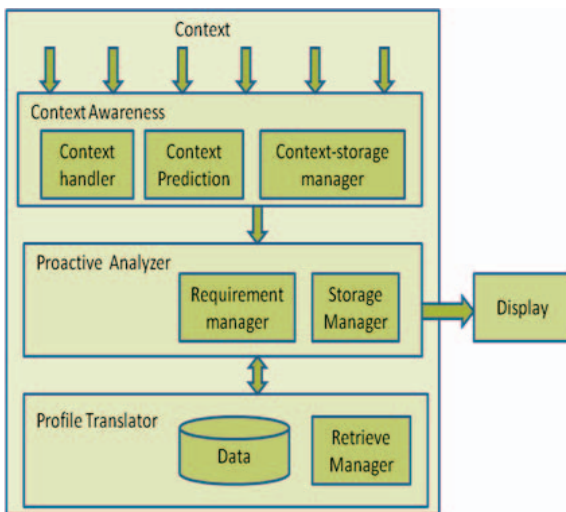


Fig. 1: Proposed System Architecture

The Fig. 1 summarizes layered architecture for the proposed system which incorporates interrelated functionalities. The detailed description of each layer is as follows.

#### • Context Awareness Layer

Context is taken as main input to the system. The basic task of context handler is to recognize the current context in which user is operating. Recognition of context can be done by checking stored context. Sometimes it may happen that the user is using that app first time or navigating the new web site. Now, if user is in new context then the whole data is passed to Context Predictor. Context Predictor checks if this current context needs the profile to be generated. If require then this context is passed to Context Storage Manager. Context Storage Manager stores new context or updates previous data according to the situation. This way, first layer recognizes the context that is nothing but the situation awareness and suggests if current context is appropriate for profile translation. And finally forwards this contextual information to the next layer.

#### • Proactive Analyzer Layer

It takes the contextual information which is provided by upper layer. The Requirement Manager in this layer will gather all the required information of the profile. This is done without user's request which is nothing but extracting the requirements from the context proactively. Here, best results can be achieved by properly examining the current context and gathering results accordingly. After this accumulation, the data is pushed to the next layer.

#### • Profile Translation

The layer takes the requirements from second layer via Retrieve Manager. It will check if those user requirements are fulfilled by the database. If the user requirements are satisfied then it creates the abstract view of profile. The layer will pass this abstract view to the Display Manager from Proactive Analyzer Layer. It will display the view proactively.

For secure profile translation authorized user can access this web app with authentication. And also cannot update profile without login to the system.

#### B. Use case of PTPACM

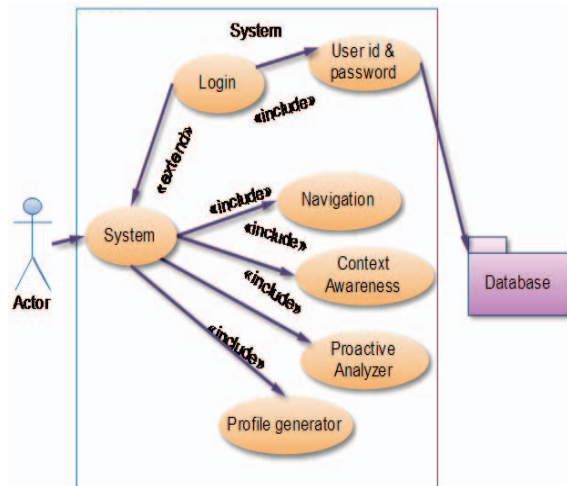


Fig. 2: Use Case Scenario

Fig. 2 shows the use case for the context aware proactive system. Here user is able to update his profile database which is stored on device only. When user visits the website, his credentials are automatically get filled by the system by context awareness mechanism which includes requirement gathering and creating required profile view using profile translation

### C. Proposed Algorithm

Let,  $C \leftarrow \text{context}$   
 $A \leftarrow \text{User's Action}$

**Sense** function will sense user's action and will return current context. This context is passed to the ContextHandler. **ContextHandler** will handle this context. Handling of context is done by using stored context information. Here, **NewContext** function takes context as input, compares it with stored context and returns true (Boolean value) if the context is new i.e. not available in stored context. If so, then **Predict** function is called in **ContextPredictor**. **Predict** function checks if current context requires profile to be generated. If yes, the **ContextStorageManager** will store the new context. If profile generation is not required then reject current context and goto step 1 to repeat i.e. again sense user's action. Now if current context is not new context i.e. old or stored context then directly goto step A.2. At the end the context that needs profile to be generated will be passed to the **ProactiveAnalyzer**.

```

1]  $C \leftarrow \text{Sense}(A)$ 
A]  $\text{ContextHandler}(C)$ 
  A.1 if ( $\text{NewContext}(C)$ )
     $\text{ContextPredictor}(C)$ 
    a] if ( $\text{Predict}(C)$ )
       $\text{ContextStorageManager}(C)$ 
      Goto step A.2
    Else
      Reject context;
      Goto step 1
  Else
    Goto step A.2
A.2  $\text{ProactiveAnalyzer}(C)$ 

```

Let Profile type can store whole profile of user which contains attributes and specific values of these attributes i.e. attribute – value pairs.

So Profile  $P = \{ T_1, T_2, \dots, T_n \}$

Where  $T_i = R_i V_i$

$R_i = i^{\text{th}}$  attribute

$V_i = \text{value of } R_i \text{ attribute}$

Profile  $P[1..n][1..n] \leftarrow$  set of attribute-value pairs in user's profile

Credential  $[c1..cm] \leftarrow$  set of attributes

AbstractView  $[a1..am] \leftarrow$  set of values

In this algorithm **FindAttribute** function will scan the context and will check if any attribute to be retrieved is present in the context. If present, the function returns true or false otherwise. Using **GetAttribute** function one attribute from the context is saved into credential array and is marked as taken. Now at the end of while loop we get all attributes that should be retrieved in credential array. Now compare each attribute in credential array with each profile entry to retrieve values. If match is found then retrieve value in **AbstractView**. And if no match is found in whole profile then make new attribute entry in profile. After all comparisons we get abstract view of values in profile. Pass it to **ContextStorageManager** which will store and display it to user.

*ProactiveAnalyzer (context C)*

A] While ( $\text{FindAttribute}(C)$ )

A.1]  $\text{credential}[] \leftarrow \text{GetAttribute}(C)$

B] While all attributes in  $\text{credential}[]$  are not checked

B.1] for each attribute in **Profile P**

a] Compare **current credential** with attribute in **P**. If matched

$\text{AbstractView}[] = \text{value in } P$

Break for loop

B.2] If **current credential** Not matched with any attribute Make new attribute entry in profile **P**

B.3] increment **current credential** index

C]  $\text{ContextStorageManager}(\text{AbstractView})$

C.1] store and display AbstractView to user

### V. IMPLEMENTATION DETAILS

PTPACM proposed in this paper is implemented on Android platform as it supports context aware framework, as well as proactive user interface.

The screenshot shows a mobile application titled "MyProfileGenerator" running on an Android device. The interface is a web browser view displaying a form for creating a profile. The form includes the following fields: "Email address" (filled with "advaitrailkar@gmail.com"), "First name" (filled with "Advait"), "Last name" (filled with "Railkar"), "Desired username" (empty), "Choose a password" (empty), "Re-enter password" (empty), "Nationality" (dropdown menu showing "- Select -"), "Current location" (dropdown menu showing "- Select -"), and "Mobile number" (filled with "91-"). A "Save Profile" button is located at the bottom of the form. The status bar at the top shows the time as 11:45 AM and the battery level at 55%.

Fig. 3: Initial attributes displayed after entering the URL

Android platform provides android.webkit.WebView component to give browser view. The page source of the desired url is parsed (javax.swing.text.html.parser) to extract



the input tags. This class allows reading the different tags, its attributes, values and all other details. So that application can access the input tags with its name attribute which is nothing but credentials. If this credential is not present in database then a new entry is added or if it is already present in the database (SQLite), then at the time of url loading the application access those credentials and fills it in page. Figs 3, 4, 5 show snapshots for the same.

Fig. 4: New attributes entry in the profile

Fig. 5: Restored attributes displayed to the user

## VI. PROBABILISTIC MODEL

User visits websites which needs the details of the user for the application such as ticket booking, transactions etc. Therefore, considering visiting sites which are having profile details (E) and visiting a site which does not require details of the profile user (N).

Set  $R = \{1, 2, 3, \dots, n\}$  which considers all possible outcomes in given set i.e. E (profile details) and N (not required details of profile user) and Matrix  $P = \{P_{ij}\}$  where all matrix entries satisfy  $0 \leq P_{ij} \leq 1$ .

In short, this matrix is represented in the form of Graph Adjacency Matrix;

$P(G) = P_{ij}$  of the graph G is the matrix with,  
 $P_{ij} = 1$  if  $(i, j) \in E(G)$  i.e. required field value of the profile.  
 $P_{ij} = 0$  if  $(i, j) \notin E(G)$  i.e. not required field value of the profile.



Fig. 6: Visiting Sites of the User

Consider scenario in Fig. 6 as visiting sites of the user. Below matrix in table II, symbolically can be represented as,

Let,  $\text{Row\_sum}(\text{Service}) = X$ ,  
 $\text{Column\_sum}(\text{Attributes}) = Y$ .

Where, X gives count of attributes requirement for particular service. And Y gives occurrence of particular attributes in different services.

TABLE II. ADJACENCY MATRIX FOR USER DETAILS X VISITED SITES

	Name	Email	Phone	credit	Address
www.ebay.in	1	1	1	1	1
www.amazon.com	1	1	1	1	1
www.railway.gov.in	1	0	0	1	1

Event E is set of all actual possible outcomes which are required in visiting sites; Event N is set of all non-important sites where  $N = R - E$  and Sample Space  $R = \text{Set of all possible outcomes which are finite sites called as sample points as visiting and non usable sites.}$

According to Bayes' rule there are two possibilities such as

1. If the given site is not having profile details are called as Independent Events.

$$P(R/N) = P(R) \quad \text{and} \quad P(N/R) = P(N) \quad (1)$$

2. If the given visiting site requires profile details are called as Dependent Events or Mutual Events then, Conditional dependent events occurred

$$P(E_i/R) = \frac{P(E_i).P(R/E_i)}{P(E_1).P(R/E_1) + P(E_2).P(R/E_2) + \dots + P(E_n).P(R/E_n)} \quad (2)$$

Where E = Mutual Events,  $\{E_1, E_2, E_3, \dots, E_n\}$

## VII. CONCLUSIONS AND FUTURE WORK

In this paper, we have proposed the architecture for providing proactivity in Smartphone, using profile translation architecture. In this paper we also proposed a pseudo codes for different operations in the functional blocks of presented architecture. While accessing website usually user has to provide some credentials which is under service provider's control. But keeping some constraints like consistency of data and privacy in mind, user controlled profile is put into the implementation of the proactivity model for android smartphone. The android based context aware proactivity framework is a step towards user control vision in Android Smartphone system. Speed of brain indeed very fast but typed, written or spoken command is not. So if context awareness can decrease the phase of input the profile information, it will increase the efficiency

Current and future work includes the implementation of the remaining system, and a field study to evaluate it with users interacting with a mobile device in a realistic scenario in order to have a better feedback related to use this kind of proactive systems in daily life.

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