ISSN No. 0976-5697

Volume 5, No. 5, May-June 2014

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

Context Aware Intelligence: A Framework for Immersive Customer Experience

Amit Badheka
Senior Technical Architect
Research & Innovation, IGATE Global Solutions
Mumbai, India
amit.badheka@igate.com

Abstract: In this paper, a novel approach for developing context aware solutions for enterprise applications is presented. We have developed a new approach to building intelligent business applications that provide adaptability and efficiency to existing business process, thereby enhancing the customer experience. The approach is modelled around 'Situation' of an entity. The context engine uses intelligence to extract and analyze the contexts and act as demanded by the situation. The viability of the context engine is exemplified by a use case from the financial services domain, and uses various contexts of an investor to provide relevant recommendations.

Keywords: context aware solutions, context aware intelligence, context engine and insurance

I. INTRODUCTION

Products like Google Glass™, and Google's Self-driving Car tend to excite many people across the world. However, these are just a few examples to establish that we are heading towards the age of Context Awareness, where technology can fulfill the promise of personalized experiences at an unprecedented level.

By using information about the user's context, applications can be made intelligent enough to infer the user's intent; and therefore, influence his behavior. Context awareness originated as a term from ubiquitous computing and has been a topic of research since last few decades [1, 2, 3, 4, 5]. However, recent developments in smart mobile devices, ubiquitous presence of sensors, affordable wireless communications, big data technologies and proliferation of social networks enable organizations to leverage technologies related to location tracking, proximity awareness, voice recognition, social media integration and so on, to build context aware intelligent solutions.

This paper describes how enterprise applications can be enhanced with context aware services. We present a conceptual framework for modeling Context Aware Intelligence (CAI). The architecture of our platform, based on this framework, is discussed in detail. How such a platform can be used to enhance customer experience is then described through a case study.

II. CONTEXT AWARE INTELLIGENCE

Context Aware Intelligence (CAI) helps enterprises identify and develop adaptive enterprise applications.

A. *Conceptual Framework:*

We have defined four core elements of a solution based on CAI as below:

a. ***Entity*** – 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 application.

b. ***Sensing*** – This provides a means to acquire data or information about the physical world or some aspect of the physical world.

c. ***Thinking*** – Analysis and Reasoning about sensed data to obtain information that together with other (perhaps built-in) knowledge can then be used to infer the context or situation of entities.

d. ***Action*** – Action that can be performed in time to be of use for the user, and in an ideal situation, provides control to the user over the action taken.

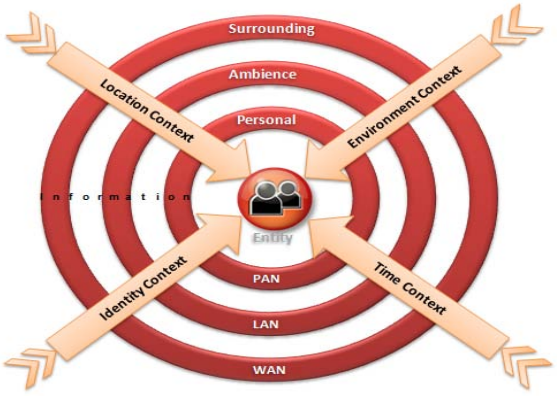

Figure 1: Context Aware Intelligence

As shown in Figure 1, we have considered multiple levels of context, for the purpose of collecting information:

a. ***Personal*** – Any contextual information about the entity that can affect the behaviour of application. The objective is to derive information about the entity such as Identity (Who), Intent (Why), Action (What/How) and so on.

b. ***Ambience*** – Any contextual information about the immediate environment around entity, that can be sensed. The objective here is to derive Temporal (When) and Spatial (Where) information about the environmental condition in which events are happening.

c. ***Surrounding*** – Any contextual information beyond 'Ambience', that can vary from a city to a country or a continent. The object here is to derive information related to business and social data that stretches the geographical boundaries.

For simplicity and completeness of context modeling in enterprise applications, we have classified contexts into the

following four basic categories, which are also depicted in Fig. 1:

a. ***Identity Context*** – This category considers data about entity such as user profile, intent, actions, characteristics, demographics, preferences, interest and history.

b. ***Location Context*** – Location can be described in different ways, depending on the application requirements such as local vs. remote, relative vs. absolute, location point vs. location area, and so on. The two main groups that we have considered are physical vs. geographical.Physical location is related to a global geographic coordinate system and provides an absolute, accurate, grid based position in the form of a <latitude, longitude> pair. Geographical location is used to deal with natural geographic objects, such as countries, cities, and also zip codes, postal addresses and so on.

c. ***Time Context*** – This category deals with information required to handle dynamic environment in the application such as change of situation over time, support for inference on various changes that may take place over a period of time, time zones, time interval and so on.

d. ***Environment Context*** – This category deals with physical objects and devices that exist in an application environment, and participate in data acquisition, reasoning and action.

B. *Enterprise Architecture:*

IGATE's Context Aware Platform (ICAP) provides a scalable and flexible solution for integrating information from different sources such as social networks & external interfaces, IGATE's Context Aware Framework (ICAF) and the application services.

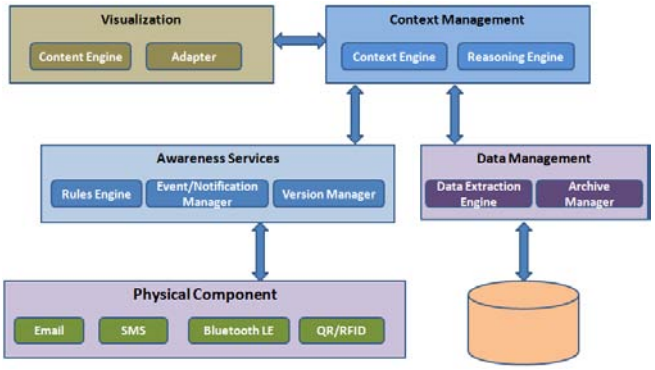

Figure 2: ICAP Architecture Layer

ICAP provides a layered architecture for building CAI solutions and building context aware application functionality as shown in Figure 2. The layers defined are very generic and provides loose coupling between various components. The architecture provides flexibility to pick & choose components from various technology options as required for implementing specific business requirements. The main layers of ICAP architecture are:

a. ***Visualization*** – The visualization layer deals with the user interface (UI) and interaction level components. Some key components in this layer are content engine and channel adapters.

b. ***Context Management*** - The main responsibility of components in this layer is to identify and acquire the context, check for change in state of context, identify impacted situations and evaluate them. The main components in this layer are context engine and reason engine for context analytics. It is also responsible for taking into consideration user security & privacy, before evaluation of user situations.

c. ***Awareness Services*** – This layer has components necessary to define context rules, generate and send events, notification, and context versioning.

d. ***Data Management*** – This layer deals with the interaction with various interfaces for data extraction, retrieval & aggregation, and archiving.

e. ***Infrastructure***– This layer takes care of physical hardware and infrastructure such as sensors/ devices required to sense contextual information.

C. *Context Aware Framework:*

IGATE's Context Aware Framework (ICAF) is a 'Situation' based framework. The Situation based application allows us to focus on two main things about the entity – intent and the state of its environment. The Situation model in ICAF provides a way to describe the Situation that can be easily recognized. The Context Manager monitors the state of contextual information, and evaluates the respective situation in case of a change in user environment as defined by the situation. Figure 3 below provides an overview of ICAF.

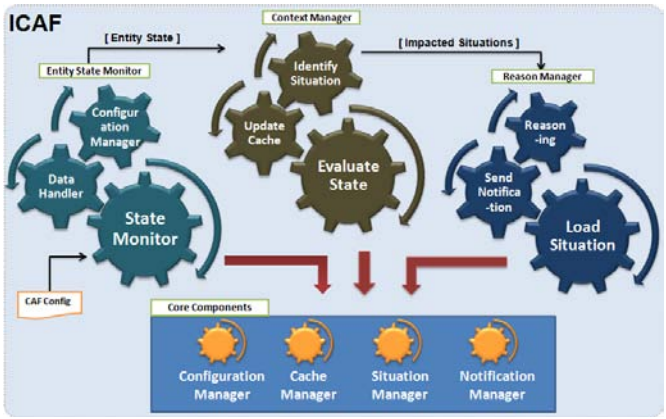

Figure 3: Context Aware Framework

Key features of ICAF are:

a) Situations based framework to make it easier to build CAI applications

b) Integrated Cache management and In-Memory data handling capabilities provides high performance data processing

c) Framework that can be configured (rather than requiring any custom coding) to provide adapatability to various business domains

d) Rapid development of CAI applications

The ICAF approach supports the creation of adaptive and intelligent applications by providing alternative solutions for various technology components, supported by suitable development artifacts like reusable libraries, implementation guidelines.

III. CASE STUDY – CAI IN INVESTMENT MANAGEMENT

The use case considered here is to enable an investment plan provider (or Third Party Administrator (TPA)) to generate relevant, personalized recommendations that influence investment decisions by using various contextual

information about the investors such as: (a) demographic details (age, gender), (b) current financial details (annual income and any changes to it), (c) past investment details (plans invested, current fund status), and (d) social details (contribution and returns of other people, investment sentiments, changes in social status such as marital status). This is depicted in Figure 4 below.

Figure 4: CAI in Investment Management

A. *Objective:*

The investment management solution built using ICAF provides personalized information, and empowers investors to take informed decisions about their investments. The main objectives of this application are to demonstrate the following aspects of ICAF:

a. Easy-to-define Situations in investment management process, that can be evaluated without an investor's intervention
b. Situations that can consume data from various sources to generate contextual information of the investor and provide relevant recommendations.
c. Ability to get information such as social network data, market data and investor details such as financial details (income), investment details (plans invested, current fund status), and social details (contribution and returns of other people, investment sentiments).

B. *Business Scenarios:*

The application demonstrates three scenarios where an investor has invested in a retirement plan (referred to as 401(k) plan in the US). Investor needs to be regularly informed about his contribution and the return on investment so that he/ she is able to take informed decisions that may result in better accumulation of funds for retirement. The situations that were implemented as a part of this case study are as follows:

a. ***Deferral rate situation:*** The situation determines the deferral rate, i.e. contribution rate of investor, and evaluates the situation on various parameters such as: comparing investor's deferral rate against average deferral rate of 401(k) plan, average deferral rate by investors in same gender, annual compensation and age group. The system then generates notification to the investor so that he/ she can adjust the contribution rate for better retirement fund.

b. ***Return rate situation:*** The situation determines the return rate of 401(k) plan in which investor has invested in, and evaluates the situation on various parameters such as comparing investor's return rate against average return rate of 401(k) plan, average return rate by investors in same gender, annual compensation and age group. The system then generates notification to the investor so that he/ she can adjust the investment for good returns and hence better retirement fund.

c. ***Investment mood situation:*** The situation determines how the investor is feeling about investments, based upon his chatter on social networking sites. Such social data is analyzed, by applying sentiment analysis to determine things like person looking for new investments, feeling happy/ not happy about the returns on investments and so on. Based on these findings, that person is provided with relevant, personalized recommendations.

C. *Solution:*

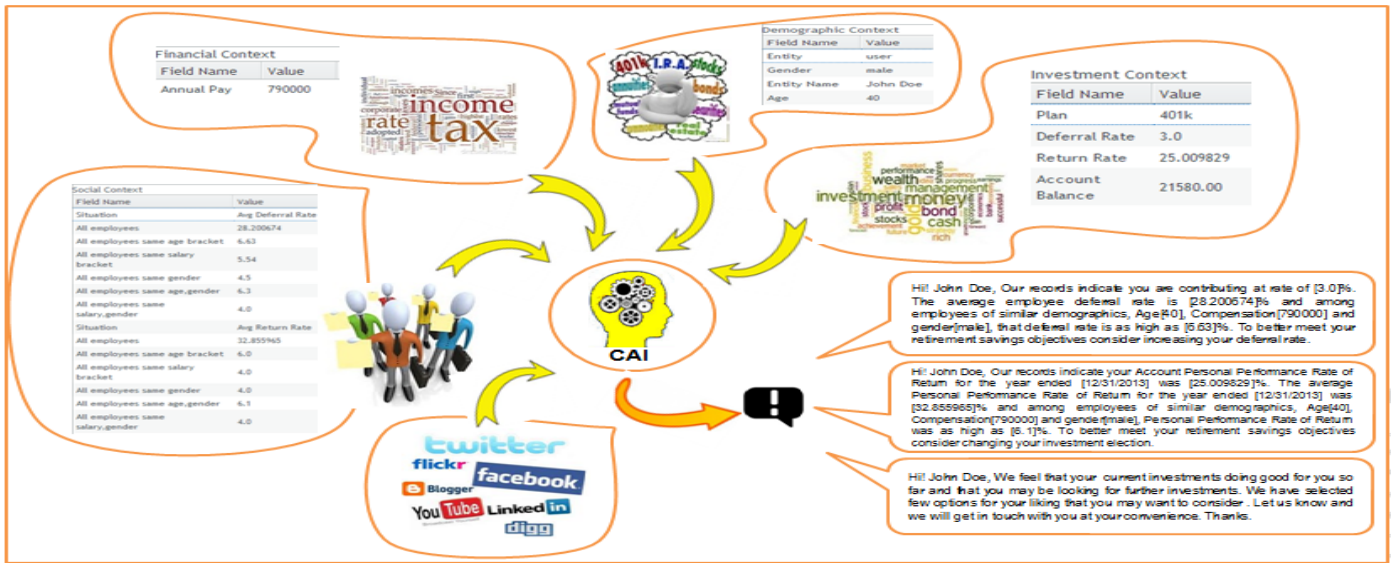

Figure 5 : ICAP based Investment Management

The context aware investment solution is built using IGATE's Context Aware Platform (ICAP). We defined situations, by providing the intent and environmental information (context) that can recognize the situation. The environmental information we considered for both these situations are personal details (name, gender, age), financial

details (annual pay), investment details (investment plan, contribution/deferral rate, return rate, current fund status), social details (investment information about other investors in same plan, age, gender, pay group). ICAP based Investment Management solution is depicted in Figure 5.

ICAP provides a data extraction layer for seamless integration with various social networking sites and external systems to fetch data required for situations defined in the application. We are fetching huge amount of data from social networks and pre-populating them for further analytics like sentiment analysis. ICAP also provides faster query based data retrieval, which is seamlessly integrated with ICAF using the handlers. ICAF context manager evaluates data as per polling policy, and evaluates the situation depending upon the state of contextual information. It also generates notifications, which the investor can access using either web channel or mobile channel. ICAP also provides synchronization capabilities between various devices for enriched user experience.

D. Implementation Challenges:

Context aware computing is an emerging technology in mainstream application development. The retail industry is the one that has seen maximum adoption of this technology. Some challenges that we identified in adopting this concept in financial services domain are:

It was a challenge for us to identify a framework that can support multiple channels such as web and mobile, since most commercially available context aware solutions were focused on mobile channel only.

It was a challenge to build context engine that can analyze any kind of situation from location based to custom ones specific to business scenario, and generate relevant notifications.

Data retrieval and aggregation was a challenge since information can come from many sources.

IV. CONCLUSION

In this highly competitive age, organizations need to offer innovative products & services, be effective in product selling, and ensure efficiency in service provisioning. It becomes very important for organizations to understand end-user needs, what worked for him/ her, and what did not to provide personalized service experience to each and every end-user. The rise in smart mobile devices, use of sensors for device communications and social networks are the catalysts that an enterprise can leverage in order to keep customers regularly informed with relevant information, to make decision making easier. ICAP and ICAF are examples of how such personalized, decision-support capabilities can be provided to individuals in a relatively easy, configurable manner.

V. REFERENCES

[1] B. Schilit, N. Adams and R. Want, “Context Aware Computing Applications,” 1st International Workshop on Mobile Computing Systems and Applications, 1994.

[2] C. Bolchini, C. A. Curino, E. Quintarelli, L. Tanca and F. A. Schreiber, “A Data-Oriented Survey of Context Models,” SIGMOD Record, Vol. 36, No. 4, 2007, pp. 19-26.

[3] P. Lombardi, V. Cantoni and B. Zavidovique, “Context in Robotic Vision: Control for Real-Time Adaptation,” International Conference on Informatics in Control, Automation and Robotics, 2004.

[4] G. Chen and D. Kotz, “A survey of Context-Aware Mobile Computing Research (Tech. Rep. TR2000-381),” Department of Computer Science, Dartmouth College, Hanover, 2000.

[5] A. Dey, G. Abowd and D. Salber, “A Conceptual Framework and a Toolkit for Supporting the Rapid Prototyping of Context-Aware Applications,” Human-Computer Interaction, Vol. 16, No. 2-4, 2001, pp. 97-166.

[6] Belko Abdoul Aziz Diallo, Thierry Badard, Frédéric Hubert, Sylvie Daniel, “Mobile and Context-Aware GeoBI Applications: A Multilevel Model for Structuring and Sharing of Contextual Information”, 2012

