A Context-Aware Requirement Model for Agriculture System on Mobile Apps

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ABSTRACT: *Mobile applications are software programs that can be based on different mobile devices and operating systems such as android, ios, symbians etc. These are not only just desktop applications reformatted for a small display but also has the ability to communicate to anywhere to make essential changes and to show how user interact with an application needs to be dealt with. This paper presents a requirement model for specifying different contexts in a comprehensive and integrated manner. It also constitutes a model that shows a conceptual and logical approach that combines different ontology and different context parameters. This paper explores and evaluates to present how information can be provided through mobiles via different contexts. This paper also comprises how the required information will be given to farmers through mobile applications to some extent.*

Keywords: Context, Context Elements, Context Awareness, Domain Ontology, Contextual Information and Coalition

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1. Introduction

Context-aware computing is a mobile computing paradigm in which applications can discover information and can provide relevant contextual information. Mobile and context-aware computing applications respond to changes in the environment in an intelligent manner. Context-awareness feature includes context to present information and services to a user. Using context it automatically executes service for a user and provides information to users. Context-aware applications can utilize numerous different kinds of information sources. Often, this information comes from sensors, whether they are software sensors detecting information about the networked, virtual and hardware sensors detecting information about the physical world. Specifically, context-aware applications tend to be enhanced mobile applications due to the user context changes frequently subject to the user's mobility, behavior and the need for context-aware behavior is greater in a mobile environment. The recognition of context means that the user's information needs can be anticipated and responded to in a more automatic manner. Information and service needs may vary according to the user's immediate situation. To make more effective to mobile apps, applications running on mobile platforms should be aware of the user context and adapt to any change occurred.

Section 2 discusses overall work in the area of context-awareness in mobile applications. Section 3 presents the context-awareness and architecture of context-aware model in mobile apps development. Section 4 represents requirement analysis of an agricultural system based on context elements. The proposed requirement model is given in section 5. Implementation of this model is given in section 6. Conclusion remark and future work are given in section 7.

2. Related Work

The rapid advances in the technologies of mobile computing and wireless communications have brought opportunities for various mobile applications running on handheld devices. Through enabling technologies, for e.g. Wi-Fi and 3G mobile application users may access services such as payment through mobiles and share information at anywhere & anytime. To be more effective applications running on mobile platforms should be aware of the user context and adapt to any change occurred in the surrounding environment. For instance, consider a taxi booking application that filters search results based on the user location and returns only the relevant results. Mobile internet services enable access information in more flexible manner. Color displays and the growing capacity of more developed mobile model have brought about enhanced visual appeal and user interfaces. However the services are unaware of the user's context. The service is the same regardless of the changes of the user's surroundings and the mobile device is not aware of the user's mobility. In fact, contexts have been used in various applications in mobile devices that deal with modeling situations, beliefs, probabilities, spatial, and temporal relations, web semantics, integration of heterogeneous knowledge resources and databases. In context-aware mobile computing [8], the application adapts not only to changes in the availability of computing and communication resources but also to the presence of contextual information. Context aware system should be aware of the very specific context that falls in its management responsibility including, context storage, dissemination, adaptation, provision, reasoning and system behavior with respect to context management. It means that ability of the context aware system should adapt and consequently react to the expected dynamic changes of the context. Context-awareness is a maturing area within the field of ubiquitous computing. It is particularly relevant to the growing sub-field of mobile computing as a user's context changes more rapidly when a user is mobile, and interacts with more devices and people in a greater number of locations. Context-awareness is also a field in the wide range of pervasive or ubiquitous computing [12]. Context-aware systems are able to adapt their operations to the current context without explicit user intervention and thus aim at increasing usability and effectiveness by taking environmental context into account. Due to the nature of context-aware applications, which often react to changes of the context during their execution, context server is provided a subscription-based push mechanism [12] which provides synchronous access to the context. Using this possibility the application is informed about changes or the invalidation of the subscribed context. To support context-awareness on mobile devices the architecture must contain some characteristics such as light-weightiness, extensibility, robustness, meta-information and context sharing. Context data distribution [11] is the capability to gather and to deliver relevant context data about the environment to all interested entities connected to the mobile ubiquitous system. In fact, context data distribution is extremely significant from both the service and the middleware perspectives. On the one hand, service adaptation is triggered by received context data. Hence, context data have to be timely delivered to let services promptly adapt to the current execution context.

3. Context Awareness

Context-awareness refers to the idea that distributed applications can both sense, and react to changes in their environment. These applications have information about the circumstances under which they are able to operate and react based on rules. Context-awareness is often applied in ubiquitous or pervasive computing, which is a computing model in which computer functions are integrated into everyday life in an invisible way. Context is any information that can be used to characterize the situation of an 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 applications themselves. A system is context-aware if it uses context to provide relevant information and services to the user, where relevancy depends on the user's Task. Context awareness modeling includes the main concepts such as context and entity. Context also can be defined as the interrelated condition in which something exists which subsumes the existence of an entity. An entity is the bearer of context.

Here in this Figure 1. entity is a physical thing which exists in the real world such as person, student. The container entity is the entity which is capable of holding other entities. The intrinsic context is inherent to a single entity like the temperature of an entity. The relational context inheres within the relationship between two or more entities. For e.g. we can consider friendship between two people.

3.1 Categorization of Context elements

Context can be divided into four categories such as

• Computing context includes device properties which classifies as network connectivity, communication cost& bandwidth, orientation, touch and display.

• User context includes the user's profile, role of user, location, process & task associated with user and current social situation.

• Physical context includes lighting, noise levels, humidity and temperature.

• Time context includes time of a day, week, month, and season of the year.

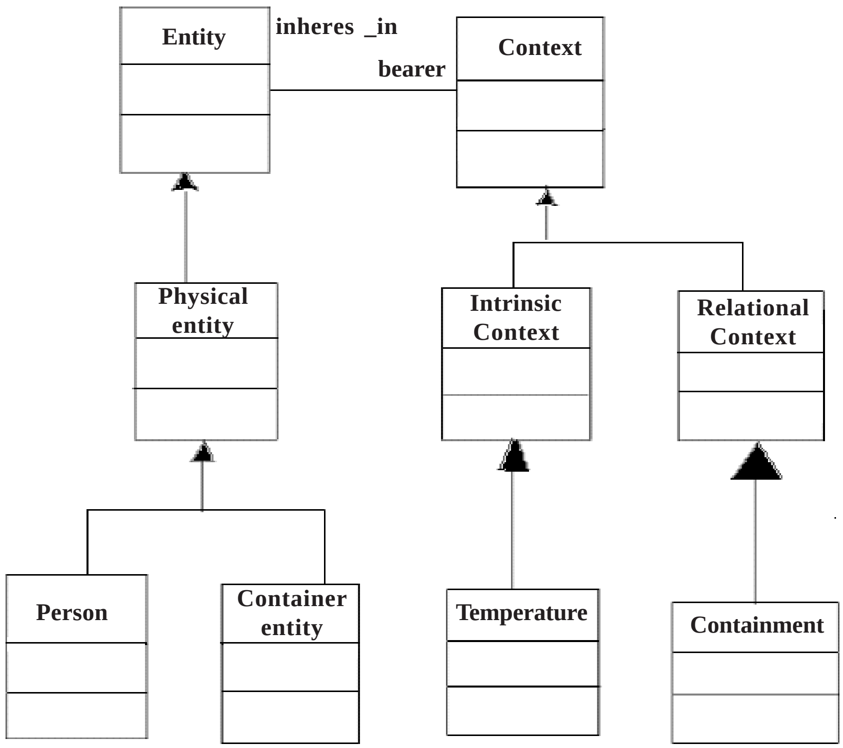

Figure 1. Context and Entity

Each of these entities may be described by various attributes which can be classified into some categories such as identity (each entity has a unique identifier), location (an entity s position, co-location, proximity etc), status (meaning the intrinsic properties of an entity, e.g., temperature and lightning for a room, processes running currently on a device etc), time (used for timestamps to accurately define situation, ordering events etc), activity of the user and user's goal or task. Based on these contexts, several context parameters or elements can be generated and it is shown in this figure (Figure 2).

a) Device properties includes monitoring of a mobile device s internal processes and it provides explicit information on how device applications have been used. Essential information sources are basic communication applications such as, call, messaging and browsing. Other applications providing useful information are the ones that contain explicit information about user's scheduled tasks, preferences, and social network and device settings in various situations. These types of applications include calendar, phonebook and profiles in mobile apps. The mobile apps or device category contains that device and device-related information such as in mobile scenarios that includes device type and display properties. The device (mobile) is used to sense, process, store, and transfer context data. The sensed or inferred context can be communicated to the outside world. Device contains different types of sensors such as physical sensors, virtual sensors and logical sensors. The mobile phone s most important use is just not to run an application but to communicate with the outside world. The context device supports both local (infrared and Bluetooth) and wide-area (GSM and GPRS) [8] communications. It provides communication services through standard internet protocol using General Packet Radio Service (GPRS), Bluetooth transfers, Short Message Service (SMS), and Multimedia Messaging Service (MMS). The communication channels share presence information or obtain sensor data using GPS over Bluetooth. Context information concerning touch describes the physical interaction between a device and a user. Information can be obtained from a touch sensing system integrated into a device. It provides explicit information when it is in user's hand and when not. The touch sensing system uses two conducting surfaces to detect touch. The touch detection system is implemented [9] by taking two conducting surfaces very close to each other. However, there exist situations when a device is not with a user i.e. for example, when the device is on a table. The information about its position is calculated from accelerometer sensor. Also the orientation of the device which includes the displays up or down, left or right can be done from accelerometer sensor. The accelerometer not only measures acceleration of the [9] device but also how the device is tilted. It is possible to match the movement pattern of the device to certain situations, such as the device is in the user's hands, laying on a desk or held to the user's ear. In mobile device camera is used to provide brightness context for display. It is also used to recognize the lighting conditions of the surrounding. It is possible to use 2D barcodes [12] and the camera to get information about a location that is equipped with them. For example the public transportation system is using them on bus stops. When people use the bar code they can get a hyperlink to a timetable with real-time bus schedules.

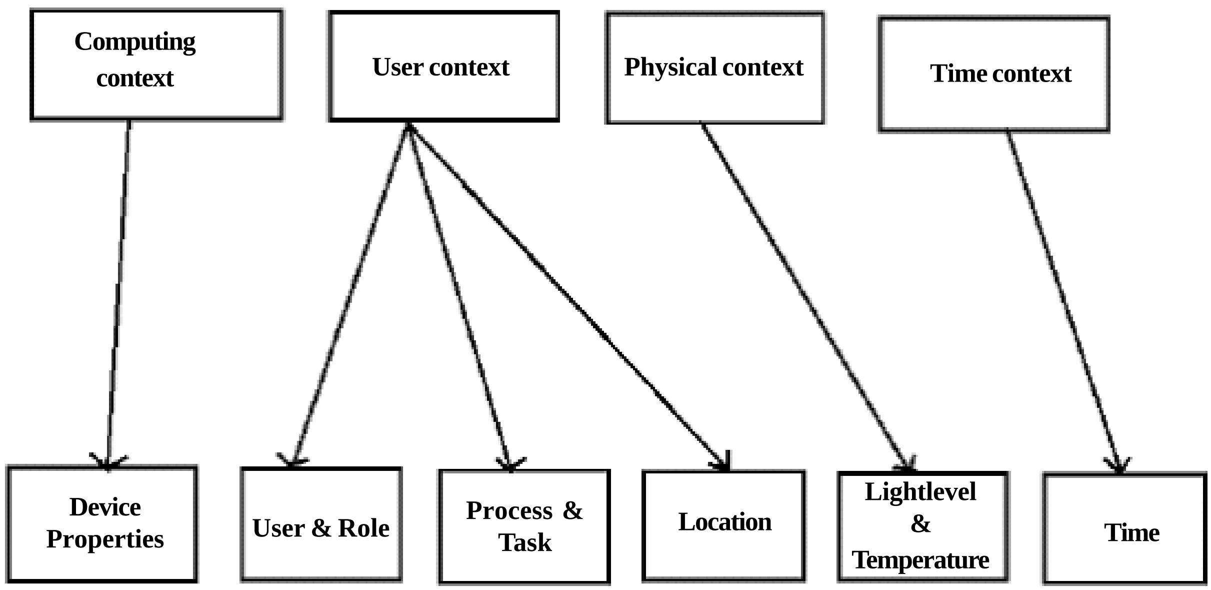

Figure 2. Categorization of context elements or context parameters

b. User and Role holds context information related to user and its activity, for example, movements and dynamic gestures of a mobile device user are examined by processing the three accelerometer signals, which provide the acceleration data of a device in three orthogonal directions aligned with the axes of the device. Activities of a user cause dynamic accelerations to the device a user is carrying, for example, walking causes certain periodic signal characteristics. The recognition of user [9] movements can be carried out using methods in frequency domain, processing signal waveforms in time domain and using other feature extraction methods such as, wavelets. The user of a mobile device performs various types of gestures when using a device. A typical one is answering an incoming call. When answering an incoming call the user first raise the device so that he/she see who is calling and then lift the device to the ear. The recognition of gestures is implemented by symbolic representation and coding of sensor signals. This user and role context also includes categorization of users according to their role, such as various types of customers, or different types of employees. User and its activity [9] is captured by monitoring user interactions such as the user's goals, tasks, work context, business processes. They are captured by physical sensors. For example user's activity on mobile screen either touch or swipe can be captured by touch sensors which are implemented in mobile devices. Similarly the profiles of the mobile phone are selected automatically according to the user's context or its role. The phone chooses to ring, vibrate, adjust the ring volume, or keep silent, depending on whether the user is in office or in meeting or in stationary. For example when the user's work context is to attend the meeting and he does not want to be disturbed by any call but he wants to be alerted if the member of his family calls with an emergency. To enable such functionality the mobile device can log the number of the call, time and location. The priority of an incoming call can become higher if the user had many calls with the incoming number at the same time and place or if the user has previously answered calls from this number at the same time and place.

c. Process and Task represents a functional context. It represents the task or function done by the user. For example in any public sector like health care system [3], the user as nurse whose task is to visit the patient can use mobile apps which offers context aware services such as patients latest prescription to the right people at the right time. So that the user as nurse can complete its task or goal successfully. Similarly an information technology center like Apple [3] or IBM which is responsible for various technological difficulties of various public sector organizations. In that company there were supervisors on call whose task is to take necessary action if system crashes. The general descriptions of servers and systems are available in mobile apps. Hence if any problem occurs in those public sectors, the user or supervisor can get context aware information from mobiles and complete its necessary task or goal.

d. Location is a categorization of locations relevant to the application. Location [4] represents the current position of the device as well as user using GPS-coordinates and a value for the altitude. Users can identify location as fixed or relative or moving location. The context created in mobile apps is referred to as zones. The zones could be time based or location based or manually activated. The location based zones are defined by coordinates and radius of a circle. These coordinates can be retrieved from the positioning system like GPS or WLAN available in mobile apps. Global Positioning System (GPS) is perhaps the most widely used location-sensing system. Now there are many mobile phone equipped with GPS functionality, such as Nokia N95 and Samsung i550. Using satellites, cell towers, and Wi-Fi databases, GPS does a reliable job of pinpointing the location of user with in approximately 10 meters. The system s satellites transmit navigation messages, which a GPS receiver uses to determine its position. GPS receivers process the signals to compute position in 3D latitude, longitude, and altitude with an accuracy of 10 meters or less. GPS is a great solution for outdoor positioning products, such as road navigation, photo tagging, and location based searches. But GPS signals are very weak that cannot work at indoors. Because the signal strength is too low to enter into most buildings. Hence it could not provide accurate information about location of users at indoors. So, for indoor applications the position of a mobile device must be derived with the help of other approaches, e.g. using GSM, UMTS, or WLAN networks. The context -aware service [1] identifies user’s location and provides information about many places nearest to that location. The information is displayed as text or images in [6] the web based mobile apps and by selecting the contents the user can view more information about the places in that corresponding location.. For an indoor application the mobile can guide the customers with in a store and provides details of items. The customer s profiles have been stored in stores. The mobile apps can also present the customers context aware data such as location of items, and point out items for sale.

e. Time refers to different types of time information of the object. Users can identify time as seasonal, weekdays, weekends and holidays. Users identified weekdays and weekends as contexts with different informational needs. For example morning can be considered as the time of day for reading news and e-mail through mobile apps. Time information gives two types of context information which includes absolute and relative time context. Usually contextual events occur repeatedly at certain times. For example, a user goes to work at a certain time during workdays while on weekends he/she does something else. Either events occur together or they can be related to each other. For example, usually when the user leaves his/her workplaces he/she goes to a grocery store and makes a phone call to a certain number at a particular time suppose 08:00 p.m. The mobile apps provide this type of time context is referred to as absolute time context. Here if it provides the time information without starting or ending time then it is referred to as relative time context. Similarly the arrival and departure time of trains displayed in mobile apps through web based techniques provides absolute time context. Also if the starting and ending time of trains is not displayed in mobile apps then it is referred to as relative time context.

f. Physical contexts or physical context elements like light, temperature, humidity and air pressure are captured by physical sensors. The mobile apps include color sensors, IR and UV sensors to capture light. Our eyes have a tremendous dynamic range because every day we experience a tremendous range of ambient lighting levels from absolute darkness (0 lux) up through direct sunlight (120,000 lux). The type of illumination defines that the light source is either natural or artificial. The Tablets and Smartphone s, as mobile devices, must be viewed under this incredible range of ambient light. Ambient light levels are measured in lux, which is a Lumen per square meter. Smartphone s and tablets are all used under a very wide range of ambient lighting conditions that are frequently much brighter than for other displays like laptops, desktops. The screens reflect a considerable amount of the surrounding light which washes out the images users are trying to see. Microphone sensor used in mobile apps to measure volume of the background noise. It is also possible to identify places based on the characteristic background noise. For example the microphone sensor is able to recognize with background noise context only if they are located in an office or at any place. Temperature and humidity of a device s environment give about the climatic conditions as the outdoors may vary according to the time of the day and season. The temperature and humidity level are calculated from temperature and humidity sensors.

3.2 Context aware model

The model of the environment [7] in which context aware application work with is called context aware model. The context model holds all kinds of information which is categorized as context related to human factors and context related to physical environment. Context related to human factors includes information about users, user's social environment and user's task. Similarly context related to physical environments includes location, infrastructure (task performance with respect to time) and physical conditions (noise, light, temperature etc).

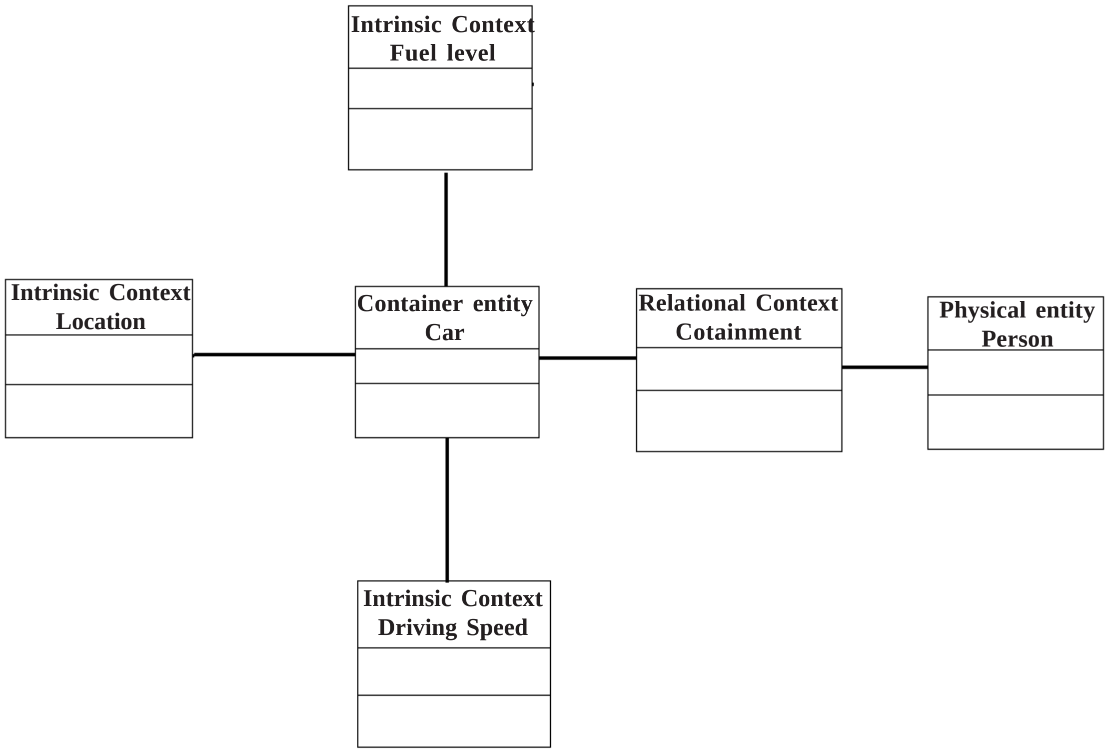

Figure 3. Context aware model of a car navigation system

Here the context model in Figure 3 shows a person, is a physical entity that drives in a car that is a container entity as because it can holds many entities. The intrinsic context is inherent in car which can be such as fuel level, driving speed and location. A context object specifies a context that associated with other context objects handheld by context manager application. The context manager is implemented as a java based web application. It includes various tasks such as context aware messaging, adaptation of context-aware content, allowing user to handle and share personal links and media files & to associate context with these objects. The contextual information as shown in Figure 4 is implemented by the service platforms [4] can be divided into some categories such as

• Contextual content- It includes link, note, media and directory objects are employed by user's personal use, sharing and linking to specific contexts.

• People and groups contextual information- It includes querying of current contexts from people and group. It is also associated with publishing context.

• Context based messages- It also includes creation of messages that will be delivered only in a certain context.

3.4 Coalition for context-aware mobile apps

It is a middleware platform to support context aware mobile apps development. It is capable of locating and extracting relevant context data from large number heterogeneous data sources distributed over many different operating environments. Here this coalition as shown in Figure 5 is designed as a service oriented architecture including various system functionalities as context data acquisition, reasoning, service registration and discovery. These are all designed and deployed as system services for developers and end-users to access. The middleware architecture consists of four logical layers.

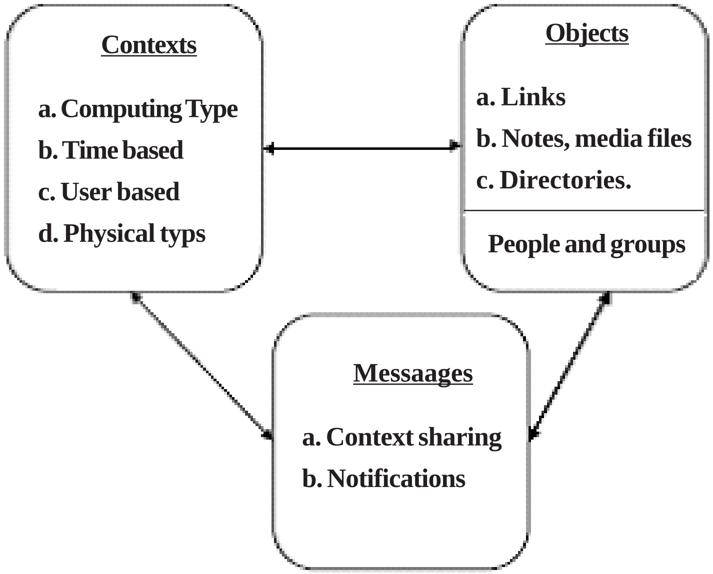

Figure 4. Contextual information

The middleware architecture [5] consists of four logical layers that include physical space layer, context data management layer, service management layer and application layer.

• Physical space layer

This layer consists of real-world physical spaces that represent the various context data sources. A physical space is an operating environment, e.g. people s homes and offices that provides context data from its attached entities such as sensors, actuators and computing devices. It mandates all the interactions of its entities with the outside world through a designated gateway known as physical Space Gateway (PSG).

• Context data management layer

This layer again define the concept of context spaces for the efficient management of physical spaces and provide support for context data. A context space can be thought of an abstraction of a collection of physical spaces having similar attributes such as office, person and shop as shown in figure 3. The physical spaces in a context space are organized as peers in several semantic clusters where each cluster represents a particular context attribute, over which the context queries for data acquisition are processed. Each physical space defines a set of context attributes, where some of them are directly derived from the sensors of that type and some are based on context reasoning over the data collected from multiple sensors. For this each physical space is associated with a physical space gateway (PSG). The PSG is a logical software module that can be deployed at any computer of choice in the physical space. For example, the PSG of a person can be the person s PDA or smart phone, and a home PSG can be a dedicated PC at the person s home. To efficiently locate and acquire context data from the desired physical space, the context management layer of coalition [5] manages all physical spaces (PSGs) by mapping first all physical spaces to their conceptual context spaces by using the respective context schema that specifies all the context attributes within the space. As an example, the space schema in PERSON embodies the properties of all physical spaces representing "*persons*" in the real world, and it has attributes such as name, age and location etc. The mapping is thus done between the context schema of the physical space and the space schema of the target context space. In reality different physical spaces may have different properties or different names for the same space schema attribute. Coalition allows such heterogeneity by providing the matching between context schema with the space schema in the middleware and if there are additional attributes that need to be defined, the space schema will also be dynamically updated so to provide a unified view for all physical spaces within the same context space.

• Service Management Layer

This layer considers the organization and discovery of services that includes system services and third party services. Applications may utilize any service in this layer during their development or execution time. Mechanisms are needed in order to provide components with support for retrieving and accessing computational services. Advertising a capability or offering a service are called export. Matching against needs or discovering services are called import. A subscription gives the right of usage. A

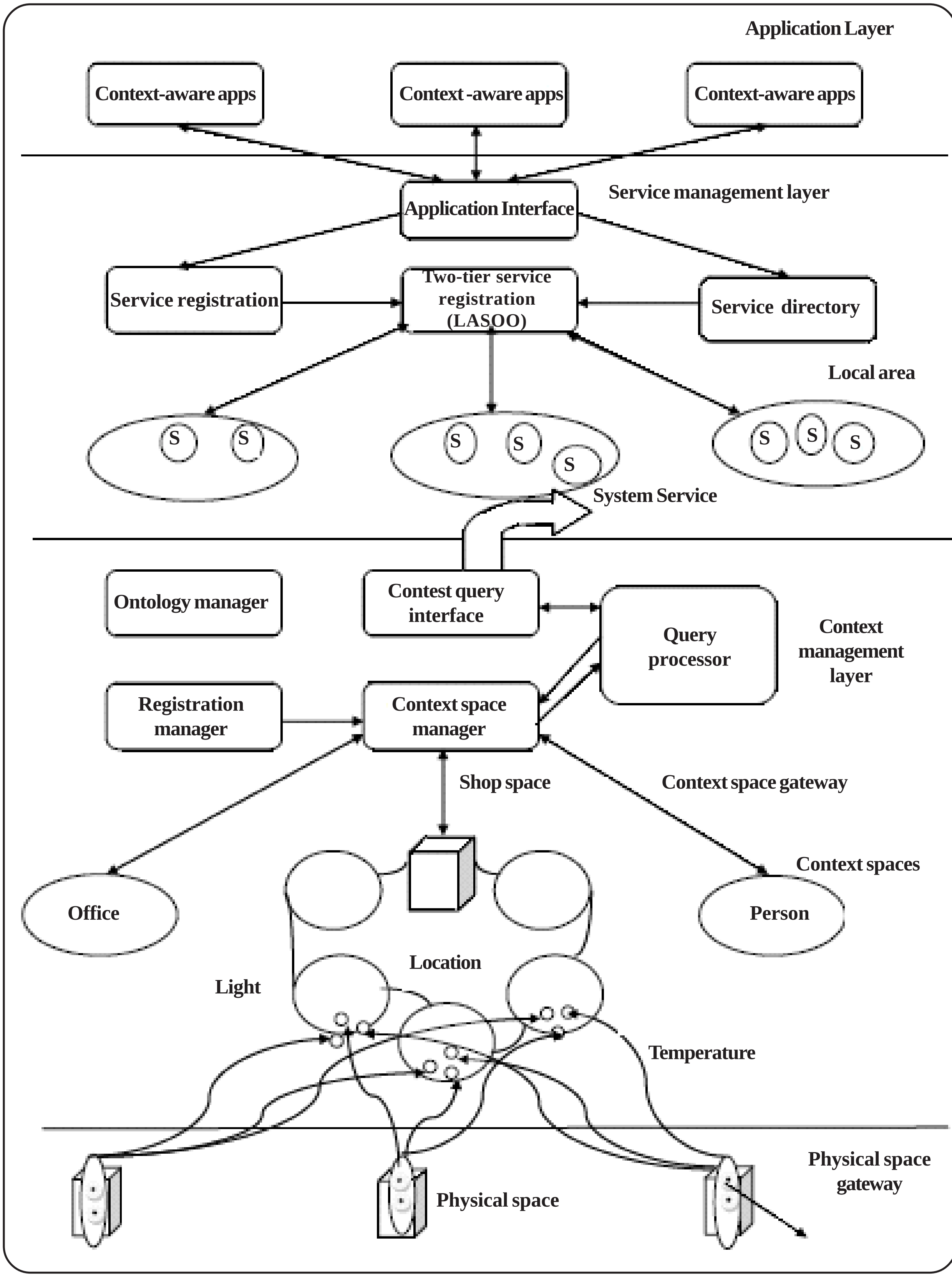

Figure 5. Coalition for context aware mobile apps

User type	Requirements	Ontology's used	Context type	Specified context based on mobile apps
Farmer	Information on choosing crops	1. soil 2. Zone 3. Season 4. Crop 5. Temperature 6. Humidity	1. Computing context. 2. Physical Context. 3. Time context.	1. Mobile apps include device properties as context parameters which provides GPRS services and different browsers. 2. Mobile apps include context as context elements which gives GPS services that provides location based information. 3.Mobile apps include timeascontext parameters which provides up-to-date market prices at a particular time or season.
Farmer	Information on for growing crops	1. Cultivar 2. Weed control 3. Disease control 4. Pest control 5. Watering 6. Fertilizer recommendation	1. Comptuing context. 2. User context	1. Mobile apps include properties ascontext parameters which provide GPRS services and different browsers. 2. Mobile apps include user's role and his task as context elements which are captured in the device to alert the user.
Farmer	Information on for selling crops	1. Storing methods. 2. Packing methods 3. Market 4. Prices 5. Transport	1. Comptuing context. 2. User context. 3. Time context	1. Mobile apps include device properties as context parameters which provide GPRS services and different browsers. 2.Mobile apps include location as context elements which information on collectors GPS services and wireless LAN networks. 3.Mobile apps include time as context parameters which provides up-to-date market prices at a particular time or season.

Table 1. Requirement analysis based on context elements and ontology for agricultural system

subscription is an agreement between the user of service and the provider of the service. It includes rules for billing, usage, restrictions and user preferences.

• Application layer

Context-aware applications lie on top of the service management layer. They can interact with middleware services to retrieve contextual information. It uses third party services to fulfill requirements by collaborating services on multiple sensors.

4. Based on context elements the requirement analysis of agriculture system on context- aware mobile apps

Agriculture has a long history since the development of the human civilization. It is the key to nurturing all living beings and the secret behind the successes of any country. Agriculture with its united sectors is unquestionably the largest livelihood provider in India and more in the vast rural areas. It also contributes a significant figure to the Gross Domestic Product (GDP). It also provides sustainability in agriculture in terms of food security, rural employment, and environmentally sustainable technologies .This includes such as soil conservation, sustainable natural resource management and biodiversity protection which are essential for holistic rural development.

The Table 1 shows, requirements of farmer and also indicates different ontology used in an agricultural system. It also shows different contexts specified in mobile apps. In the crop choosing phase [10] the farmer decides what crops to grow and how much allocate land for crop and also arrange finance for it. In this phase the farmer requires information about various contexts

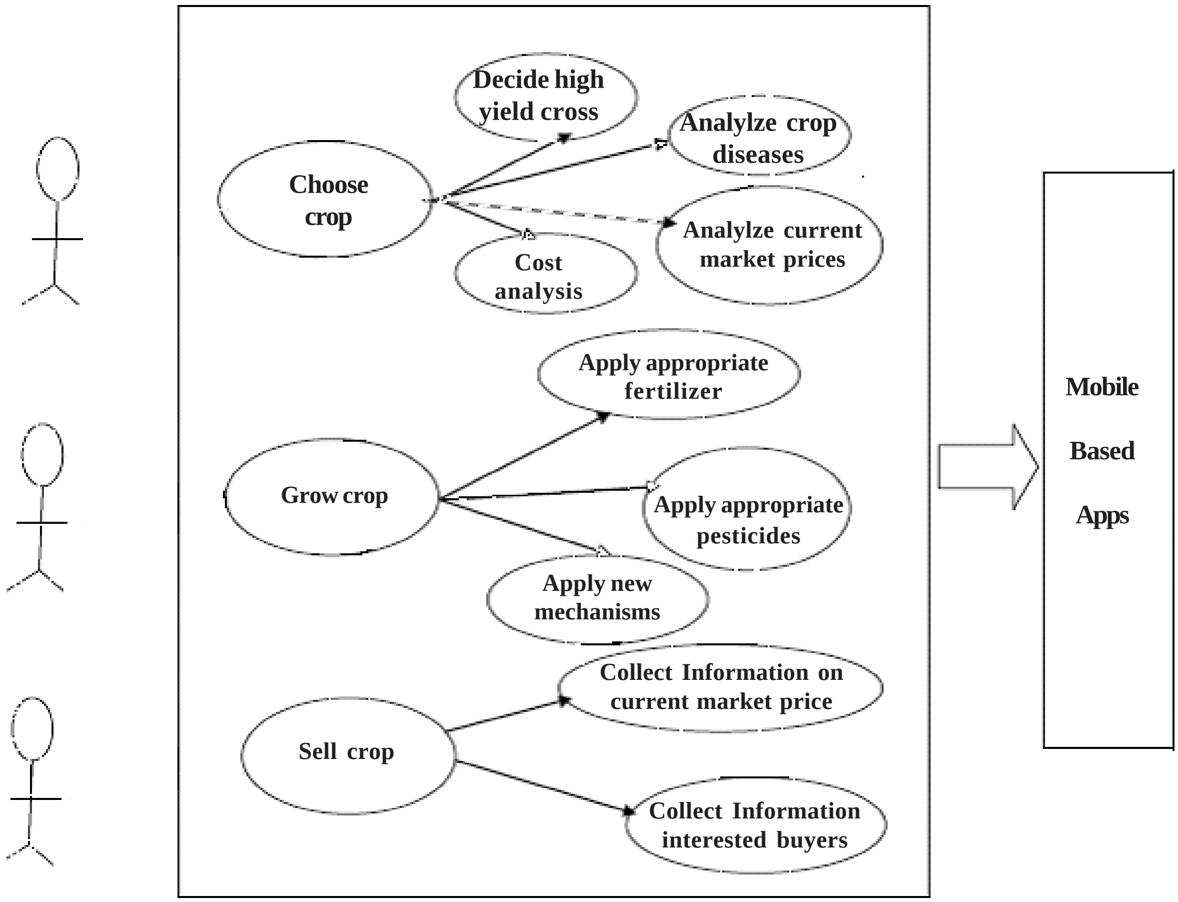

Figure 6. Use case analysis of agricultural system

as high yield corps, soil, current market prices, crop diseases, varieties of seeds and also includes information about particular crop to grow. In this first phase the farmer also finds pre requirements as water availability and water suitability to choose crop for farming. In the growing stage the farmer needs information about fertilizers, pesticides to grow crops. Farmers had concerns about their inadequate knowledge of the changing soil conditions as a result of the use of modern synthetic fertilizers and pesticides. The farmers also claimed that yields were decreasing over time despite the use of fertilizers. Similarly many of the pesticides that they had used earlier now seemed to be less effective. Previously the farmer used their own self knowledge but now they depend on multiple sources for information related to fertilizers and pesticides and herbicides. Due to this the farmer also requires information about crop diseases and herbicides. So that the farmer can know which particular herbicide can be used about a particular crop disease. They also require information about new mechanisms for growing crops. Now the last stage is the selling stage which is done after harvesting crops. In the selling stage the farmer requires information in the context of buyers, traders and current market prices. The farmers count the traders and buyers as important sources of context information related to selling stage. For example farmers in a village often look for market price information, it is not necessarily to increase their bargaining power when selling crops.

Rather it is for personal planning so that they have an idea of what to expect from their harvested crops. Often if farmers have obtained credit from a buyer they are obliged to sell their harvested crops to that specific interested buyer. When that happens, the farmer never questions the price that the buyer gives to him. The farmer has to keep up to date information about the current market prices in the entire region for the selling of crops. The farmer can get the information through mobile apps by calling people he knows. However, calling people using phones was the second most used communication mode with consistently higher phone usage amongst small holder farmers. Mobile-based agricultural [2] information system provides data-based service delivery options and voice based communications to farmers. Mobile communication technology includes all kinds of portable devices like basic mobile phones, smart phones, PDAs or tablet devices. Mobile based agricultural system can also involve services beyond simple voice or text messages. These include payments, money transfers and mobile banking through web technologies. The mobile based agricultural system delivers services based on localized contextual information. It also delivers location-specific information based on microclimatic patterns, soil and water conditions throughout the cropping season. The m-agricultural system provides information on fertilizers, pesticides to farmers for the growing of crops. This system also provides individual information for farmers on sales, current market prices and it also gives information for traders on sales, quality of the product

4.1 Use case analysis of agriculture system

The agriculture system includes actors as:

• Farmers

This system generates several key use cases which are:

• Choose crop

• Grow crop

• Sell crop

4.1.1 Choose crop

This use case includes farmer as the actor. For this the farmer decides what crop and the variety to grow at a given season with market acceptance. The actor farmer also chooses high yield crops to cultivate crops and also finds out the crop diseases. So that, the farmer can takes necessary action to avoid destruction of harvest. The farmer makes an analysis for sources of cost so that he can take financial assistance from others. Hence, this use case includes other requirements as use cases such as choosing of high yield crops, finding of crop diseases and cost analysis are shown in Figure 6. The preconditions for choosing crop subsumes finding particular crop to plant, weather information, soil type for a particular crop and land allocation. After choosing crop, the post conditions include buying inputs from the market for that particular crop.

4.1.2 Grow crop

This use case also include farmer as actor**.** In this stage the farmer collects appropriate fertilizers and pesticides from market for his farming. Hence this use case includes other use cases such as applying fertilizer, applying pesticides and applying new mechanisms which are shown in Figure 6. The preconditions for this use case are preparing or purchasing seeds and preparing lands.. For preparing seeds, the farmer has to select exact seed to cultivate crops. To prepare land the farmer has to use labor and machines to plant crops. The post conditions for this use case are harvesting crops, packing and storing of crops.

4.1.3 Sell crop

To sell crop two actors are involved where as the first actor is farmer and the other is customer. The customer actor can be further generalized as trader, collector and buyer. For selling crops the farmer requires information about current market prices and about interested buyers. Hence this use case further includes two possible use cases which are shown in Figure 6. The precondition for this use case is transportation on products. The post conditions are the farmer has to sell the product at a good and reasonable price.

5. Proposed Requirement Model

The proposed requirement model shown in Figure 7 is composed of an architecture which collects data from various sources, that is from different sensors. This architecture can be applied to any system and will fulfill the requirement of the uses in that system.

Here the crop choosing phase is the first key phase of farming cycle. In this stage the farmer needs information about various domains such as weather, high yield crops, current market prices and about crop diseases. Similarly crop growing phase and crop selling phase is the other two key phases of cultivation. In these phases also the farmer acquires information about various domains. These domains include fertilizers, pesticides, herbicides, buyers or traders and up-to-date selling prices. Here we have proposed a requirement model which subsumes these domains under various contexts. The Figure 7 shows, the proposed

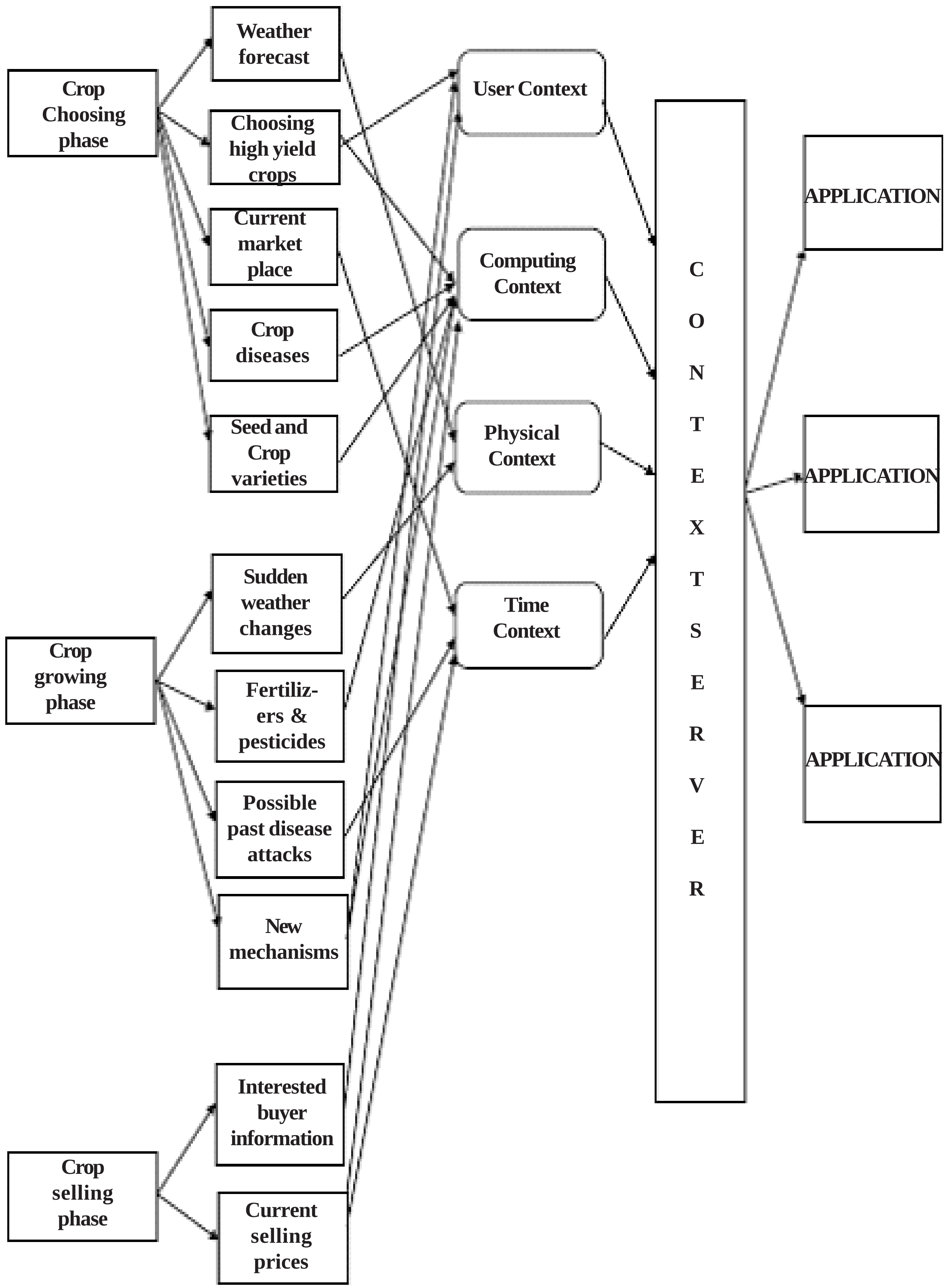

Figure 7. Proposed Requirement Model

model which has taken into consideration into several ontology *s*. This ontology is attached with the model which will provide

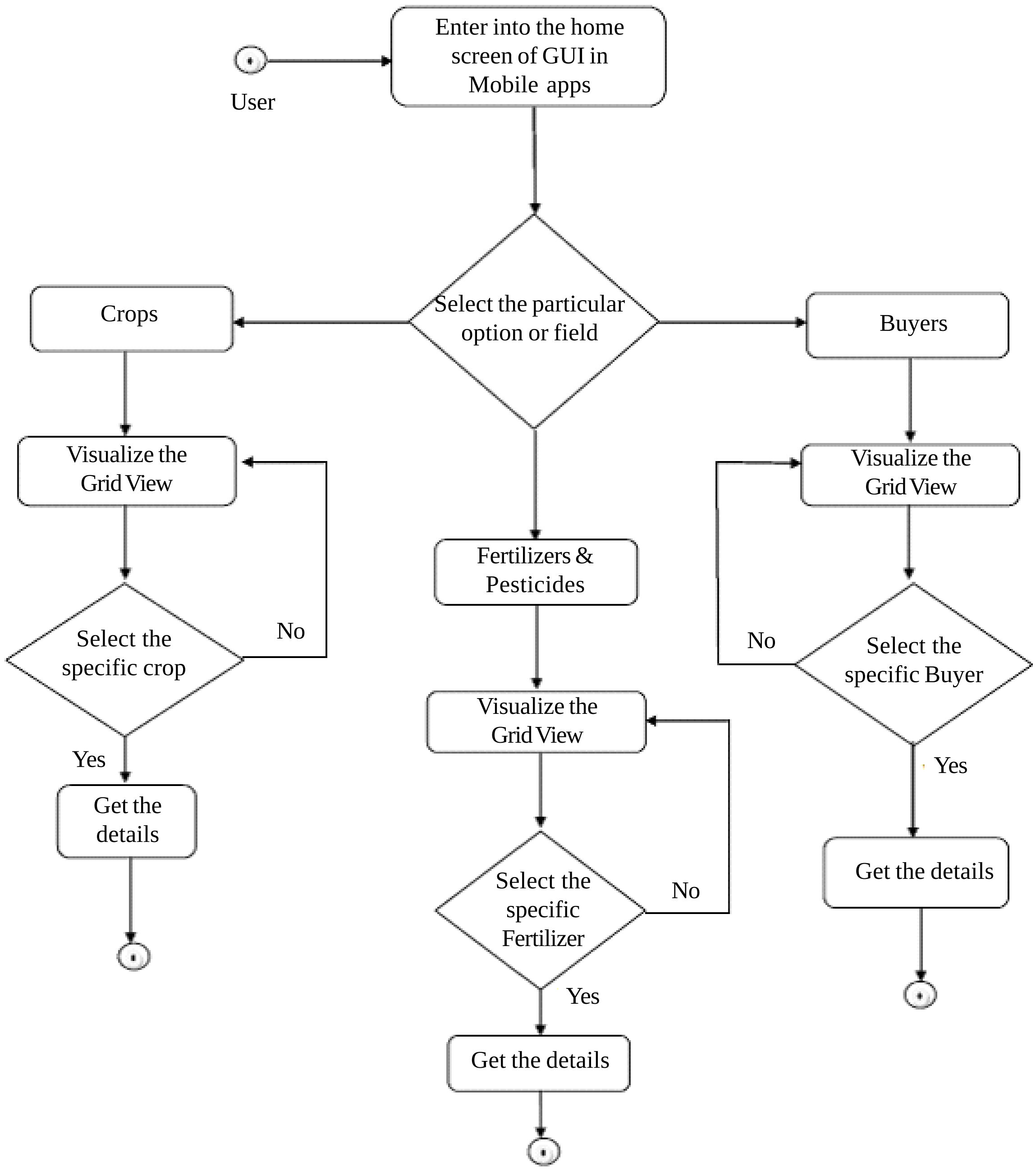

Figure 8. Activity diagram

the information needed by a farmer. These requirement contexts can be send to context server. The context server provides specific required information through mobile apps.

5.1 Activity and use case diagrams

Here the farmers or users are performing some actions on mobile devices to meet their needs or requirements Given in the proposed requirement model in Figure 7. Choosing high yield crops, fertilizers and information on buyers are combining through user contexts. Figure 8 shows the activity diagram of user's activity on mobile apps for achieving information in agricultural systems. At first the user does the first activity as entering into the home screen of mobile applications. To obtain these user contexts, the farmers select the specific option from fields such as crops, fertilizer and so on as given in mobile apps. By putting

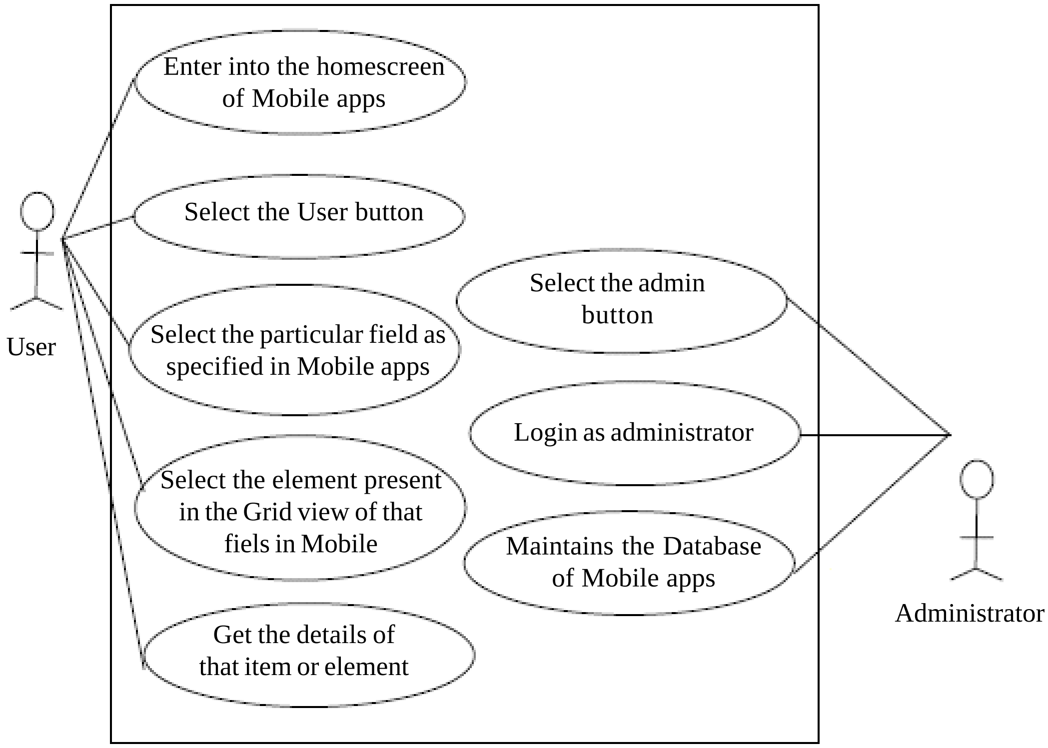

Figure 9. Use case diagram

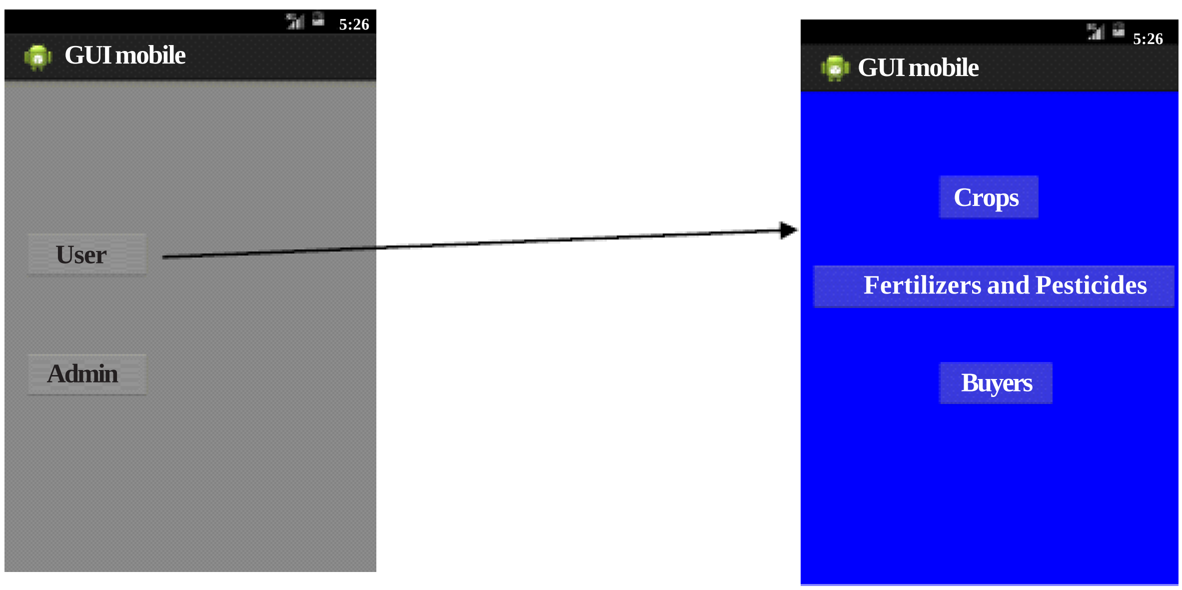

Figure 10 (a). Interaction of user with mobile apps

Here the design of agricultural application in mobile apps is obtained by taking extensible markable language, XML. After selecting the particular button, the user will get a grid view of that field as given in Figure 10 (b).

click on the crop field, the user will get the grid view of crops in mobile apps. By selecting the particular crop, the user will get whole information about the crop. If the user does not do this activity, then it will again go back to the grid view of crops To know other information like information about fertilizers and information on buyers the user has to perform the same actions in mobile apps.

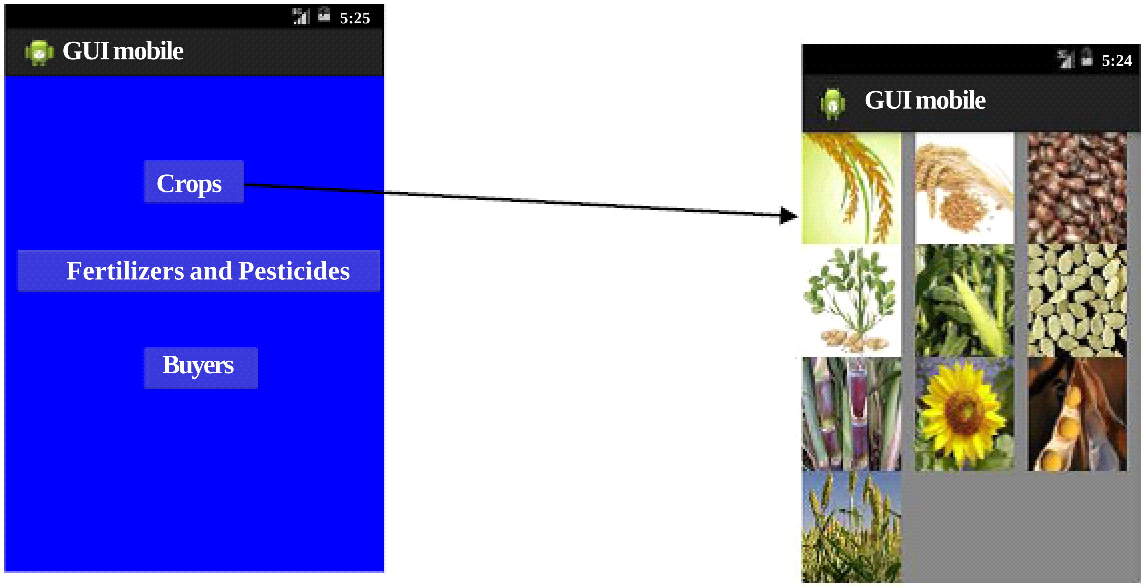

Figure 10 (b). Crops grid view

By clicking the particular crop present in the grid view, the user will get information about that particular crop. That is, the user will get area, production, season and year of production of that specific crop as given in Figure 10 (c).

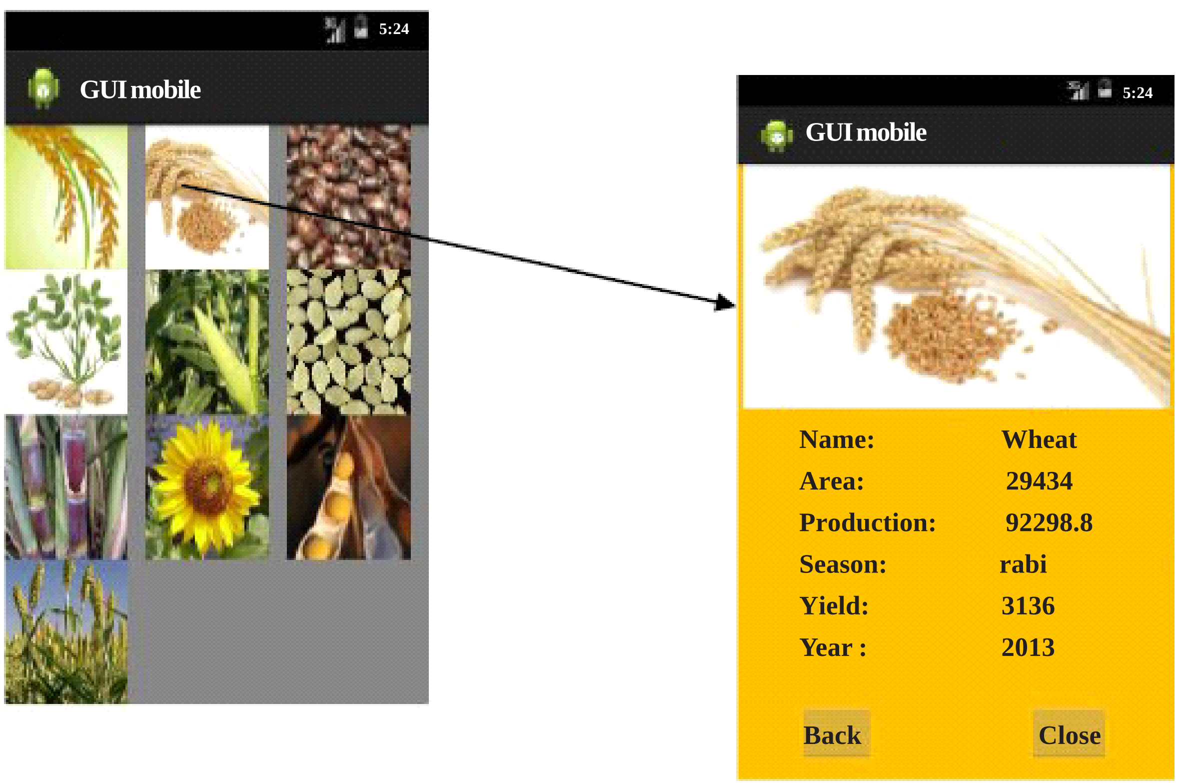

Figure 10 (c). Details of Wheat crop

Here by selecting wheat crop, the user will obtain information about wheat crop. Similarly when the user put click on rice crop present in that grid view, he will get related information of the rice crop is shown in Figure 10 (d).

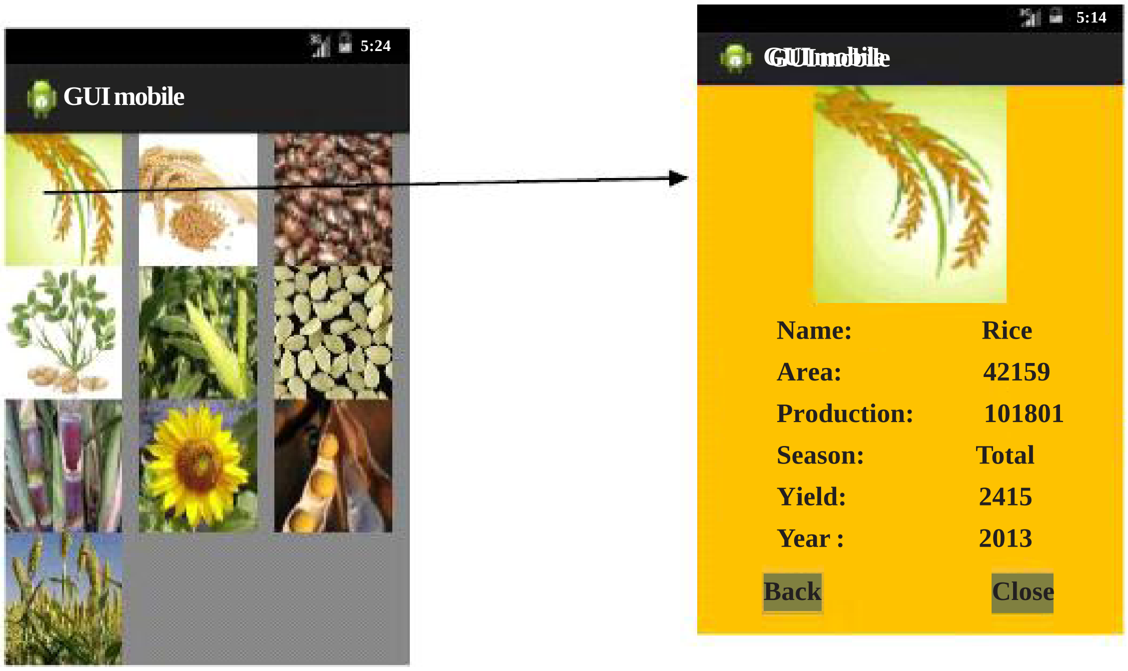

Figure 10 (d). Details of Rice crop

The administrator will maintain the database for crops, fertilizers and other data fields by choosing admin button and logging into the mobile apps as shown in Figure 10 (e).

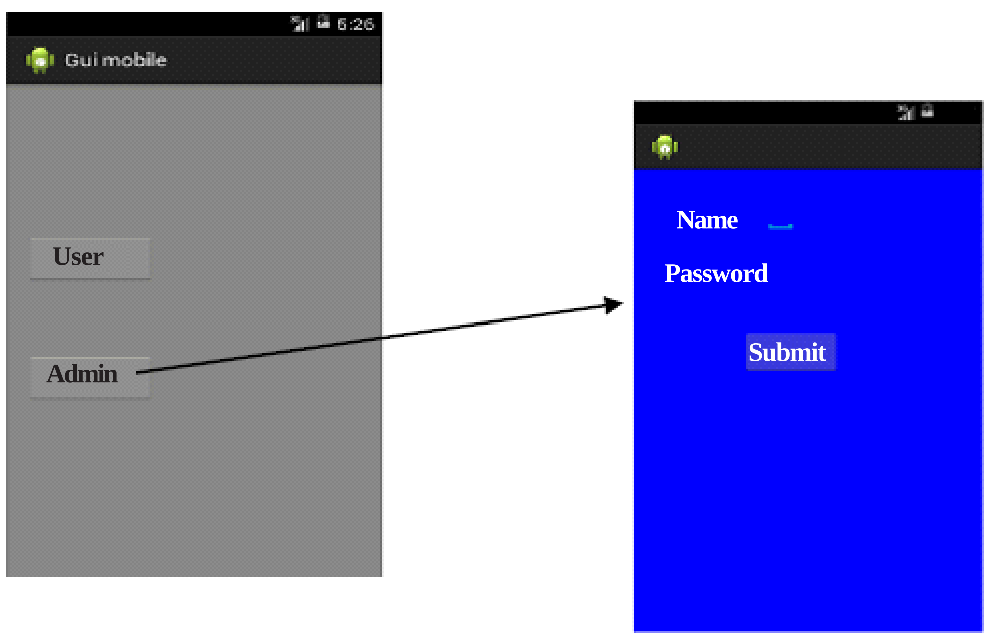

Figure 10 (e). Administrator log in through mobile apps

Here the use case diagram as shown in Figure 9 shows several use cases that are performed by two actors such as user and administrator. The actor, user first enters into the home screen of mobile apps as initiating the use case. The user chooses the user button among buttons or options given in mobile apps.After selecting the user button, user will perform another use case as choosing particular field from other fields. The user will visualize the grid view of items of that specific field and putting click on that specified item to view details of that item. Likewise the user performs a set of use cases to get the details about that item or to meet his requirements. Here another actor, administrator will initiate use case by choosing admin button in mobile apps and performs another use case by logging in as administrator. The administrator will maintain the database for users in mobile apps.

6. Implementation

The objective of this section is to provide some scenarios of mobile apps while the user as farmer is performing some actions on mobile apps. This mobile application is performed by taking android systems. In Figure 10 (a), the user interacts with the mobile apps by selecting the user button from other buttons and obtains various fields.

The requirement model as shown in figure 7 is implemented to give the farmers the required information with regard to the user's context in an agricultural system. Though the model specifies about various contexts, this implementation has taken into account only the user contexts as choosing crops and finding details about crops through mobile apps. Basically it carries out information about user contexts and how the information will be obtained by farmers in mobile apps in an agricultural system. The other contexts such as computing context, physical contexts and time contexts for agricultural system can also be implemented.

7. Conclusion & Future Work

This is an attempt towards building a context aware requirement model for mobile apps. We have taken the agricultural ontology s in consideration to map the domain based information onto the agricultural system. Therefore, the proposed requirement model will provide mobile based information system, which will be an effective way to make an intervention as most farmers now-a-days have access to a mobile. The requirement model can be extended to a comprehensive process model for development of mobile based information systems. Also, a framework can be developed to incorporate the various contexts such as computing context, physical context and time context etc. by studying the various design patterns of mobile based information systems.

References

[1] Kaltj, J., Ziegler, J., Lohmann, S. (2005). Context-aware Web Engineering, modeling and applications, revue d'Intelligence artificielle, 19 (3) 439-458, source-DBLP.

[2] Kolari, J., Lakko, T., Hiltunen, T. (2004). Context- aware services for mobile user: Technologies & user experiences, Espoo, VTT publications, 539, 1- 167.

[3] Zhu, J., Chen, P., Pung, H., Oliya, M. (2011). Coalition, A platform for context-aware mobile application development, *Ubicc Journal*, 6 (1) 722-735.

[4] Nijhuis, K. N. (2007). Context-Aware Services for constrained mobile devices, thesis paper and research project, p. 1-66

[5] Raento, M., Oulasvirta, A., Petit, R., Toivonen, H. (2005). Context Phone: A Prototyping Platform for Context-Aware Mobile Applications, *Journal of IEEE Pervasive Computing*, 4, 51-59, IEEE Educational Activities Department Piscataway, NJ, USA.

[6] Baldauf, M. A survey on context-aware systems, *Journal of International Journal of Ad Hoc and Ubiquitous Computing*, 2 (4) 263-277.

[7] Mäntyjärvi, J. (2003). Sensor-based context recognition for mobile applications, Espoo, VTT Publications, 511, p. 1-122.

[8] Anagnostopouls, C.B., Tsounis, A. (2007) Context Awareness in Mobile Computing Environments, *An international Journal, Wireless personal communication in ACM*, p. 445-464.

[9] Hofer, T. (2003). Context-Awareness on Mobile Devices, the Hydrogen Approach, IEEE Journal published in proceedings of the 36th Annual Hawaii International Conference on system sciences, p.10.

[10] Bellavista, P., Corradi, A. (2012). A Survey of Context Data Distribution for Mobile Ubiquitous Systems, *Journal, ACM Computing Surveys*, 44 (4) 1-49.

[11] De Silva Lasanthi, N. C., Goonetillake, S., Jeevani., Ginige, A. (2012). Towards using ICT to Enhance Flow of Information to aid Farmer Sustainability in Sri Lanka, Published in 23rd Australasian Conference on Information Systems, p. 1-10.

[12] Brugger, F. (2011). Mobile applications in agriculture, Syngenta Foundation, Basel, Switzerland..

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