Alternative Design Space Analysis for Electronic Commerce System

P. Rajarajeswari, D. Vasumathi and A. Ramamohanreddy

Abstract Electronic commerce system is a popular way of web application services for business people, customers, and Employees. We observed so many challenges of electronic commerce system in an information system. Electronic commerce system is used for doing business transactions, funds transfer that involves transfer of information through the internet. Electronic commerce system is used for buying the products or selling the products through the internet. This paper presents the model of electronic commerce system with different design alternatives. Implementation of different design alternatives is used for modeling of electronic commerce system. In this paper, alternative design space analysis is used for deriving different design alternatives of the system. This paper presents an architecture view of the system based on UML modeling language. Alternative design space analysis can also applicable for designing industrial applications in an electronic commerce system.

Keywords Electronic commerce system · Software architecture · Object oriented design modeling · Alternative design space analysis

1 Introduction

Software architecture solves the design problems for large type of systems. It provides the correct arrangement of component and connectors. It gives high-level design structure of software system. It is developed based on requirement

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analysis of functional and non-functional requirements. It is achieved with the result of assembling a certain number of architectural elements in a well manner [1]. It also achieves the performance requirements of the system. ADL language and UML languages are used for describing software architecture design process [2].

Electronic commerce system uses computer and communication technologies for doing sales process of organizations. Various companies are able to purchase the items by using electronic commerce system. This type of system consists of different modes for purchasing the items by using web server model. Description of electronic commerce system is given in Sect. 2. In Sect. 3 model of electronic commerce system is presented. Alternative design space analysis is applied for electronic commerce system that is given in the Sect. 4. Heuristic rules are given in the Sect. 5. Implementation of domain model for electronic commerce system is given in Sect. 6. Conclusions are presented in the Sect. 7.

2 Electronic Commerce System

E-Commerce (EC) system is one of the applications for Web services. It provides various services for customers, partners, and employees [3]. E-commerce company services are able to pay the amount based on market demands. This type of system manages the production of various companies, deliver the product within the given time based on market demands, trade, and management [4]. E-commerce system is used by various companies for reducing the budget cost and tries to avoid wastage of more resources. It can be used for doing business activities. Several factors are related with the progress of electronic commerce system development. Its requirements are altered into its constraints because of the drawback of enterprise size, technical force, and economic strength. Normally electronic commerce system is used for purchasing goods. Computers, networks, and software components are to be used as the devices for performing activities of electronic commerce system.

Essential components of electronic commerce system:

1. Catalog management
2. Content management
3. Search management
4. Access control and security
5. Profiling and Personalizing

2.1 Process Flow of Integrated E-Commerce Model

It consists of three phases.

1. Buyer phase
2. Exchange phase
3. Seller phase

1. *Buyer phase* Checkout the item in the database source based on client request. If that item is available in the database source and fulfill order for that item. Ordered item is delivered to seller and purchase that selected item by the buyer. Use and maintain that item based on market demands.
2. *Exchange phase* Information is transferred in between the buyer and seller phases for purchasing products through the internet. Interactions are made with the help of personal agents for deploying the products to the customers.
3. *Seller phase* Seller identifies the customer items, arrange that items which are available in the database and fulfill the order of selected items by buyers. Dispose those items to the buyers with the help of sellers. Process flow of integrated e-commerce model is shown below. Buyer phase, exchange phase, seller phase are the main phases for business to customer model in online shopping process (Fig. 1).

2.2 Architecture for Electronic Commerce System

Architecture for electronic commerce system consists of online shopping and electronic procurement system. Online shopping process is performed either in

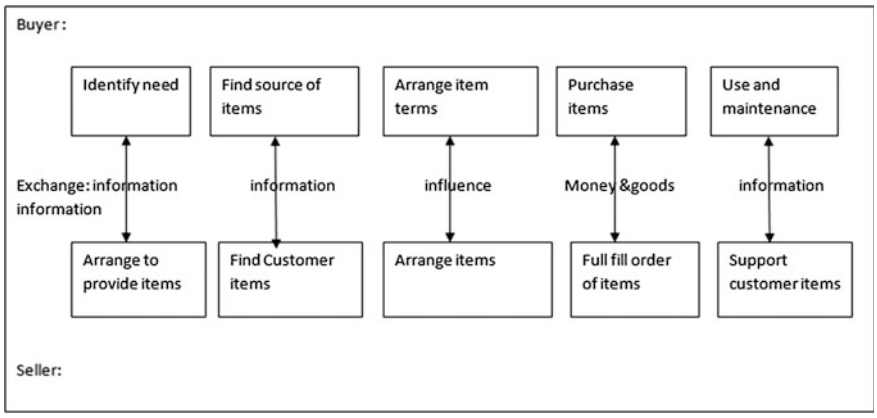

Fig. 1 Process flow of integrated E-Commerce model

Business to Business (B2B) or Business to Consumer (B2C). Government sectors are able to do their business by using electronic procurement system. Today electronic procurement system is of two classes' supplier centric system and buyer centric system. In supplier centric system suppliers are able to manage and update the information based on catalog of products. In buyer centric system buyers are able to maintain and usage of the catalog of products [5].

2.3 Example: Web-Based E-Commerce Architecture System

Web-based ecommerce architecture consists of client, tier-1 to tier-N, and data management system. This type of architecture provides communication in between the various components and gives their functions. Web-based e-commerce architecture provides communication in between client and Servers. e-commerce items are purchased throughout the worldwide by using this type of system (Fig. 2).

3 Models of Electronic Commerce System

Electronic commerce system is one part of e-business which can deal with transactions electronically in between various organizations and third party. Clients are allowed to purchase their products through e-shopping, e-billing process. Electronic commerce system consists of four levels in a conceptual way. These are online shopping, Electronic procurement system, Payee and Payment system [6]. In case of Online shopping item buyers are able to pay the items based on business to business or business to consumer model.

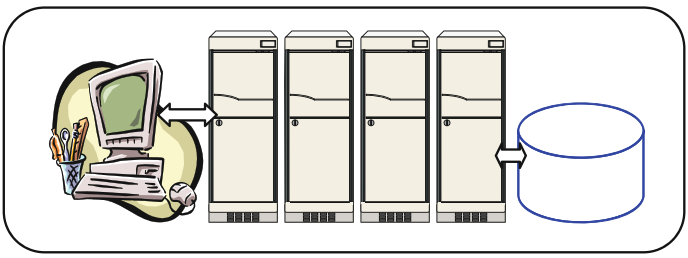

Fig. 2 Web-based e-commerce architecture system

3.1 Conceptual Level Model of Electronic Commerce System

Online shopping, electronic procurement system, payment system payee is the major levels of electronic commerce System. Online shopping system is performed by using business to business model or business to consumer model, catalog and product are the major components in electronic procurement system. In case of Payment system, products or items are purchased by the buyers with the help of cash mode, smartcard, credit card options (Fig. 3).

3.2 Architecture View of Electronic Commerce System

Architecture view of Electronic commerce system is described with the help of UML modeling language [7]. Static diagrams, dynamic diagrams, behavior diagrams are used to describe the structure and behavioral aspects of the system. Among these diagrams class diagram shows the structural relationships in between the components and connectors. Use diagram shows the behavioral aspect of the system.

3.2.1 Class Diagram

Class diagram shows the relation in between the classes and their relations. 1 … *n*, 1 … 1 relations are provided in between the classes and their relationships. It provides structural relationship in between the components and their connectivity. Each class can be considered as one of the component in this system (Fig. 4).

3.2.2 Use Case Diagram

Use case diagram shows use cases and actor. This diagram can be shown below. Each use case shows the operation of the customer (Fig. 5).

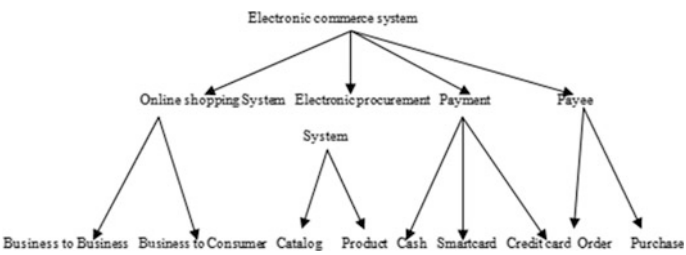

Fig. 3 Conceptual level model of electronic commerce system

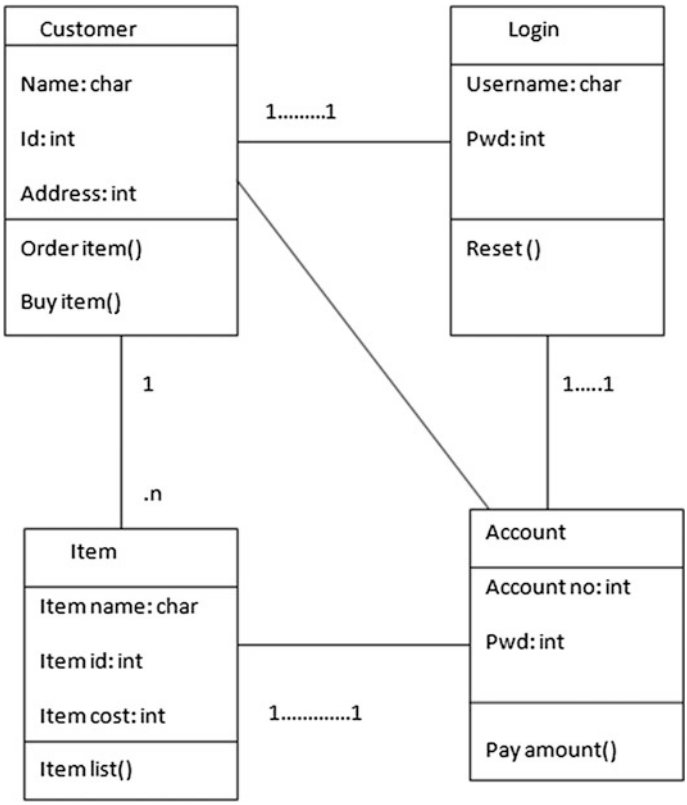

Fig. 4 Class diagram of electronic commerce system

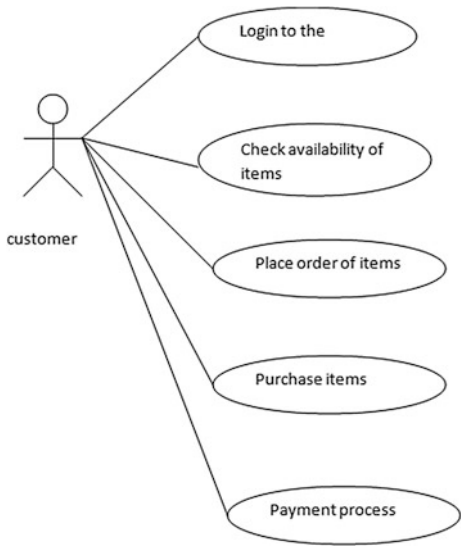

Fig. 5 Use case diagram of electronic commerce system

4 Alternative Design Space Analysis for Electronic Commerce System

Alternative design space analysis is used to define the design space and derive the various design alternatives of system in the design space. Same system can be shown in different ways based on different characteristics is called design alternatives Alternative design space analysis is used for constructing the design space model [8]. In this analysis generate the design space and construct the design space with multidimensional values. Concepts are taken as dimensions for the design space. Main concepts for Electronic commerce system are online shopping, electronic procurement system, payment system, payee. Business to business, business to consumer, catalog, product, cash, smartcard, credit card, order, purchase are the sub-concepts of electronic Commerce system. Concepts of electronic commerce system names are taken as column names and sub-concepts are taken as entry values for each column (Table 1).

Design space model This model is defined with the help of concepts in the multidimensional space [9]. Concepts are considered as coordinates of the design space and sub-concepts are the dimensions for each set of coordinates in the design space. Constraints or design space rules are used for defining the design alternatives of the system in the design space.

Reduction of design space Selection or Elimination of design alternatives is possible by using logical operators to do the reduction of design space.

Representation of Design space We define a model by using design algebra concept in the design space. Design alternatives are derived in the design space for a given design problem. Design space is spanned by a set of independent dimensions. Online shopping, electronic procurement system, payment system, payee are the dimensions of design space. Here '∧' represents the composition relation that is a mandatory relation, '∨' represents the OR relation, '**;**' represents the alternative relation, '**?**' represents the optional relation. Coordinates of the design space are business to customer or business to business that are to be taken as the dimensions for the design space of online shopping item concept. We define the model of online item as follows:

Online item = {online item system ∧ payment system ∧ payee}
In this case, online shopping item process may be performed by using business to business or business to consumer model.
Payment system may be cash mode, credit card mode and smartcard mode.
Payee maybe order mode, purchase mode.
Consider for example: Define the payment system as follows.

Table 1 Alternatives for the concept of Electronic commerce system

Online shopping system	Electronic procurement system	Payment	Payee
Business to business, Business to customer	Catalog, product	Cash, smartcard, credit card	Order, purchase

Payment system = {Cash mode∨ Credit card mode ∨ Smart card mode}
Total set of design alternatives for buying an item through the electronic commerce system maybe 96 ways. Query-based approach is used for selecting and eliminating design space with the help of conditions.
Select concept from design Model where <Condition>
Reduction of design space is possible for the design of electronic commerce system with the selection of items by using query condition which is given below.
Electronic commerce item: Select from online shopping item
Where <online. Item and (business to consumer or business to business)>
Implementation of item is possible by mapping the domain alternatives in the design space. We can specify the model in the following form.
Property set of object can be defined as follows
P_{object} = (CL; OP; AT) {CL: class, OP: operation, AT: attribute} the symbol';' specifies the alternative feature.
M_{item} = (TY, CT, NO) {TY: Type, CT: Cost, NO: Number}
Design space is defined with the mapping relation. Mapping the elements of item to the elements of the object. Design space: $M_{\text{item}} \rightarrow P_{\text{object}}$
Design alternatives for Electronic commerce item are found by using Object oriented design model in the design space which is defined as follows.
Electronic commerce item: Object-electronic item: = Electronic commerce item. weave (Object). Implementation of all the alternative object-oriented electronic commerce item includes in the set of object-electronic item. This set includes 96 design alternatives.

5 Heuristic Rules Method

This type of method uses heuristic rules with the help of conditional statement which is in the form of IF <condition> THEN <consequent> statements. Consequent portion is either selection or elimination operations for reducing the design space [10]. Design alternatives are selected from object-electronic Commerce item may be specified in a query. These rules are decided to include only alternatives for the Electronic commerce item.

Object-electronic commerce item: Select from Electronic commerce item

Where <itemtype.CL and item selection.OP>

We got 96 alternatives by using the above rule. This type of design rules may also reduced by Stakeholder constraints [5].

5.1 Modeling for Heuristic Rule Method

Development of software process is performed in a formal way that can be considered as a new technique in case of the knowledge-based engineering. Heuristic

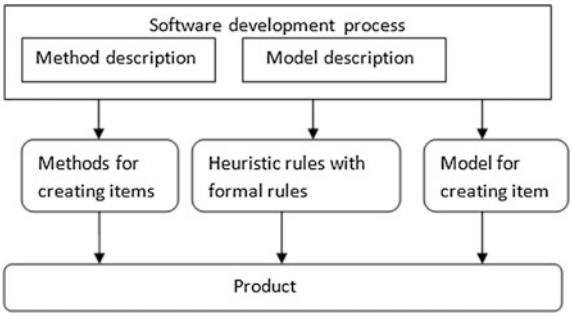

Fig. 6 Modeling of Heuristic rule method

rules are used for doing formal Software development method. In this type of modeling two types of descriptions can be considered. One is model description and other one is method description. Method description provides description for methods which are used in software process. Model description is performed by using heuristic rules is shown (Fig. 6).

6 Implementation of Domain Model for Electronic Commerce System

Four design alternatives are possible for the sub-concept of online shopping item process. The sub-concept of Payment mode can be done in three ways. Payee is in two ways are possible features of Design alternatives. Number of design alternatives for the implementation of this system is 96.

In design algebra concept we calculate the num of design alternatives for doing the computation of product alternatives from a given domain model. Each type of

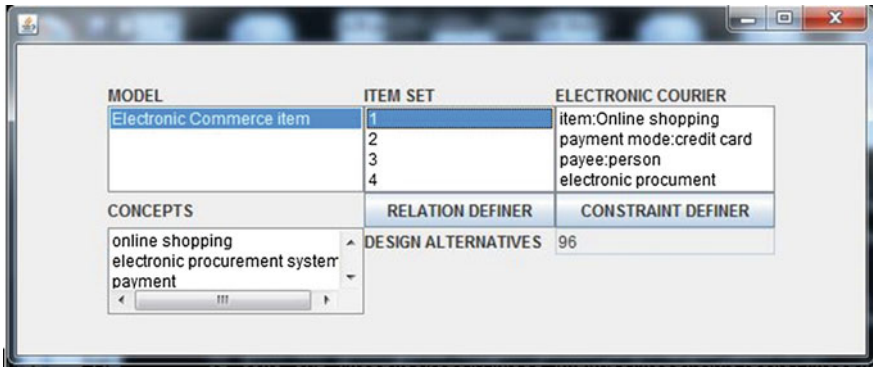

Fig. 7 Model of electronic commerce item

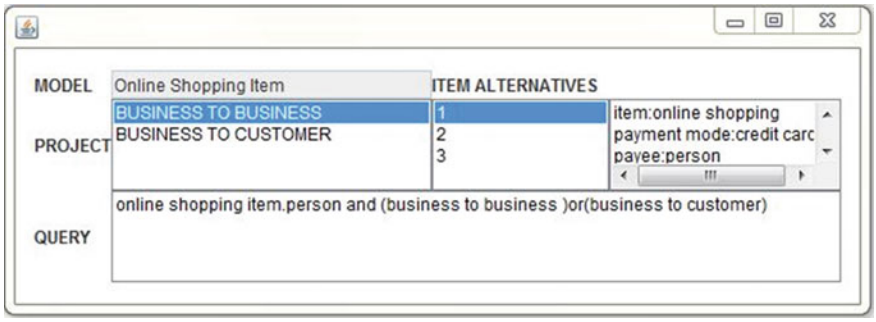

Fig. 8 Model of online shopping item

design alternatives can be selected based on design constraints. Electronic commerce system is implemented by using java programming language.

Model definer tool for Electronic commerce item and online shopping item is shown below (Figs. 7 and 8).

7 Conclusions

- In this paper, we provide description of Electronic commerce System model in a Conceptual way. We presented alternative design space analysis for Electronic commerce system.
- Various design alternatives are derived and implemented by using design algebra techniques in the design space. In future work design algebra concept can also be used for doing design process of industrial product and transaction system.

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