Modeling of the Software for System of Currier Service

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Abstract: **In this paper, we describe modeling of the software for system functioning of currier service based on Dial-a-Ride. Rational Rose with UML is used for working of the model. Description of the software development is given in phases of defining project requests, analysis of requests, planning and implementation with the accent on the planning phase.**

Key words: **Modeling, OOM, UML, OOP, Dial-a-Ride**

I. INTRODUCTION

In order to organize adequate courier service according to up-to-date principles of informative society, it is necessary to develop and implement the software that includes the following elements:

- Vehicle communication - dispatching centre,
- Monitoring (positioning and supervising of vehicles),
- Tracing of parcels,
- Routing and
- Data base on users.

A special kind of routing problem - dynamic systems Dial-a-Ride are used for this service's requirements. Its elementary features are collecting and dispatching of passengers and goods as well as non-existence of fixed routes and the need for their adapting to new requests during the time.

In order to reach its highest efficiency, quantity and profitability, it is necessary for this service to be based on highest standards of information communication technology. The link between several systems based on completely different techniques are supposed. Here belong the transport system as a base, telecommunication system (GPS, 3Ap or cellular network) for communication and stating of current locations of courier service vehicles and information system with the address base, GIS (Geographic Information System) elements, computer software which makes a choice and routing of vehicles according to certain algorithm and, at the end, the software that joins all cited subsystems and synchronize all activities necessary for functioning of this complex totality.

The development of these complex softwares using the techniques for object-oriented programming (OOP) became even more efficient with the method for object-oriented modeling (OOM). After a great amount of researching in this field, UML was established.

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II. PROJECT REQUESTS FOR THE COURIER SERVICE SOFTWARE

The system of this kind is very complex and experts in different fields must be engaged in order to get a product that will function irreproachably.

In this phase, it is necessary to describe what this system should do, not the way it will be done. That will be defined in the proceeding phases of development. It is important that the contents of data undoubtfully give instructions to every member of the project team for making certain models.

A. Contents of the documents with projects requests

Project requests of the system of courier service contain description of the software that will enable:

- monitoring (positioning and supervising of vehicles),
- tracing vehicles and parcels,
- dynamic routing according to Dial-a-Ride,
- communication between dispatchers and service users and
- connection between mentioned subsystems and data base containing necessary data for working of the whole system.

The document contains elementary requests, description of functions and basic abstraction of the system.

B. The role and the environment of the system

The software system that has to be made must give high efficiency to the service as well as the user. Good communication (phone connection and interactive Internet communication) must exist between the service and the user. Having delivered service request and receiving it automatically and/or entering necessary data on the user (civic data, the address, current locations) by a dispatcher, his location must be marked on the digital city map. Simultaneously the current location of courier vehicles (coordinates have to be obtained by GSM or GPS system) must presented together with former routes, as well as the locations of served and unserved users (these locations should be marked in different colors). After words, the choice of vehicles that will be send to new locations with updated route has to be made by using certain routine (by the most appropriate algorithm of the dynamic system Dial-a-Ride). This procedure is being repeated with every new request for service.

It would be useful that the system works in environment of PostNet and business LAN with 100BaseX Ethernet standard with the possibility of expanding and adapting to other networks. The work in Windows and two-layer client - server architecture (the possibility that the belonging database is located on one of the servers) is also advisable.

C. Description of the domain

Domain is described by its key abstractions (classes). In this problem, we can see the following four totalities (packages) with their key abstractions:

- data base "Addresses",
- digital city plan "Map",
- locating system "Positioning" and
- dynamic routing system "Routing".

Database "Addresses" must include all relevant data of users, their addresses, courier vehicles and parcels. "Map" (in vector's format) is the elementary means for monitoring and has to afford graphic illustration of most elements from database. The system "Positioning" is located out of the PostNet and its task is to give data on vehicle positions in certain time intervals. The abstractions regarding dynamic Dial-a-Ride system are placed in "Routing" package.

D. Functioning requests

Use case can be divided into following groups:

- data base operations,
- graphic objects operations,
- geolocation system operations and
- route optimization operations.

"Data base operations" are the data input of users and vehicle locations, creating of certain queries that afterwards generate necessary graphic presentations.

"Graphic objects operations" relate to object selection (users addresses, courier vehicles and their routes) on digital map and their presentation.

"Geolocation system operations" belong to the external system that should do the service of inserting data on courier vehicles locations in certain time intervals.

"Route optimization operations" have to be generated according to the algorithm of route optimization and vehicle choice and then these data should be put on the city map.

III. The Analysis of Project Requests

In the analysis phase, the use case model and the domain model are being defined according to the project requests.

According to the project requests, four packages can be clearly noticed and they should include all structural elements and the ones describing system functioning (fig. 1).

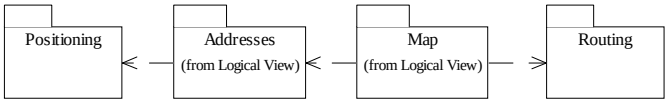

Fig. 1. Use Case View/Main

A. Analysis of functionality

The package "Positioning" will be presented by the symbol of an actor (performer) because this automated system is out of PostNet and does the service of inserting data into the system. In this section, we show the most striking diagrams, which give the description of the system performance according to the functional requests.

In Fig. 2, we present the main diagram of use cases for the package "Addresses" which consists of use cases, actors and navigable associations.

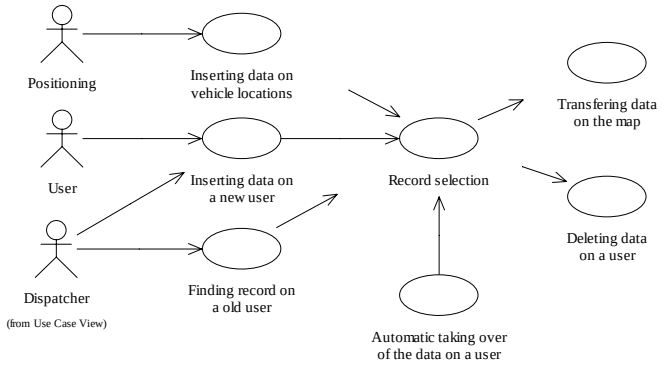

Fig. 2. Use Case Diagram: Addresses/Main

Fig. 3 shows the use case diagram of the package "Map" with all functionalities (use cases) regarding graphical presentation and all the details performing in reality.

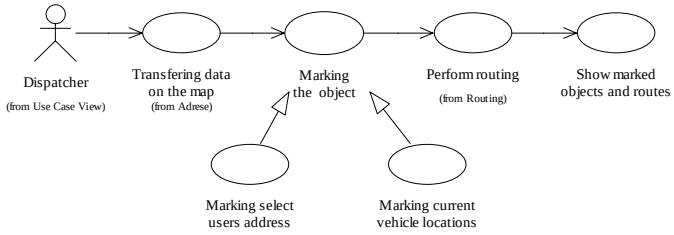

Fig. 3. Use Case Diagram: Map/Main

In Figs. 4 and 5, we present diagrams of activities and interaction (sequence) belonging to certain use cases on preceding diagrams.

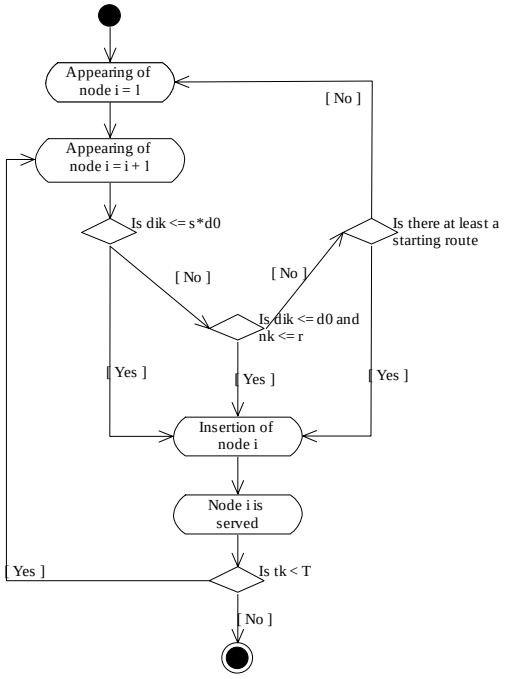

Fig. 4. Activity Diagram: Do the routing/Routing

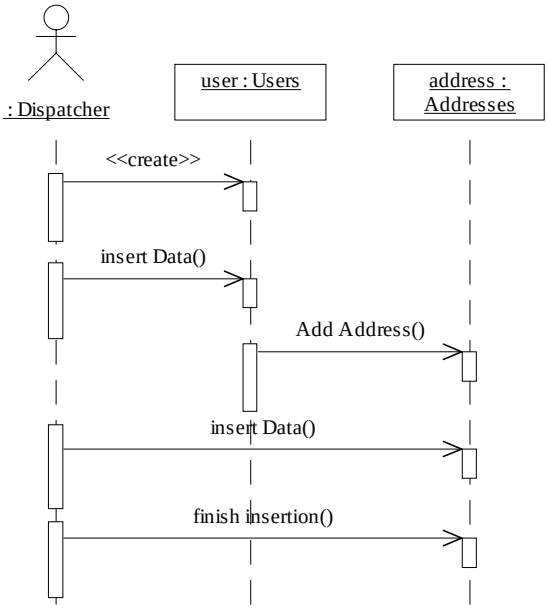

Fig. 5. Sequence Diagram: Insertion of data on a new user/Insertion

B. Domain analysis

In further analysis, we can notice the two diagrams of key classes giving domain description.

In Fig. 6, we give a diagram of classes for package "Addresses" that represent the database.

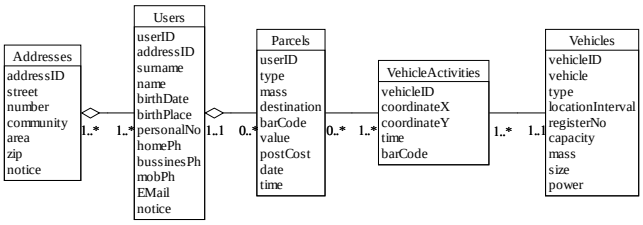

Fig. 6. Class Diagram: Addresses/Main

In Fig. 7, we give a diagram of classes for the package "Map" representing a city plan with its objects.

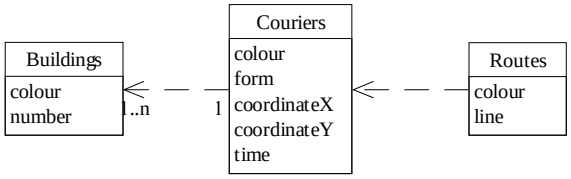

Fig. 7. Class Diagram: Map/Main

IV. PROJECTION PHASE

In this section according to the project request, we present a project model of first iteration for use case "Data input on new customer" and "Transferring objects on the map". It is done by certain collaborations (fig. 8).

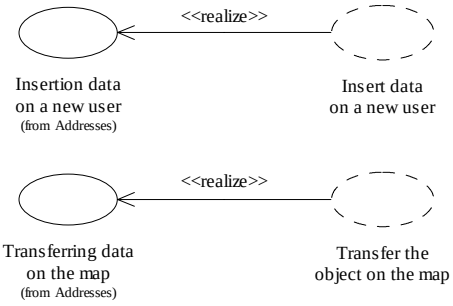

Fig. 8. Collaborations/Main

Fig. 9 shows a diagram of classes taking part in accomplishing use cases relating the database on a user with his first request for service.

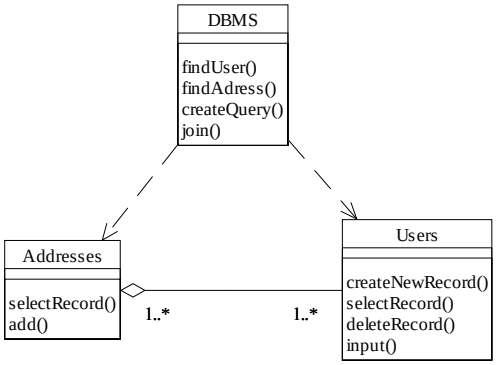

Fig. 9. Class Diagram: Collaborations/Users and addresses

In Fig. 10, we can notice messages and flows of data between instances of classes from the previous diagram. We can also see the marks showing the features of objects relating to each other.

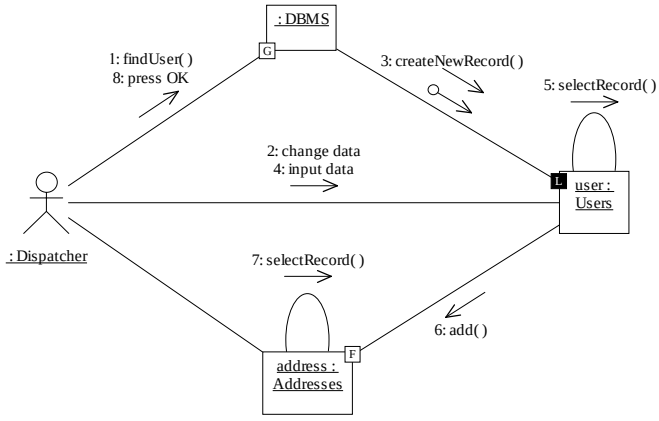

Fig. 10. Collaboration Diagram: Insertion of data on a new user/Insertion

The classes used for marking a graphical presentation of users' addresses and courier vehicles on the city map are shown in Fig. 11 and the appropriate diagram of collaboration is shown in Fig. 12.

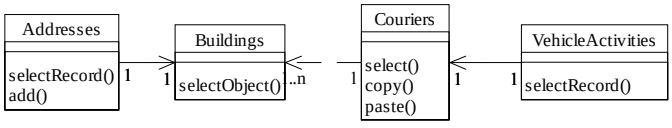

Fig. 11. Class Diagram: Collaborations/Transferring

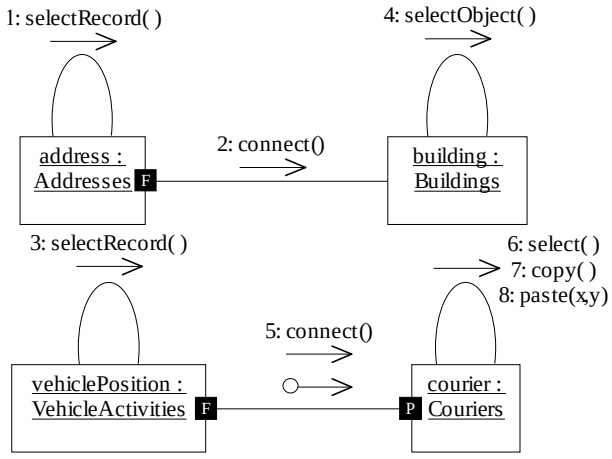

Fig. 12. Collaboration Diagram: Objects transferring on the map/Transferring

V. Implementation Phase

The phase of implementation is (like previous phases) presented in one (first) iteration. The presentation of implementation is given in the package "Component View" on component diagrams. In the main diagram, we can see packages containing all components implementing the classes of the package "Logical View" (fig. 13).

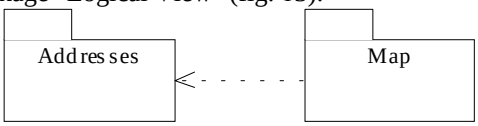

Fig. 13. Component Diagram: Component View/Main

In Fig. 14, we present the components of the package "Addresses" and in Fig. 15, the components of the package "Map" are presented. Both packages are added to the packages with the same names from logical view.

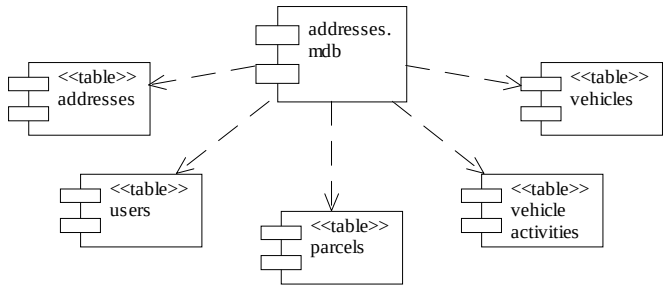

Fig. 14. Component Diagram: Addresses/Main

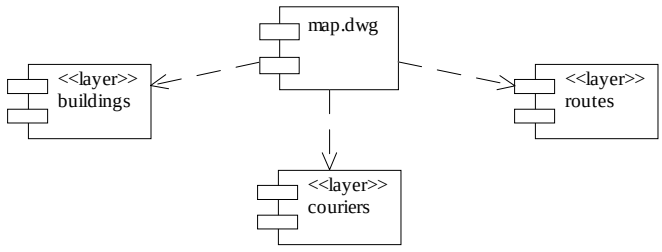

Fig. 15. Component Diagram: Map/Main

In physical sense, the shown components are tables of database and layer maps in vector format.

Generated source code in C++ language for the components of these two packages is placed in implementation files *.cpp and heading files *.h. The given source code depends on the specification of components and other features of the model.

VI. Conclusion

In the area of Serbia so far does not exist any courier service that works according to the principles of modern information communication technology, even though there is the need for it. Since a high level of communication and computer technology is accomplished, as well as a great number of experts, neither a long period of time nor great financial resources are necessary for applying of these technologies.

As for as domestic market is concerned, we can say that the most important data necessary for software support to courier service are accessible. That means that we already have digital maps of Belgrade and other big cities of Serbia. It is also possible to take over some data from other users' bases as well as the data on telephone subscribers. There is the possibility of applying location systems based on the mobile network of "Telekom" of Serbia.

The presented software model can be used as the starting one and be improved in practice in further iterative incremental procedure. Depending on changes of environment and market conditions, new improved versions would be accomplished. This dynamic approach (fast development, implementation, reversible engineering) just makes UML possible. So it is quite justified to consider the development and the implementation of courier service software in Serbia.

It is also necessary to make preliminary simulation models on the base of conducting a query of potential users and market research and thus make favorable service costs possible.

VII. References

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