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SIMULATIONS IN ORDER TO CONFIGURATE AN IT APPLICATION THAT ALLOWS ONLINE BOOKING AND PURCHASE OF THE SINGLE TRAVEL TICKET FOR THE RAILWAY TRANSPORT AND THE ROAD SYSTEM IN ROMANIA

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Abstract: In some EU Member States, platforms for online booking and purchasing travel tickets for multimodal passenger transport have been operating successfully for several years. However, till now, a single system for online booking and purchasing multimodal transport tickets online has not been developed at EU level. Creation of an integrated travel ticket reservation and payment system has been on the EU's transport policy agenda for over 10 years. Online booking and purchasing travel ticket offers a lot of benefits, not only for passengers, but also for passenger transport companies and responds to the current needs of the society, one of them being the need to travel. The main objective of the implementation of the integrated e-ticketing system is to improve the quality of passenger services and, therefore, to encourage them to use public transport, as an alternative to their own means of transport and thus to reduce carbon dioxide emissions.

Keywords: integrated ticketing and payment system, e-ticketing, passenger transport, passenger mobility, multimodal passenger transport, door to door journey, UML activity diagram

1 INTRODUCTION

In Romania there is no common information system, which allows the online booking and purchase of travel tickets for several modes of transport. At the moment, in our country there is not even a common system for issuing travel tickets, which connects all rail passenger transport operators, a system that, in the near future, will become mandatory by transposing European legislation into national law.

2 MODELING THE ONLINE BOOKING AND PURCHASE PROCESS OF THE SINGLE TRAVEL TICKET

In order to create the web application, with the help of which the single travel ticket for rail and road transport can be online booked and purchased, it is necessary to model the process, using, for example, the Unified Modeling Language (UML), Business Process Model and Notation (BPMN) or Systems Modelling

Language (SysML). Currently, UML is the most widely used language for modeling online platforms for online booking and purchasing train tickets.

2.1 Unified Modeling Language

UML is a visual representation language that can be used to model business processes, represent the structure of an application, describe the architecture of a system etc.

Activity diagrams are used to model the dynamic aspects of a system. They render a decomposed activity in actions that can be performed sequentially or in parallel.

3 SIMULATION OF THE ONLINE BOOKING AND PURCHASE PROCESS OF THE SINGLE TRAVEL TICKET

The solution for simulating the online purchase process of the single travel ticket for train and bus transport was chosen so as to include the connection of a locality from Vâlcea County with the city of Mangalia, via Bucharest, considering that there is no direct connection by railway between Râmnicu Vâlcea and Bucharest. The simulation of the online purchase process of the single travel ticket for multimodal transport will be done using the UML activity diagram, starting from the premise that passenger Mihai Popescu, retired, wants to leave locality of Călimănești, Vâlcea County, and arrive in the city of Mangalia. He benefits of the discount on trains and buses tickets and wants to arrive next day in the city of Mangalia, after a stop in the city of Bucharest, choosing the cheapest travel ticket.

3.1 Travel routes by train and by bus

3.1.1 Călimănești-Bucharest route on the road system

On the Călimănești-Bucharest route, Mihai Popescu will be able to travel by Dacos company bus, which operates direct races on this route, with the Ionescu company, which operates races on the Călimănești-Râmnicu Vâlcea and Râmnicu Vâlcea-Bucharest routes or with the Cento Trans company, which operates on the Călimănești-Bucharest route.

Table 1. Races operated by road carriers, on the route Călimănești-Râmnicu Vâlcea-Bucharest

Company	Departure time Călimănești	Arrival time Râmnicu Vâlcea	Arrival time Bucharest	Time traveled	Traveled distance	Price ticket without discount	Discounted ticket price pensioners
Cento Trans	02,50 am	03,30 am	05,55 am	3h25 min	194 km	68 lei	-
Dacos	12,34 pm	01,04 pm	04,00 pm	3h26 min	194 km	44 lei	22 lei
Ionescu	06,00 pm	06,20 pm	-	20 min	17 km	6 lei	3 lei
Ionescu	-	05,05 pm	08,08 pm	3h03 min	177 km	34 lei	20 lei

3.1.2 Bucharest-Constanţa-Mangalia route by railway

The railway undertakings CFR Călători, Astra Trans Carpatic and Softrans operate, on this route, trains for passenger transport.

Table 2. The trains racing operated by the railway undertakings, on the route Bucharest-Constanța-Mangalia

Company		CFR Călători					Astra Trans Carpatic	Softrans
Departure time from Bucharest		03,14am	05,52am	06,25 am	07,00 am	08,15 am	08,00 am	10,20am
Arrival/departure time Constanța		05,59 am	11,04 am	09,04 am	09,20 am	10,35 am	10,22 am	12,38pm
Arrival time at Mangalia		08,05 am	-	10,43 am	11,05 am	12,26 pm	11,26 am	-
Time traveled Bucharest-Constanța		2h45 min	5h12 min	2h39 min	2h20 min	2h20 min	2h22min	2h18min
Time traveled Constanța-Mangalia		1h47 min	-	1h21 min	1h23 min	1h29 mi	58min	-
Time traveled Bucharest-Mangalia		4h51 min	-	4h18 min	4h05 min	4h11 min	3h26min	-
Traveled distance Bucharest-Constanța		225 km	225 km	225 km	225 km	225 km	225 km	225 km
Traveled distance Bucharest-Mangalia		279 km	279 km	279 km	279 km	279 km	279 km	-
Ticket price without discount Bucharest-Constanța	I st class	79,95 lei	48,5 lei	88,4 lei	88,4 lei	88,4 lei	-	-
	II nd class	54,05 lei	30,3 lei	59,6 lei	59,6 lei	59,6 lei	59,5 lei	55 lei
Discounted ticket price Bucharest-Constanța pensioners	I st class	57 lei	33,85 lei	60,55 lei	60,55 lei	60,55 lei	-	27,5 lei
	II nd class	29 lei	15,65 lei	31,75 lei	31,75 lei	31,75 lei	29,75 lei	-
Ticket price without discount Constanța-Mangalia	I st class	22,1 lei	-	-	24,1 lei	24,1 lei	-	-
	II nd class	15,6 lei	-	16,9 lei	16,9 lei	16,9 lei	17 lei	-
Discounted ticket price Constanța-Mangalia pensioners	I st class	16 lei	-	-	17 lei	17 lei	-	-
	II nd class	8 lei	-	8,5 lei	8,5 lei	8,5 lei	8,5 lei	-
Ticket price without discount Bucharest-Mangalia	I st class	89,85 lei	-	99,4 lei	99,4 lei	99,4 lei	-	-
	II nd class	60,1 lei	-	66,3 lei	66,3 lei	66,3 lei	66 lei	-
Discounted ticket price Bucharest-Mangalia pensioners	I st class	63,95 lei	-	72 lei	72 lei	72 lei	-	-
	II nd class	35,15 lei	-	38 lei	38 lei	38 lei	33 lei	-

3.1.3 Constanţa-Mangalia route

The route is operated by several road transport companies: Sir Impex S.R.L. (Sir Trans), Comanto 94 (Comanto Trans), Simpa Trans and SC Gifan Strong SRL (GSM Trans).

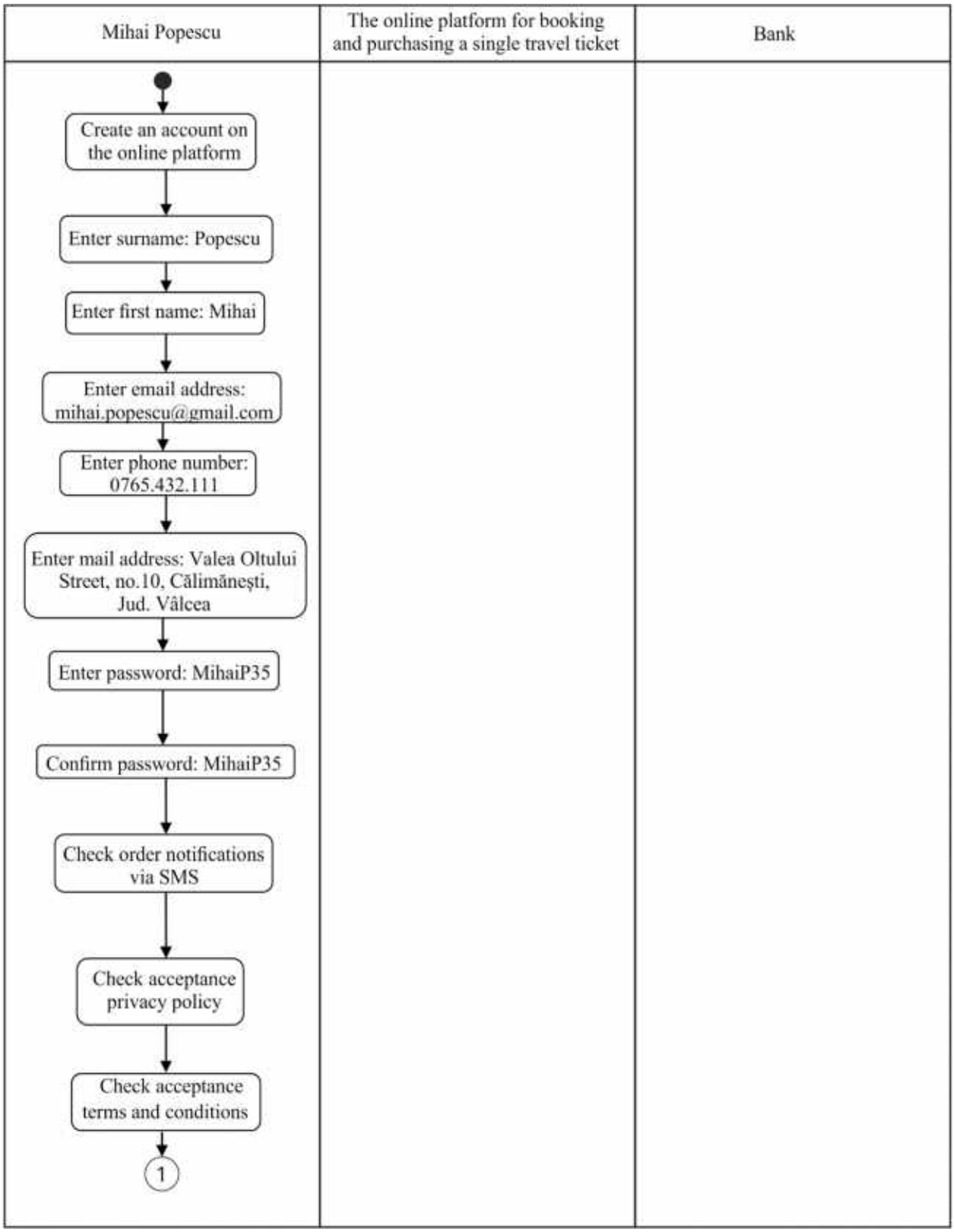
Table 3. Races operated by road carriers, on the route Bucharest-Constanța-Mangalia

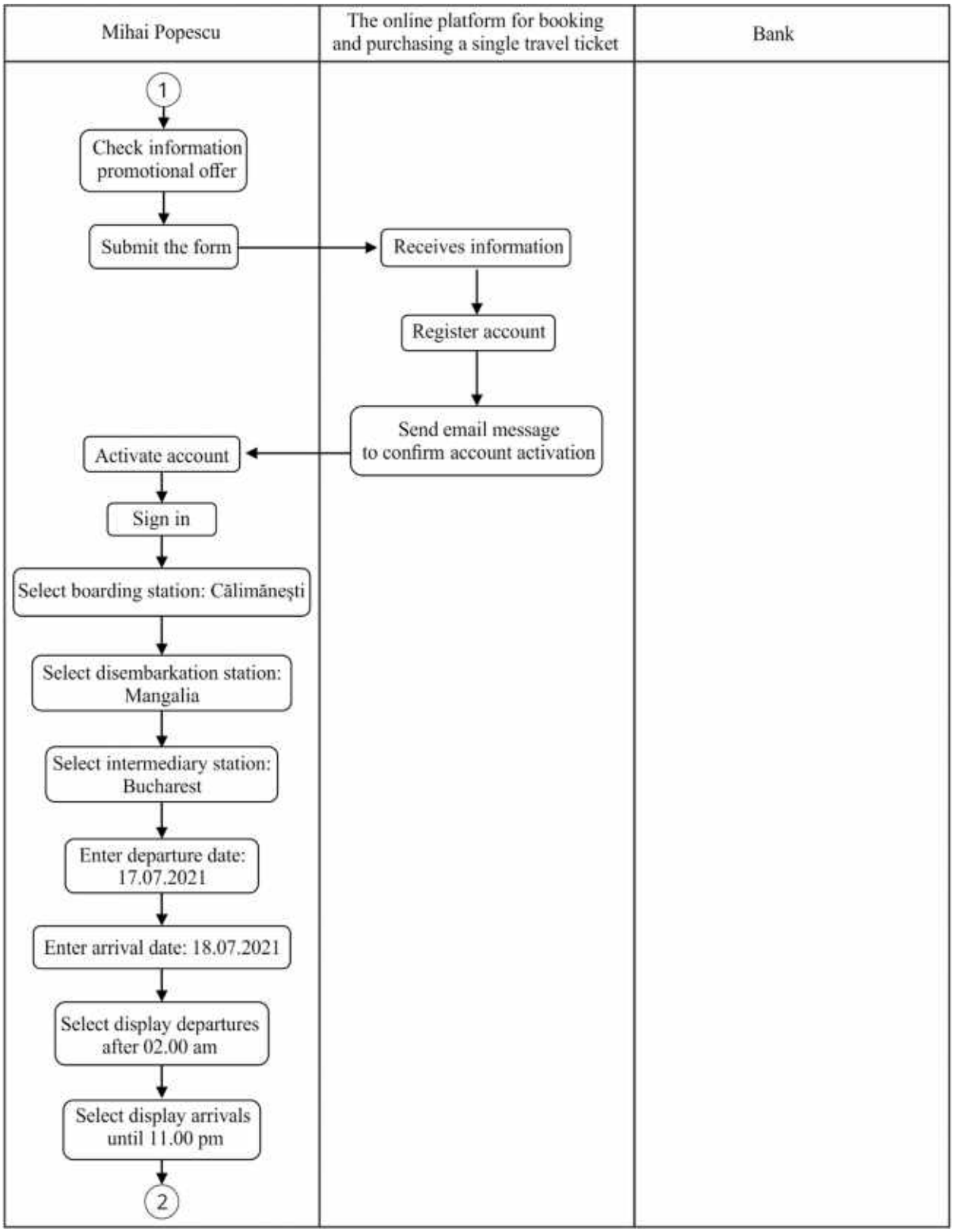
Company	Sir Trans					Comanto Trans							Simpa Trans								GSM Trans			
Time of departure from Bucharest	05,30 am	07,00 am	08,30 am	10,00 am	07,00 pm	06,15 am	07,45 am	09,15 am	12,00 pm	02,30 pm	05,00 pm	09,15 pm	10,45 am	12,15 pm	01,45 pm	03,15 pm	-	04,45 pm	06,15 pm	07,45 pm	-	12,00 pm	02,30 pm	05,00 pm
Time of arrival/ departure to/from Constanța	08,30 am	10,00 am	11,30 am	01,00 pm	10,00 pm	09,10 am	10,40 am	12,10 pm	-	-	-	11,45 pm	01,45 pm	03,15 pm	04,45 pm	06,15 pm	07,10 pm	07,45 pm	09,15 pm	10,45 pm	02,45 pm	03,00 pm	05,30 pm	08,00 pm
Time of arrival at Mangalia	09,30	11,00	12,30	02,00	11,00	10,10	11,40	01,10	04,00	06,30	09,00	00,25	02,25	03,55	05,25	06,55	08,00	08,25	09,55	11,25	03,30	04,00	06,30	09,00 pm
Travel time Bucharest-Mangalia	4h					3h55min							3h40min								4h			
Travel time Constanța-Mangalia	1h					1h							40min								1h			
Distance traveled Bucharest-Mangalia	269 km					269 km							269 km								269 km			
Distan-ce tra-veled Constanța-Mangalia	44 km					44 km							44 km								44 km			

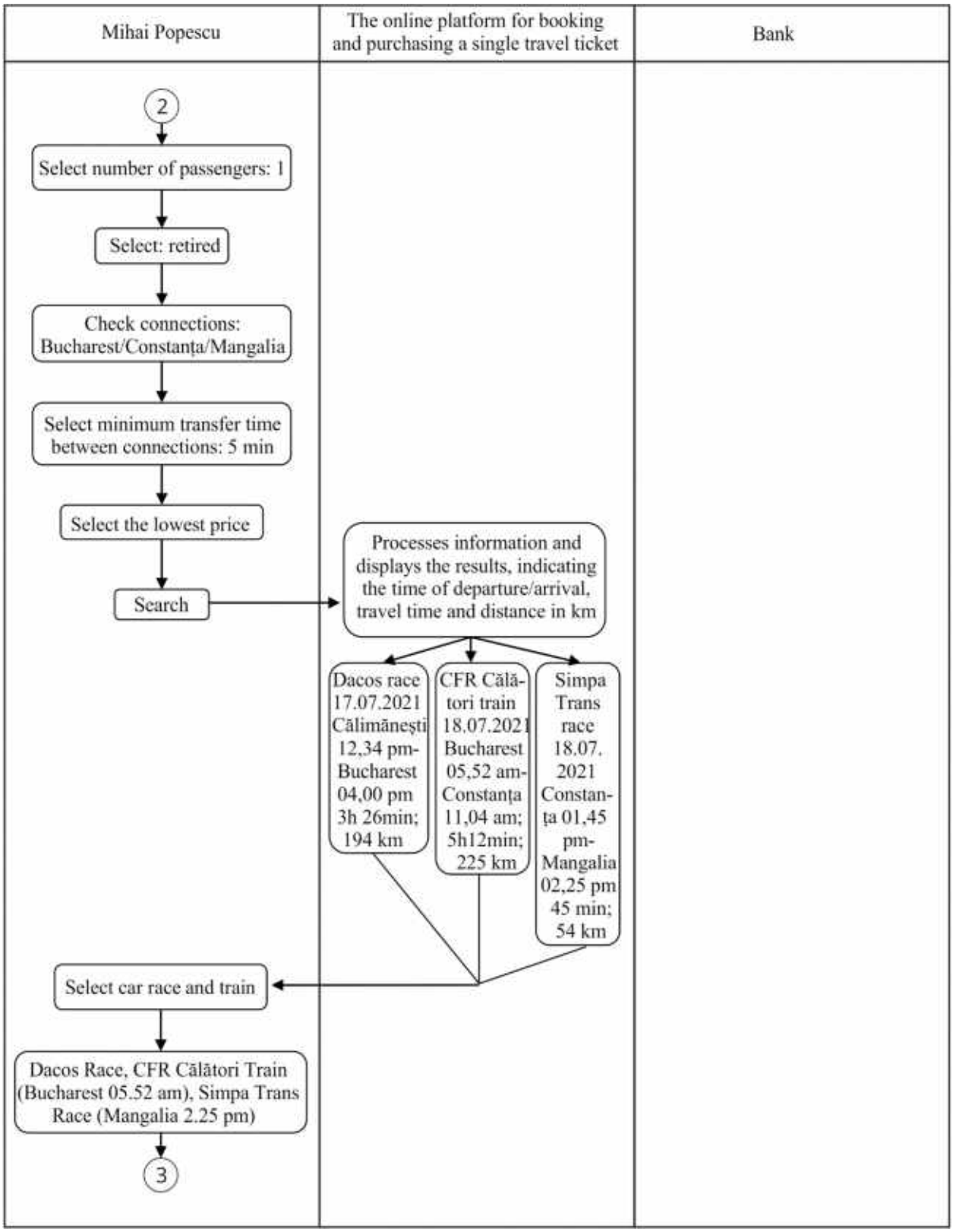
Company	Sir Trans	Comanto Trans	Simpa Trans	GSM Trans
Ticket price without discount Bucharest Mangalia	70 lei	70 lei	70 lei	60 lei
Discounted ticket price Bucharest-Mangalia pensioners	35 lei	35 lei	35 lei	35 lei
Ticket price without discount Constanța-Mangalia	70 lei	70 lei	12 lei	14 lei
Discounted ticket price Constanța-Mangalia pensioners	35 lei	30 lei	6 lei	7 lei

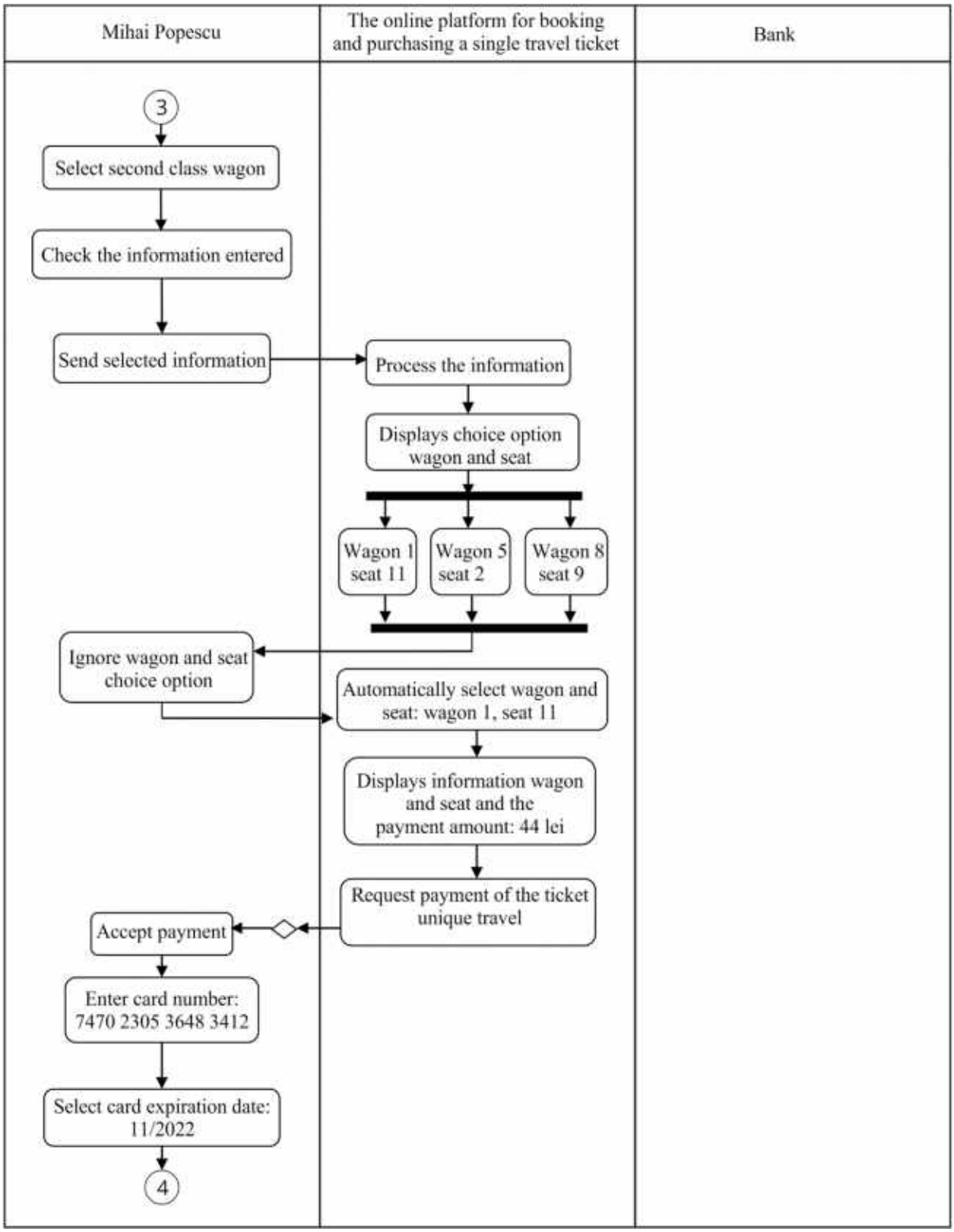
3.1.4 Activity diagram

The activity diagram will represent the flow from one action to another.


Mihai Popescu
The online platform for booking and purchasing a single travel ticket
Bank
Create an account on the online platform
Enter surname: Popescu
Enter first name: Mihai
Enter email address: mihai.popescu@gmail.com
Enter phone number: 0765.432.111
Enter mail address: Valea Oltului Street, no.10, Călimănești, Jud. Vâlcea
Enter password: MihaiP35
Confirm password: MihaiP35
Check order notifications via SMS
Check acceptance privacy policy
Check acceptance terms and conditions
1


Mihai Popescu
The online platform for booking and purchasing a single travel ticket
Bank
1
Check information promotional offer
Submit the form
Receives information
Register account
Send email message to confirm account activation
Activate account
Sign in
Select boarding station: Călimănești
Select disembarkation station: Mangalia
Select intermediary station: Bucharest
Enter departure date: 17.07.2021
Enter arrival date: 18.07.2021
Select display departures after 02.00 am
Select display arrivals until 11.00 pm
2


Mihai Popescu
The online platform for booking and purchasing a single travel ticket
Bank
2
Select number of passengers: 1
Select: retired
Check connections: Bucharest/Constanța/Mangalia
Select minimum transfer time between connections: 5 min
Select the lowest price
Search
Processes information and displays the results, indicating the time of departure/arrival, travel time and distance in km
Dacos race 17.07.2021 Călimănești 12,34 pm-Bucharest 04,00 pm 3h 26min; 194 km
CFR Călători train 18.07.2021 Bucharest 05,52 am-Constanța 11,04 am; 5h12min; 225 km
Simpa Trans race 18.07. 2021 Constanța 01,45 pm-Mangalia 02,25 pm 45 min; 54 km
Select car race and train
Dacos Race, CFR Călători Train (Bucharest 05.52 am), Simpa Trans Race (Mangalia 2.25 pm)
3


Mihai Popescu
The online platform for booking and purchasing a single travel ticket
Bank
3
Select second class wagon
Check the information entered
Send selected information
Process the information
Displays choice option wagon and seat
Wagon 1 seat 11
Wagon 5 seat 2
Wagon 8 seat 9
Ignore wagon and seat choice option
Automatically select wagon and seat: wagon 1, seat 11
Displays information wagon and seat and the payment amount: 44 lei
Request payment of the ticket unique travel
Accept payment
Enter card number: 7470 2305 3648 3412
Select card expiration date: 11/2022
4

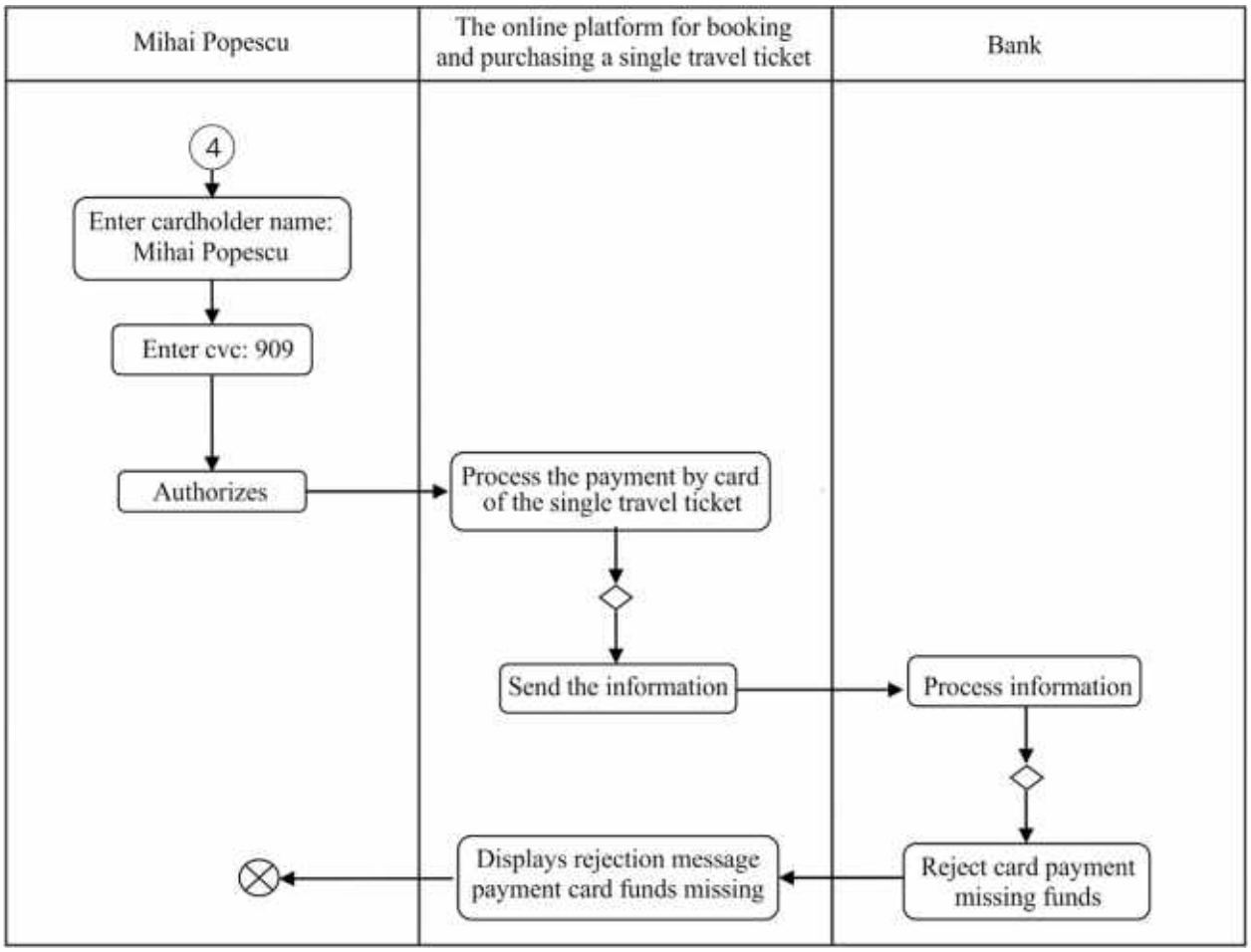


Figure 1. UML activity diagram for simulating the process of purchasing a single travel ticket

4 GENERAL CONCLUSIONS

The online booking and purchasing of the single travel ticket responds to the current needs of the society, one of them being the need to travel and encourages the use of public transport which leads to the reduction of pollution.

Although in some EU Member States, platforms for booking and purchasing tickets for multimodal passenger transport online have been operating successfully for several years, a single booking system for online purchase of travel tickets for multimodal transport has not been developed yet at EU level.

In Romania there is no common information system, which allows the online booking and purchase of travel tickets for several modes of transport. At the moment, in Romania there is not even a common system for issuing travel tickets, connecting all railway passenger undertakings, a system that, in the near future, will become mandatory by transposing European legislation into national law.

The solution for simulating the process of online purchase of the single travel ticket for the transport by train and bus was chosen so as to include the connection of a locality from Vâlcea County with the city of Bucharest and the city of Mangalia, given that there is no direct link by rail

between Râmnicu Vâlcea and Bucharest, but there are many races operated by road carriers.

According to the timetable and the fares of the travel tickets displayed on the websites of the road and railway transport companies, it results that, although the travel ticket price of the direct road racing Călimănești-Mangalia is lower, the duration of the trip is higher compare to multimodal passenger transport, thus proving the usefulness of developed of a computer application to allow the online booking and purchase of travel tickets for multimodal transport.

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