Introduction to Industrial Informatics

ASE-9316 (A'17)

Final report of

A knowledge-driven monitoring and orchestration system (KDMOS) for the assembly line - FASTory

Submitted by

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System objective and system architecture

This **KDMOS** system enables a customer to design customized mobile phone. Customer can order his desired phone via web service (User interface). Web service is going to pass the order information directly to the Ontology Service which is a Knowledge base system. The Knowledge base(KB) contains the capabilities of different equipment in production line as well as user product needs.

The FASTory line is equipped with INICO S1000 REST-enabled controllers for robots and conveyor systems. Orchestrator service invokes service, event, and data URLs to produce the desired phone with a specified color, keypad and structure Using the KB to make decisions. When the product is done, controller sends message to the server. Also, Customer can order and check the status of the product at any time.

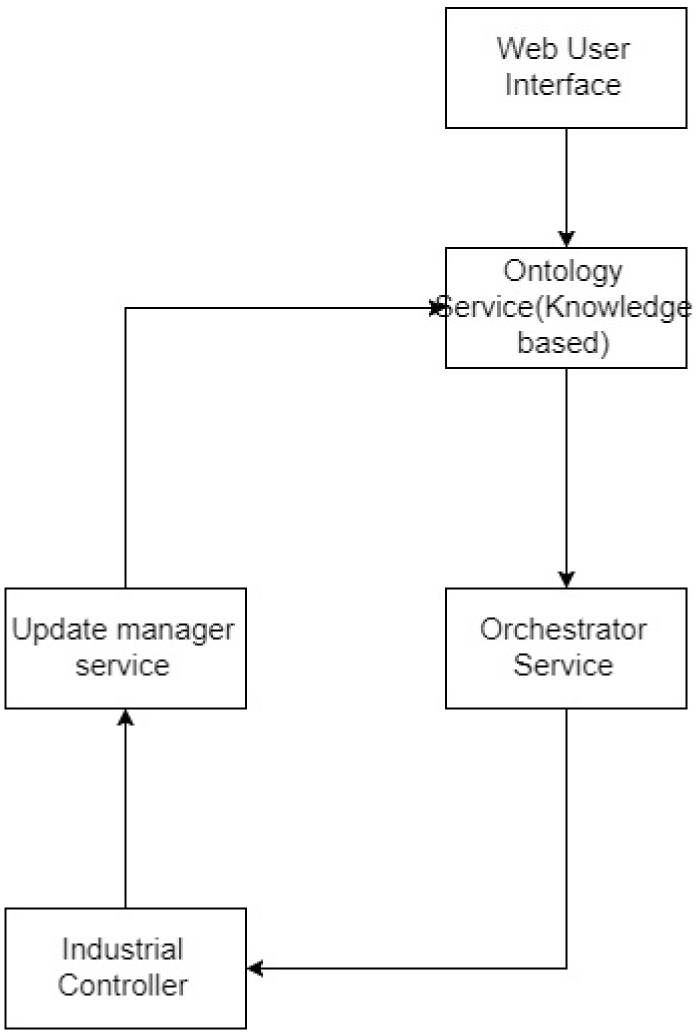


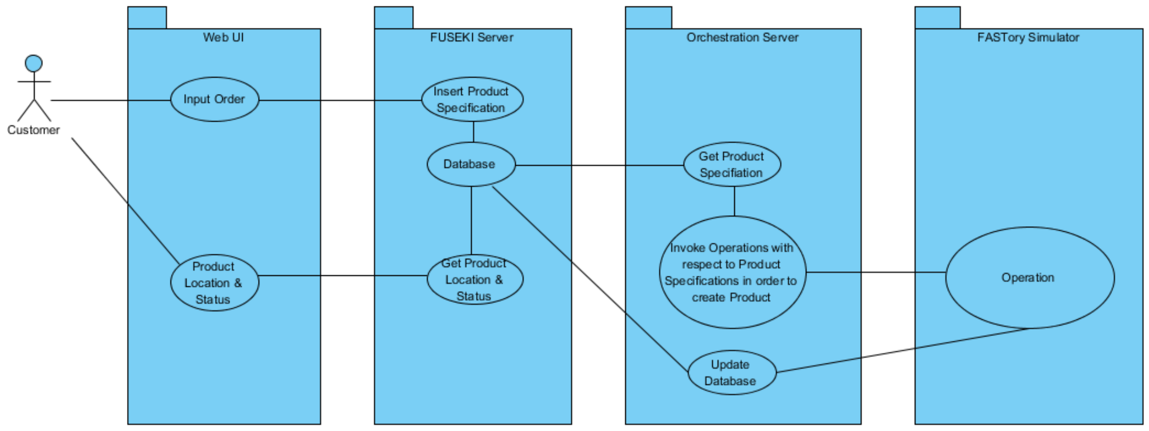
Figure 1: System architecture

Diagrams

During the first iterations, we had very different ideas than we have now, because we did not pay attention to the word knowledge driven. However, since we figured out what this project is about we had to dramatically reduce the features (payment, delivery, etc.), we planned to implement at the start of the project (Note. Even though it would still be possible to implement, but it would get even more complicated for us). In the end, the diagrams were not extended, they were reduced a lot. But the thing that changed a lot was a logic behind them.

Each diagram completed each other because every one of them described the system from different point of view. Use case described functionality of the system, Sequence described interactions; Class diagram described structure of the system, Activity diagram described changes in the system.

This diagram shows general structure of the system. It shows how data from the customer are processed and put into the Knowledge Database. Customer also has access to the KB and can request location and status of his product. Orchestration Server can make use of that data and can start the production. Orchestration Server also gets feedback from the FASTory simulator and can update KB.



Web UI
FUSEKI Server
Orchestration Server
FASTory Simulator
Customer
Input Order
Insert Product Specification
Database
Get Product Specifiation
Invoke Operations with respect to Product Specifications in order to create Product
Operation
Product Location & Status
Get Product Location & Status
Update Database

Figure 2: Use Case diagram

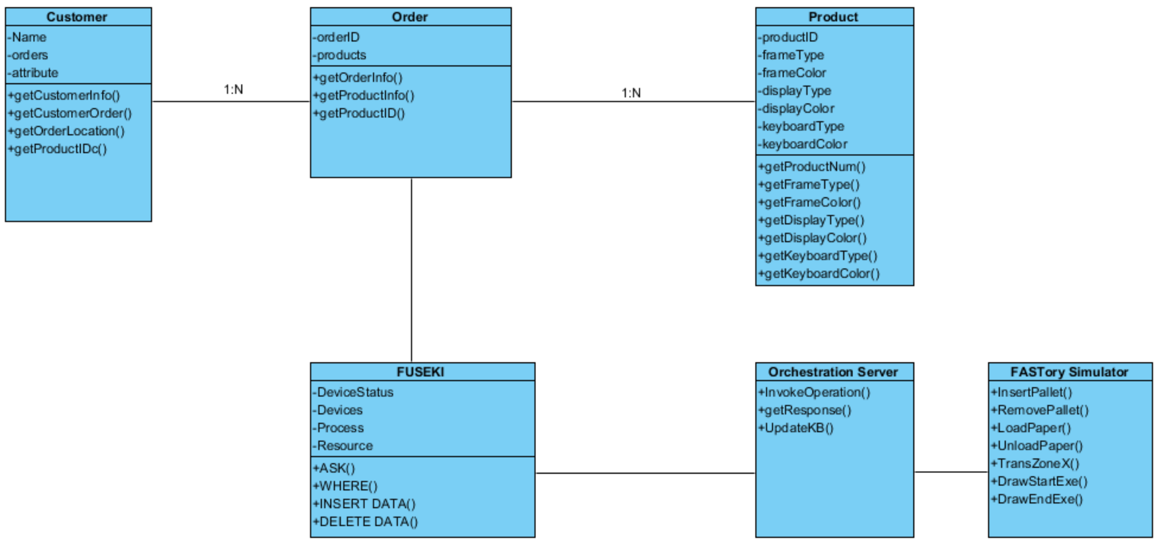


Figure 3: Class diagram

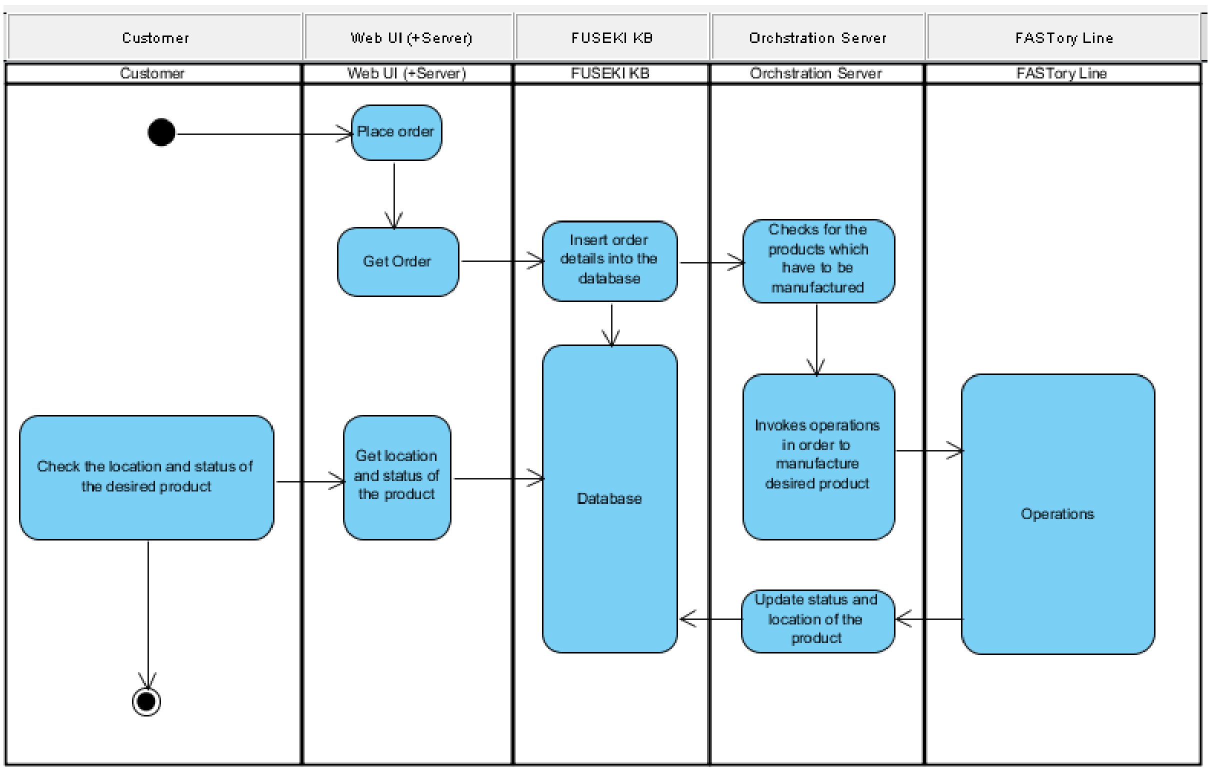

Customer
Web UI (+Server)
FUSEKI KB
Orchstration Server
FASTory Line
Customer
Web UI (+Server)
FUSEKI KB
Orchstration Server
FASTory Line
Place order
Get Order
Insert order details into the database
Checks for the products which have to be manufactured
Database
Invokes operations in order to manufacture desired product
Operations
Check the location and status of the desired product
Get location and status of the product
Update status and location of the product

Figure 4: Activity Diagram

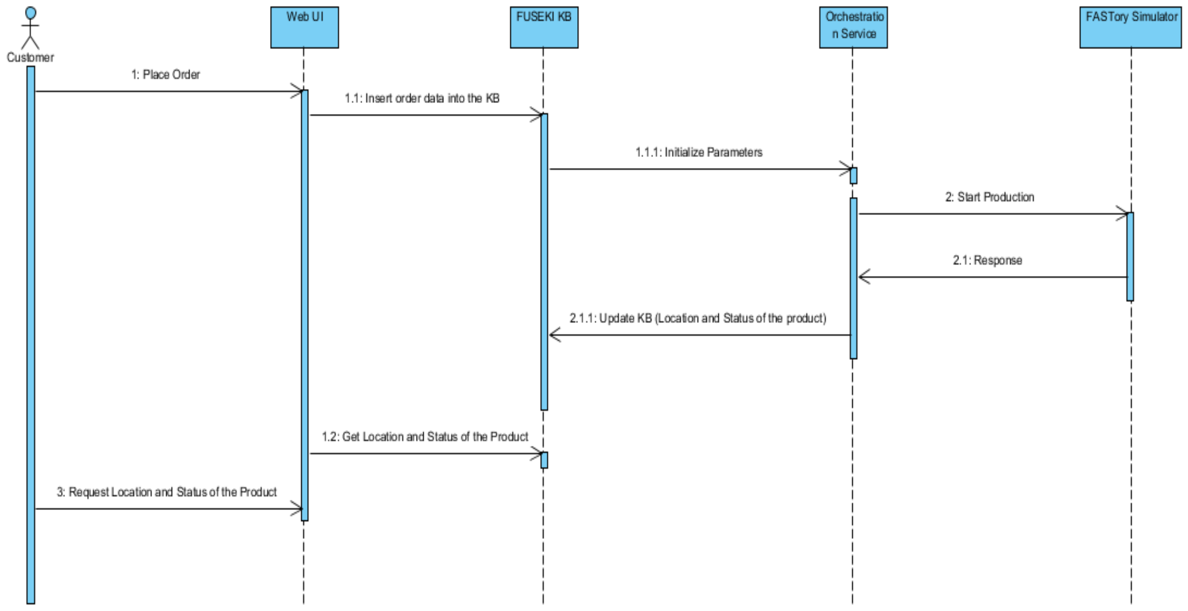

Customer
Web UI
FUSEKI KB
Orchestration Service
FASTory Simulator
1: Place Order
1.1: Insert order data into the KB
1.1.1: Initialize Parameters
2: Start Production
2.1: Response
2.1.1: Update KB (Location and Status of the product)
1.2: Get Location and Status of the Product
3: Request Location and Status of the Product

Figure 5: Sequence Diagram

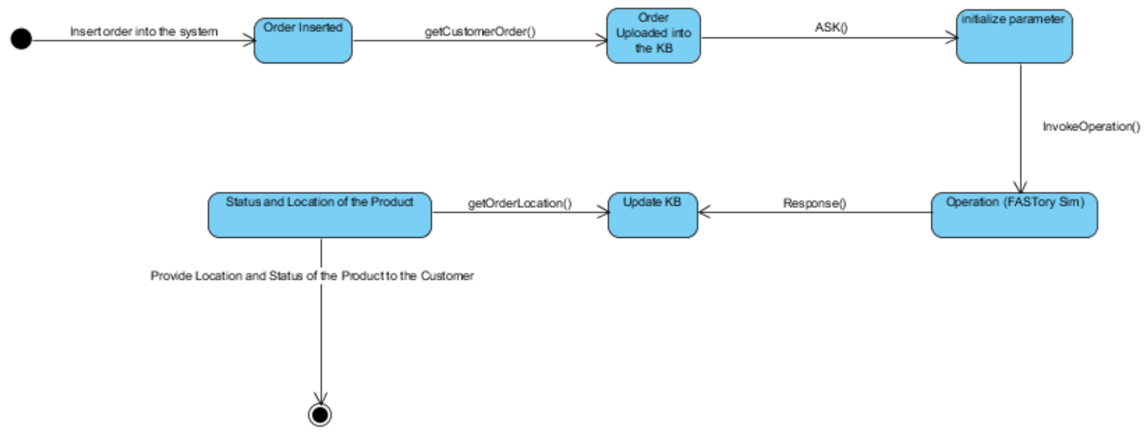
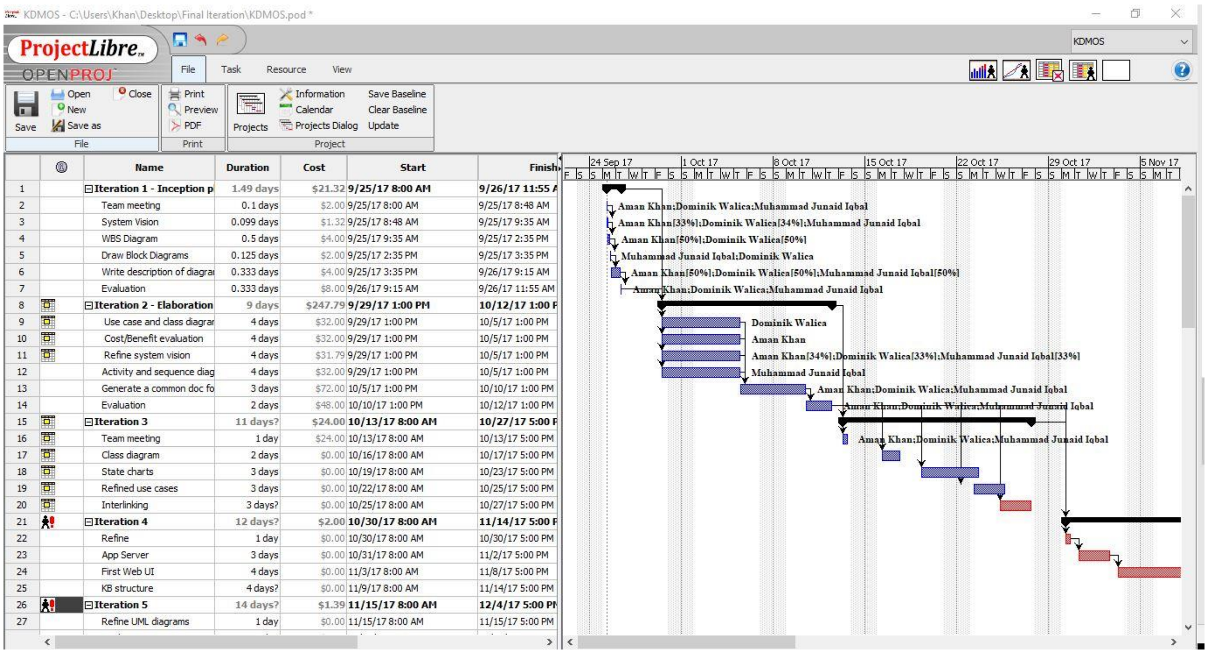

Insert order into the system
Order Inserted
getCustomerOrder()
Order Uploaded into the KB
ASK()
initialize parameter
InvokeOperation()
Operation (FASTory Sim)
Response()
Update KB
getOrderLocation()
Status and Location of the Product
Provide Location and Status of the Product to the Customer

Figure 6: State Chart

Cost analysis

In inception phase, Cost/benefit analysis play a vital role in project feasibility and risk analysis. (see file “KDMOS.pod”)

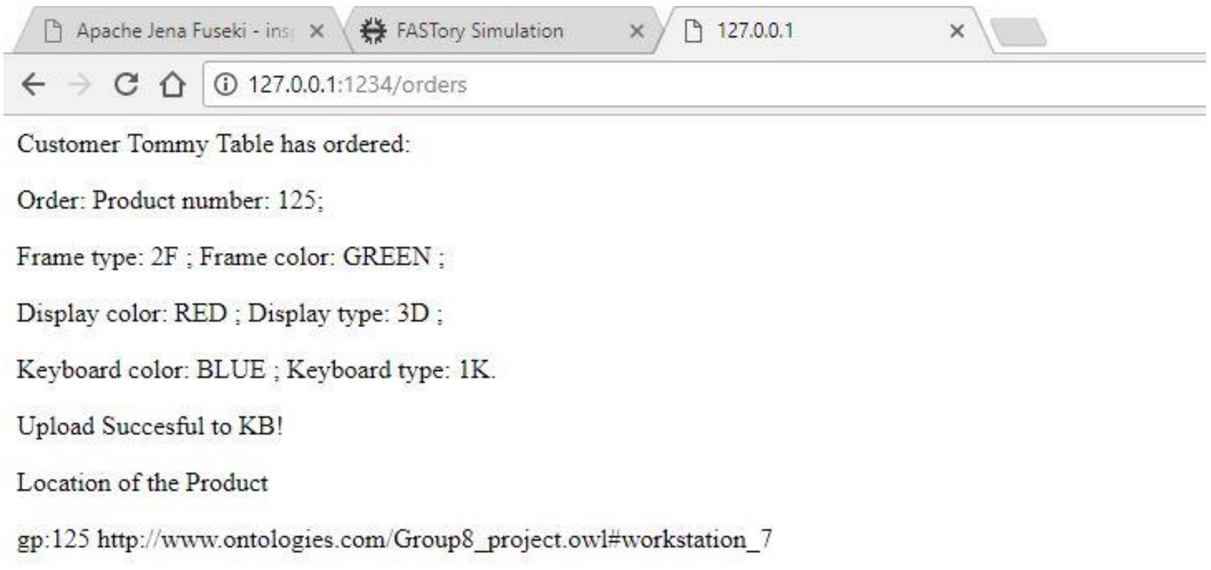

KDMOS - C:\Users\Khan\Desktop\Final Iteration\KDMOS.pod *
ProjectLibre
OPENPROJ
KDMOS
File
Task
Resource
View
Save
Open
New
Save as
Close
File
Print
Preview
PDF
Print
Projects
Information
Calendar
Projects Dialog
Save Baseline
Clear Baseline
Update
Project
24 Sep 17
1 Oct 17
8 Oct 17
15 Oct 17
22 Oct 17
29 Oct 17
5 Nov 17
Aman Khan;Dominik Walica;Muhammad Junaid Iqbal
Aman Khan[33%];Dominik Walica[34%];Muhammad Junaid Iqbal
Aman Khan[50%];Dominik Walica[50%]
Muhammad Junaid Iqbal;Dominik Walica
Aman Khan[50%];Dominik Walica[50%];Muhammad Junaid Iqbal[50%]
Aman Khan;Dominik Walica;Muhammad Junaid Iqbal
Dominik Walica
Aman Khan
Aman Khan[34%];Dominik Walica[33%];Muhammad Junaid Iqbal[33%]
Muhammad Junaid Iqbal
Aman Khan;Dominik Walica;Muhammad Junaid Iqbal
Aman Khan;Dominik Walica;Muhammad Junaid Iqbal
Aman Khan;Dominik Walica;Muhammad Junaid Iqbal

		Name	Duration	Cost	Start	Finish
1		⊟Iteration 1 - Inception p	1.49 days	$21.32	9/25/17 8:00 AM	9/26/17 11:55 A
2		Team meeting	0.1 days	$2.00	9/25/17 8:00 AM	9/25/17 8:48 AM
3		System Vision	0.099 days	$1.32	9/25/17 8:48 AM	9/25/17 9:35 AM
4		WBS Diagram	0.5 days	$4.00	9/25/17 9:35 AM	9/25/17 2:35 PM
5		Draw Block Diagrams	0.125 days	$2.00	9/25/17 2:35 PM	9/25/17 3:35 PM
6		Write description of diagra	0.333 days	$4.00	9/25/17 3:35 PM	9/26/17 9:15 AM
7		Evaluation	0.333 days	$8.00	9/26/17 9:15 AM	9/26/17 11:55 AM
8	▦	⊟Iteration 2 - Elaboration	9 days	$247.79	9/29/17 1:00 PM	10/12/17 1:00 P
9	▦	Use case and class diagrar	4 days	$32.00	9/29/17 1:00 PM	10/5/17 1:00 PM
10	▦	Cost/Benefit evaluation	4 days	$32.00	9/29/17 1:00 PM	10/5/17 1:00 PM
11	▦	Refine system vision	4 days	$31.79	9/29/17 1:00 PM	10/5/17 1:00 PM
12		Activity and sequence diag	4 days	$32.00	9/29/17 1:00 PM	10/5/17 1:00 PM
13		Generate a common doc fo	3 days	$72.00	10/5/17 1:00 PM	10/10/17 1:00 PM
14		Evaluation	2 days	$48.00	10/10/17 1:00 PM	10/12/17 1:00 PM
15	▦	⊟Iteration 3	11 days?	$24.00	10/13/17 8:00 AM	10/27/17 5:00 P
16	▦	Team meeting	1 day	$24.00	10/13/17 8:00 AM	10/13/17 5:00 PM
17	▦	Class diagram	2 days	$0.00	10/16/17 8:00 AM	10/17/17 5:00 PM
18	▦	State charts	3 days	$0.00	10/19/17 8:00 AM	10/23/17 5:00 PM
19	▦	Refined use cases	3 days	$0.00	10/22/17 8:00 AM	10/25/17 5:00 PM
20	▦	Interlinking	3 days?	$0.00	10/25/17 8:00 AM	10/27/17 5:00 PM
21	!	⊟Iteration 4	12 days?	$2.00	10/30/17 8:00 AM	11/14/17 5:00 P
22		Refine	1 day	$0.00	10/30/17 8:00 AM	10/30/17 5:00 PM
23		App Server	3 days	$0.00	10/31/17 8:00 AM	11/2/17 5:00 PM
24		First Web UI	4 days	$0.00	11/3/17 8:00 AM	11/8/17 5:00 PM
25		KB structure	4 days?	$0.00	11/9/17 8:00 AM	11/14/17 5:00 PM
26	!	⊟Iteration 5	14 days?	$1.39	11/15/17 8:00 AM	12/4/17 5:00 P
27		Refine UML diagrams	1 day	$0.00	11/15/17 8:00 AM	11/15/17 5:00 PM

Figure 7: Cost analysis

User interface

The user interface has a limited function, and user can see the ordered mobile, successful placement of the order, and able to check the current location on the manufacturing line.



Customer Tommy Table has ordered:

Order: Product number: 125;

Frame type: 2F ; Frame color: GREEN ;

Display color: RED ; Display type: 3D ;

Keyboard color: BLUE ; Keyboard type: 1K.

Upload Succesful to KB!

Location of the Product

gp:125 http://www.ontologies.com/Group8_project.owl#workstation_7

Figure 8: User interface

Ontology and Knowledge Base

The Knowledge base(KB) contains the capabilities of different equipment in production line as well as user product needs. Knowledge base helps orchestrator to make decisions. Mainly it describe the capability of the Fastory Line. Such as production line has devices: conveyor, robot, workstation and each device has status, next position, also the product need and other operations. For creating the Knowledge Base, an OWL editor named Olingvo is used, and Fuseki server is used as an ontology server. To make decisions, orchestrator can select, ask, update data by simple queries to KB.

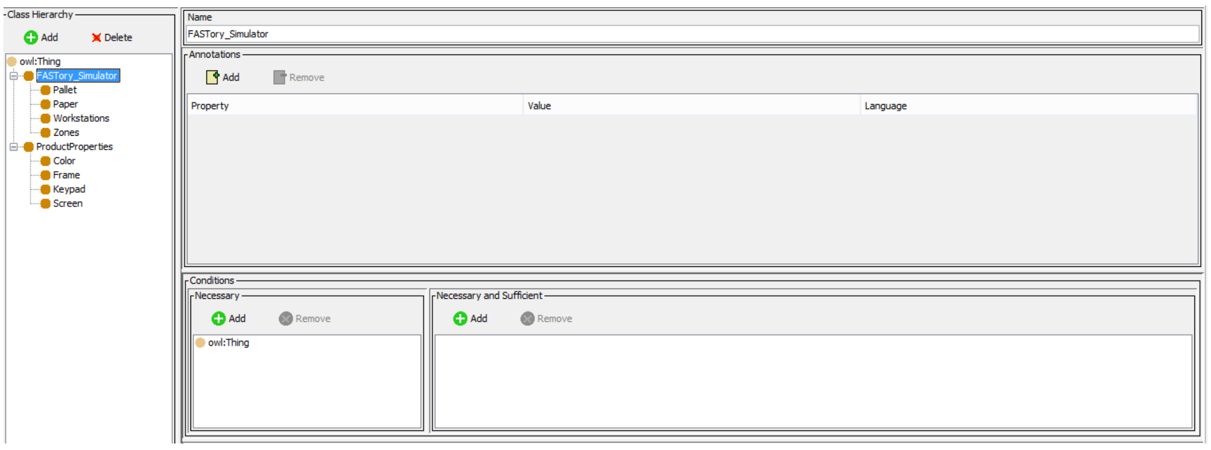


Figure 9: Classes

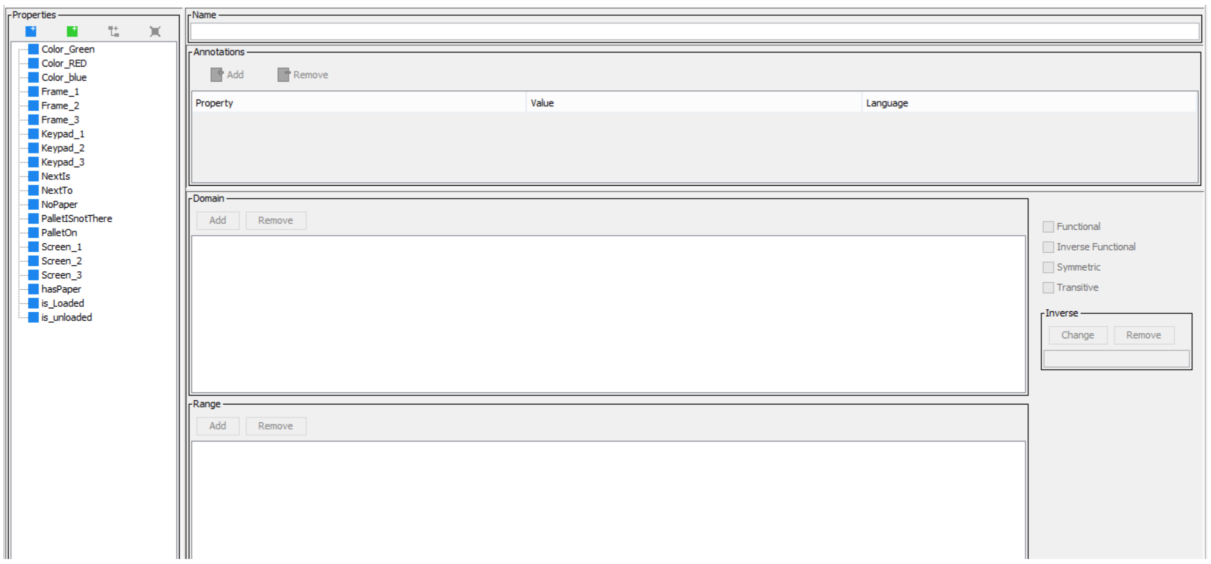


Figure 10: Properties

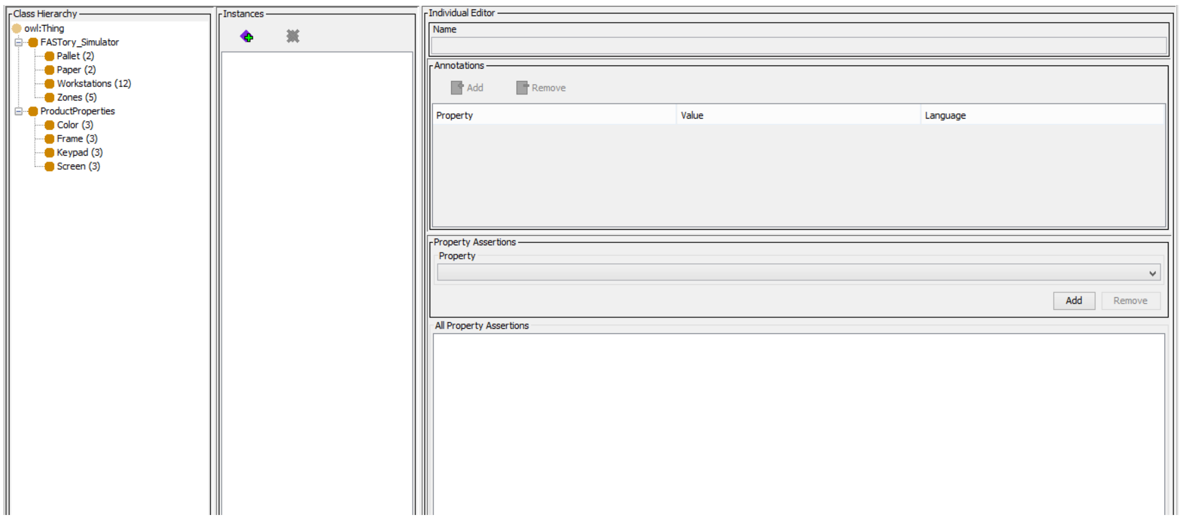


Figure 11: Individuals

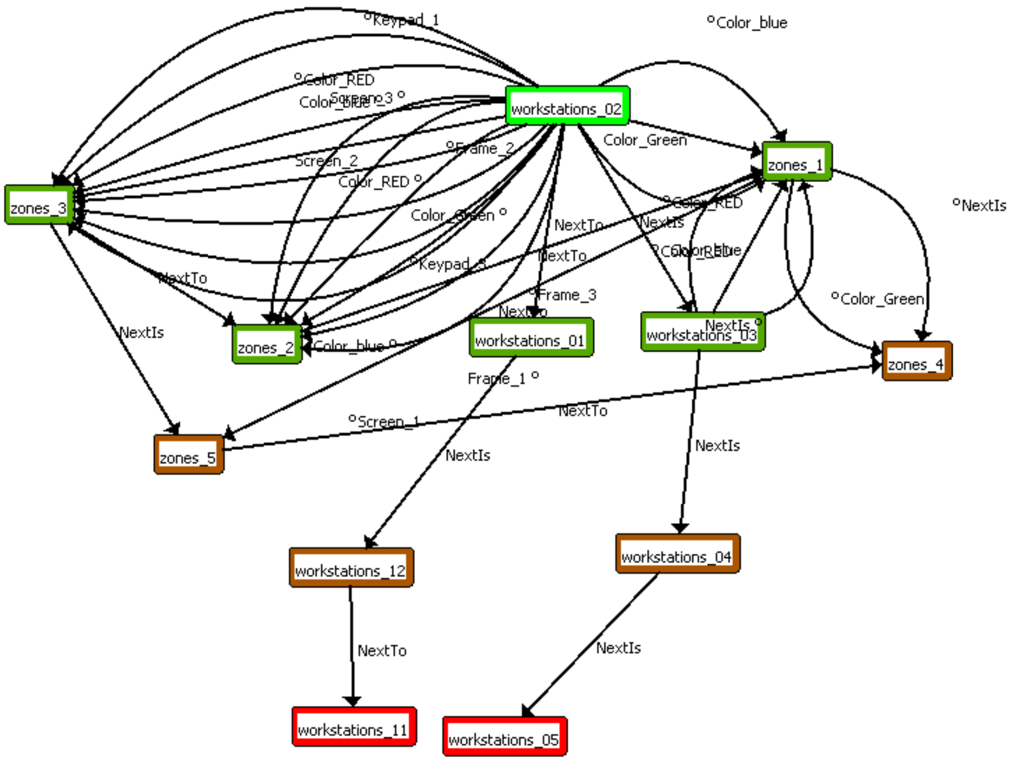


Figure 12: Graph of workstation_2