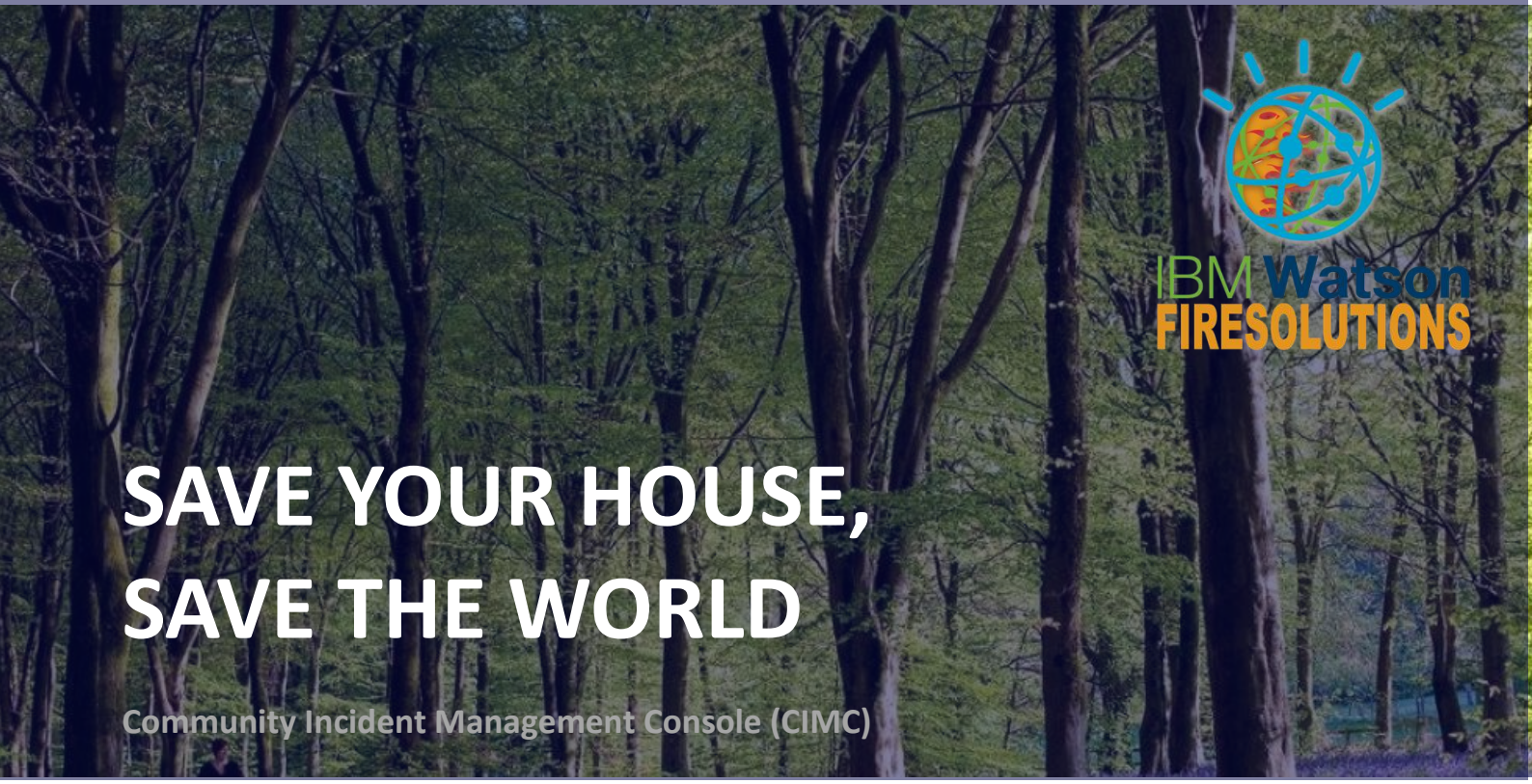


SAVE YOUR HOUSE, SAVE THE WORLD

Community Incident Management Console (CIMC)





Barcelona Firesolutions team

CIMC Technical documentation

Call for code, September 2018

1. ABSTRACT

WILDFIRES are a global emergency and when they affect housing and industry, the firefighter system can collapse quickly. In recent years we have gone from fires of thousands of hectares to tens of thousands, and especially we have begun to see fires burning beyond 5 km/h in a sustained way. Fire extinguishing capacity does not exceed 1.2 km/h. In Europe between 2017 and 2018, forest fires have caused more civil mortality than the whole terrorist problem.

Extinction systems need to focus on the fire strategy but often most of the resources are lost defending people and assets. Self-protection becomes a priority to ensure that the emergency system can maintain the response to the source of the problem, the fire.

Self-protection means being able to guarantee the safety of people in a fire environment without losing resources assuming the responsibility to execute it. Technology is needed to be able to evaluate and guide evacuations in a dynamic way. Especially, we need IT systems to advise about the evacuation conditions versus conditions of confinement in real time.

Emergency services have been operating so far with a culture of values based on the priorities of lives, material goods and the environment. We need to add now a culture of tactical value where first it manages the value of **no colapse** to be able to guarantee that we always have capacity to answer. In this step, self-protection and guidance advice is key.

Let's save our house, let's save the world with a solution called **Community Incident Management Console (CIMC).** This tool will make it easier for the communities:

- Identify the key points to protect their houses
- Measure the risk of fire and fire load
- In case of fire, calculate if the house is in the hot area
- Help to decide to evacuate or confine and the best house to confine
- Count the people on the hot area

How CIMC works –Main capabilities: (1) Prevention with fire load indicators and self-protection recommendations by house; (2) Early Detection with fire-detection alerts; (3) Making decision advice recollecting information on real time from Google Maps to calculate the time to arrive to a secure area and from Twitter to calculate the sentiment in the evacuation route; (4) Fire management to provide number of people in the hot area and searching the most valuable data to improve forest fire-fighting strategies.

Technologies – This solution uses: (1) IBM Watson Studio to create and manage cognitive models to gather insight of data; (2) IBM Watson Machine Learning to train, deploy and publish cognitive models; (3) IBM Cloud Object Storage to store data sets, trained cognitive models and training results; (4) Apache Spark service to execute Machine Learning workload; (5) Db2 Warehouse on Cloud to store the feedback data for batch predictions; (6) SQL Database to store the data and (7) Natural Language processing to analize social network inputs.

Value –CIMC is a decentralized system of fire control for wildland-urban interface that is connected to the local emergency services and it helps to reinforce the culture of self-defence. The key points for this solution are the sense of community with neighbours, increasing fire knowledge, self-protection capabilities and people empowerment to make the right decision in case of fire. Let's save our house, let's save the forest and let's save the world.

Key words – Will fire, Self-protection, firefighting, IBM Watson Machine Learning.

Team – Barcelona Firesolutions: Marco Rodriguez, Marta Rovira, Salomé Valero

Thanks to IBM Barcelona (Conchi Palla and Merche Serra) for encouraging us to attend the Call.

Thanks to our Stakeholders GRAF* (Joan Herrera and Marc Castellnou for their labor against wildfires in Catalonia and their inspiring message

**GRAF: Grups de Reforç d'Actuacions Forestals. Bombers. Departament Interior de la Generalitat de Catalunya. This technical support team is part of the local emergency services. GRAF is specialized in fire extinction strategies.*

2. SOLUTION DESIGN

2.1. USER STORIES

Self-protection Capabilities:

Domain	How it works	User stories	User case Name	Input	Output for user	Output for community/firefighters command center	Type of output value	Technology	IBM CLOUD SERVICES	CIMC aplication capability	STATUS
Self-protection	**(1) Join to the community,** complete CIMC Firesolutions test for your house and check fire risk indicator with recommendations to protect your house;	1.1	**Community Home Register**	15 variables	%Fire Risk_house	%Fire Risk_community	Number	Machine Learning – Regression. (Supervised Learning, i.e. learning where a training set of correctly identified observations is available + Continuous Learning Model Evaluation)	· Watson Studio; - An IBM Cloud Object Storage instance; - An Apache Spark service instance; · An IBM Watson Machine Learning instance; - Db2 Warehouse on Cloud instance.	**My Home / User register**	Done
		1.2	**Recommendation for your home**	3 domains	Recommedations _house	Recommedations_community	Text	Machine learning - Domain Knowledge Multiclass classification (Supervised learning, i.e. learning where a training set of correctly identified observations is available)	· Watson Studio; - An IBM Cloud Object Storage instance; - An Apache Spark service instance; · An IBM Watson Machine Learning instance.	**Home recommendation**	Done
	(2) CIMC provides a daily risk assessment report with **fire load indicators** about the community and send to FireFighters Command Center;	2	**Daily risk assessment report with fire load indicators**	Variables fire load	Fire load_house	Fire load_community	Number	Machine learning- Regression & Binary(Supervised learning, i.e. learning where a training set of correctly identified observations is available)	· Watson Studio; - An IBM Cloud Object Storage instance; - An Apache Spark service instance; · An IBM Watson Machine Learning instance.	**Risk Assesment Report**	Done
Self-protection	**(3)** CIMC uses daily weather variables to update the risk and it allows users to report fire alerts	3.1	**Weather conditions_fire risk**	3 variables (T+H+W)	% Fire Risk_weather conditions	% Fire Risk_weather conditions	Number	Machine Learning – Regression. (Supervised learning, i.e. learning where a training set of correctly identified observations is available)	· Watson Studio; - An IBM Cloud Object Storage instance; - An Apache Spark service instance; · An IBM Watson Machine Learning instance.	**Fire detection alert**	Done
		3.2	**Fire alert from users**	Fire alert from a user	Fire alert with location	Fire alert with location sent to the overall community	Alert			**Send fire alert**	Done

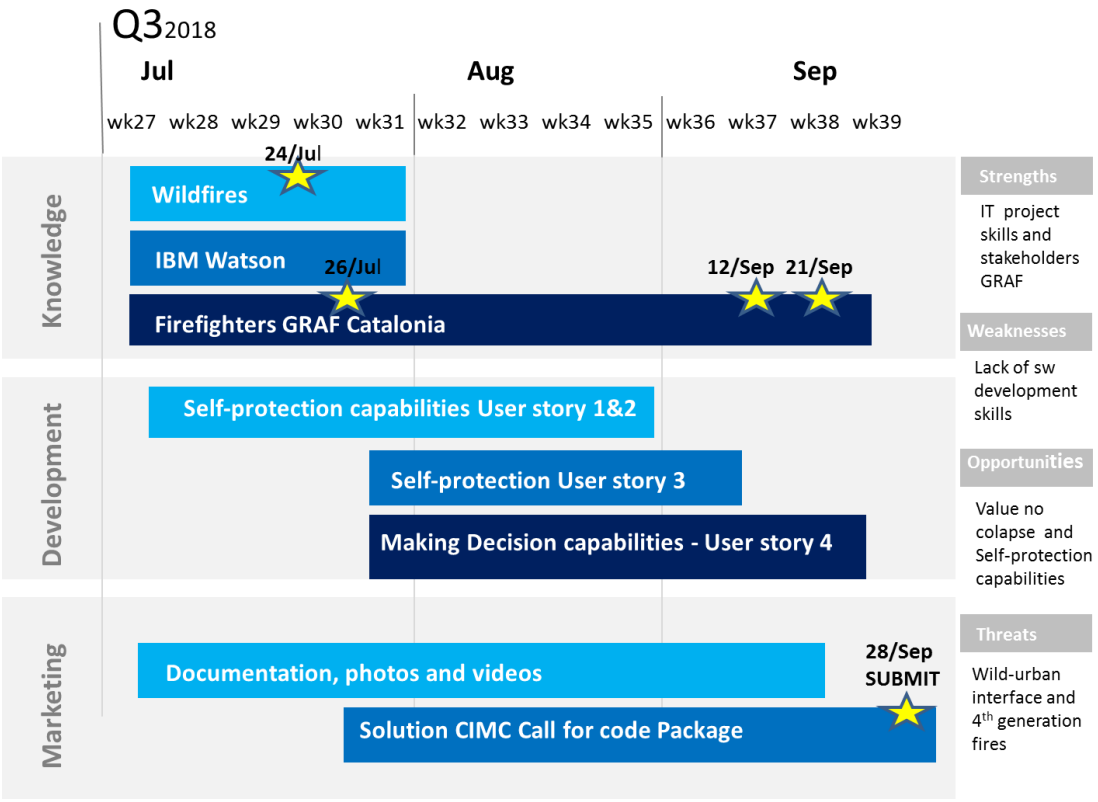
Making Decision Capabilities:

Domain	How it works	User stories	User case Name	Input	Output for user	Output for community/firefighters command center	Type of output value	Technology	IBM CLOUD SERVICES	CIMC aplication capability	STATUS
Making Decision	**(4) CIMC uses Watson Machine Learning to help** the community to make the **hard decision to evacuate or confine** in case of fire based on the information from several sources. If the final decision is confining, CIMC would recommend the best nearest house to confine the community.	4.1.	**Decision evacuate or confine**	Variables related to evacuation (time+ social sentiment Twiter evacuation way)	Recommedation Evacuation Yes/No	Recommedation Evacuation Yes/No and final decision	Alert	Machine learning- Binary	· Watson Studio; - An IBM Cloud Object Storage instance; - An Apache Spark service instance; · An IBM Watson Machine Learning instance.	**Evacuation reccomendation**	Done
		4.2	**House to confine**	Variables related to confination	The best and nearest house to confine	The best and nearest house to confine and final decision	Alert	Machine learning -Multiclass classification	· Watson Studio; - An IBM Cloud Object Storage instance; - An Apache Spark service instance; · An IBM Watson Machine Learning instance.	**Evacuation reccomendation**	Done
Making Decision	(5) CIMC uses forecast data from Firefighters to evaluate if houses are in the red/hot area or not	5	**Fire zone evaluation**	GPS information about the forecasted area affected by the fire	Yes/No (House in the hot area?)		Alert	Roadmap-priority 1			
	(6) CIMC uses information about alternative evacuation routes and reformulate the decision evacuate/confine	6	**Alternative evacuation road**	Webservice providing alternative route	Recommedation Evacuation Yes/No		Text	Roadmap-priority 2			

Fire Management Capabilities:

Domain	How it works	User stories	User case Name	Input	Output for user	Output for community/firefighters command center	Type of output value	Technology	IBM CLOUD SERVICES	CIMC aplication capability	STATUS
Fire Management	(7) CIMC recollects information about users to calculate the number of people in red/hot zone	**7**	**Number of people in red zone**	Feedback from community users	Number of people in red zone and location	Number of people in red zone and location	Number	Roadmap-priority 3			
Alert Management and monitoring	**(8)** Other services (roadmap)	**8.1**	**Fire detection alert1**	Photos from hou	Alert to the house owner	Alert to the community comm	Alert	Object detection	Fire detection alerts		Roadmap-priority 4
		8.2	**Fire detection alert2**	Twiter	Alert to the house owner	Alert to the community command center	Alert	Object detection			
		8.3	**Fire detection alert3**	Recommendations from Firefighters	Recommendations to the house owner	Recommendations to the community command center	Text	Machine learning			
		8.4	**Tex to voice**	Text	Voice	Voice	Voice	Text to voice service			Roadmap-priority 5
		8.5	**Voice to text**	Voice	Text	Text	Text	Voice to text service			
		8.6	**Data in Tetra network emergency channels**	Data	Data	Data	Data	Data through Tetra network			

2.2. ROADMAP Q3'2018

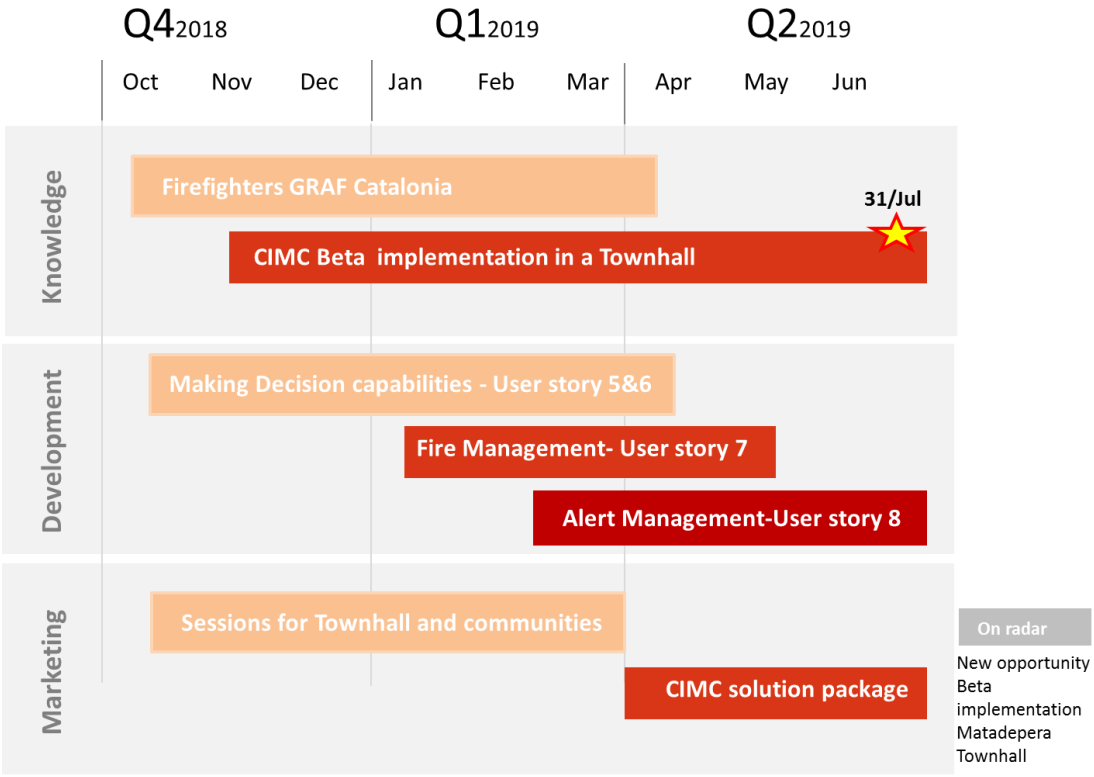


The team organized the workload in 3 areas: (1) Knowledge, to recollect all the information about Wildfires, IBM Cloud Services and main topics to work with our Stakeholders Catalonian Firefighters GRAF unit; (2) Development, to design and implement the technical solution with IBM Cloud services; (3) Marketing, to prepare all the documentation, photos, videos and the final CIMC package to submit to the Call for Code Contest.

The main milestones are the four meetings with the Stakeholders to identify the key topics and to have feedback from the Catalonia GRAF Firefighters about the solution progress. The last milestone is the final submit.

The figure contains the SWOT analysis: Strenghts, Weaknesses, Opportunities and Threats.

2.3. ROADMAP Q4'2018-Q2'2019



For next months, the team will organize the workload in the same 3 areas: (1) Knowledge, to implement the solution in a Townhall as a Beta Test; (2) Development, to design and implement the rest of user stories with IBM Cloud services; (3) Marketing, to prepare all the documentation, photos, videos about the CIMC Solution.

Our Stakeholders mentioned the opportunity to collaborate with a Townhall here in Catalonia. We will work on this implementation opportunity.

3. TECHNICAL SOLUTION

3.1. TECHNICAL SOLUTION SUMMARY

The team developed the technical solution in order to validate the model.

- The application provides a simple **web interface** for predicting several risk factors and provide with real-time insight of Twitter data, along with other real-time information to help users to make better decisions.
- The solution is based on a Web application written in **Python** that consumes **cloud cognitive services** (IBM Watson Machine Learning) and **other IBM Cloud Services** (storage, Watson Studio, Apache Spark, etc.).
- **Several Machine Learning systems** have been deployed in IBM Cloud to provide application with **predictions capabilities** (supervised machine learning) in **real-time** using a RESTful API, that have been trained with data sets coming from GreenPeace, Generalitat de Catalunya Firefighter departments websites and konstruir.com for Fire Load calculation.

Featured IBM Cloud Services:

- **Watson Studio** to create and manage cognitive models, collaborate with team, etc, to gather insight of data
- An **IBM Watson Machine Learning instance**, to train, deploy and publish cognitive models
- An **IBM Cloud Object Storage** instance to store data sets, trained cognitive models and training results

- An **Apache Spark service instance**, to execute Machine Learning workload
- A **Db2 Warehouse on Cloud instance** to store the feedback data for batch predictions.
- **SQL Database** to store the data
- **Natural Language processing** to analize social network inputs

3.2. TWO WEB APLICATIONS

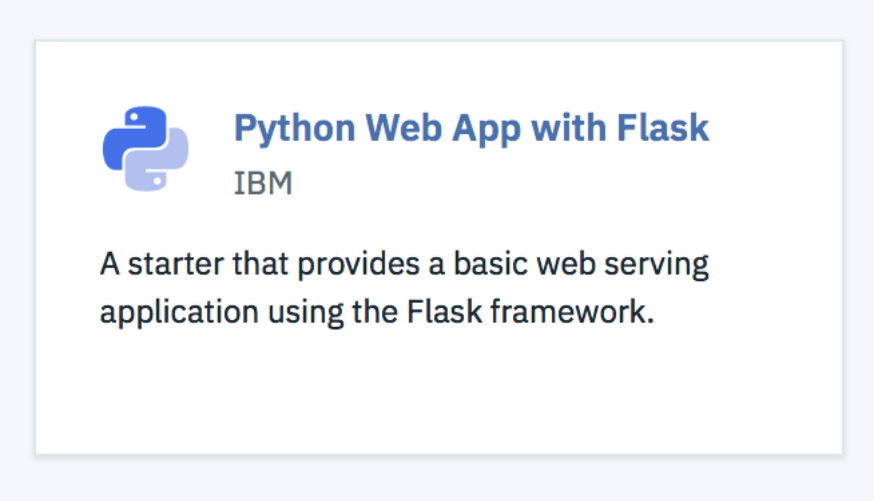
The CIMC solution is based on two web applications:

- *https://cimc.eu-gb.mybluemix.net*
  - User Community Incident Management
  - Oriented to the users of the community in order to introduce the features of their houses and get information about evacuation reccomendations, fire risk, etc.

- *https://cimc.eu-gb.mybluemix.net/cimc*
  - Community Incident Management Console
  - Oriented to give information to the community about the fire load and fire risk of the different houses in a community

The application was coded in python using the flask framework.

In order to create the app we used the IBM Cloud templates in the cloud foundry section.

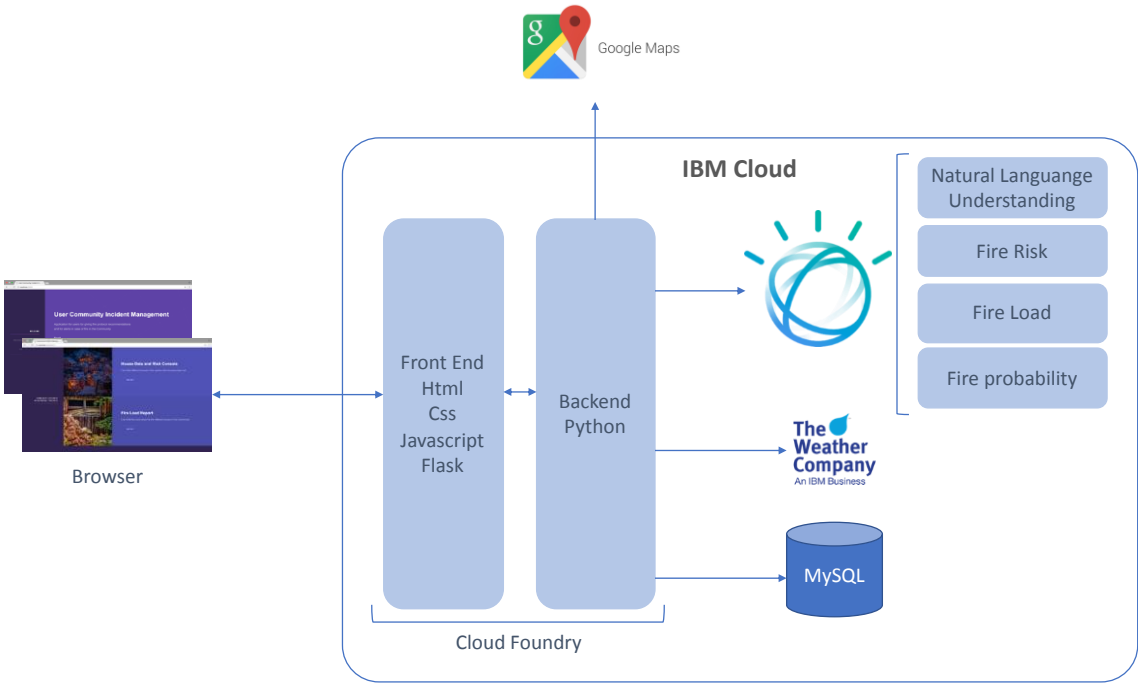


3.3. IBM CLOUD SERVICES

To implement the solution several IBM Cloud Services were used:

Service	Name	Description
App de Cloud Foundry	PythonFlaskBasicEBLYA	Is the application itself
Weather insights	Weather Company Data-gd	Is used to get weather conditions of the area of the user
Natural Languange Understanding	Natural Language Understanding-yy	Used to analyze twitter comments to evaluate if the evacuation road is ok or if it's better to consider another alternative
Compose for MySQL	Compose for MySQL-vn	Where the data is storage (user data, house data, etc)
Watson Studio	Watson Studio-95	To manage the different Watson services created for the project
Watson Machine Learning	Machine Learning-7e	For creating the machine learning models for the project
Apache Spark	Apache Spark-hl	For launching data analysis applications on a Spark cluster

3.4. SCHEMA



3.5. STRUCTURE MAIN PARTS

It was respected the structure of the project as created by IBM Cloud but all the logic and presentation parts were modified.

The logic part is in the directory:

\cimc\server\routes

This part is referred to all the code needed in order to creates the different routes of the web applications and to give them all the logic

The presentation part is in the directory:

\cimc\public

For the presentation part was used html, flask, css and javascript

There's a database procedures and tables made to simplify the code of the app.

3.6. LOGIC PART - ROUTES

Attached below the summary with the main parts of the solution. The entrance to the logic part is the file index.py where are implemented all the routes of the app.

Type	File	Description
Routes and Logic	**Index.py**	Is the core of the solution, in this file are all defined all the routes of the app. Is similar to a main function in another languages. All the logic is implemented in this file using different moudules
Configuration	**configbbdd.py**	Configuration parameters to access the database
Configuration	**listvalues.py**	List of values used in the forms
Configuration	**credentials_cimc.py**	Credentials used to access the different Watson services, Google Maps and the Weather Company
Validation	**forms.py**	Validates the input of the forms
Database access	**userdata.py**	Class to insert, update an select the information about the houses individually
Database access	**userfireload.py**	Class to insert, update and select information about the fire load of the houses individually
Reports	**report.py**	Functions to get information about all the houses risk, the fire load and to determine what is the most secure house in the community
Weather call	**weather.py**	Class to consult the weather to the Weather insights Service using the postal code
Watson call	**analysislanguage.py**	It takes text and pass to the Watson Analysis Language to determine if the text is positive, neutral o negative
Watson call	**fireload.py**	Class to consult the fire load of a house to the Watson Service created for the project
Watson call	**home_risk.py**	Class to determine the fire risk based on the features of your home
Watson call	**fireprobability.py**	Class that consult the fire probability to the Watson Service based on the temperature, relative humidity and wind speed
Google maps call	**maproute.py**	Class to get the time to get from the escape point to the meeting point

3.7. LOGIC PART- DATABASE- TABLES

For the project were used the next three tables:

Table	Description
tbl_user	Information about the user
tbl_user_data	Information about the features of the house and the fire risk
tbl_user_fire_load	Information about the fire load of the house

3.8. LOGIC PART- DATABASE- STORED PROCEDURES

Several stored procedures were used to simplify the code of the app:

Table	Description
sp_createUser	Create the user in the tbl_user table in case that doesn't exist
sp_validateLogin	Indicates if the login and password match with the information in tbl_user
sp_create_user_data	Create a home in case doesn't exist in the table tbl_user_data, storage the information about the house and the risk fire
sp_select_user_data	Select the information of a house given as parameter
sp_update_user_data	Update the information of a house
sp_select_all_user_data	Select all the houses storaged in tbl_user_data
sp_create_user_fire_load	Create fire load associated with a house in case doesn't exist in the table tbl_user_fire_load, storage the information about the fire load parameters
sp_select_user_ fire_load	Select the fire load information of a house given as parameter
sp_update_user_ fire_load	Update the fire load information of a house
sp_select_all_user_ fire_load	Select all the fire loads parameters of the houses storaged in tbl_user_data_load

3.9. PRESENTATION PART-PUBLIC

In this table are enumerated the html files that are part of the User Community Incident Management:

File	Description
index.html	Principal web page of the solution
yourhome.html	Where can be introduced the features of the user home to calculate the fire probability
homerecommendations.html	Fire probability based on the features of the house and list of recommendations
riskasessment.html	Form to introduce the values to calculate the fire load
Evacuationrecommendation.html	Report that indicates the time to get from the evacuation point to the meeting point. Evaluate texts to decide if the escape route is secure and indicate if it's better to leave or to stay at another house more secure
firedetection.html	In this area should be all the alerts about fire. Nowadays is a fire alert based on weather conditions
map_google.html	Is used inside evacuation recommendation page to paint the route using google maps

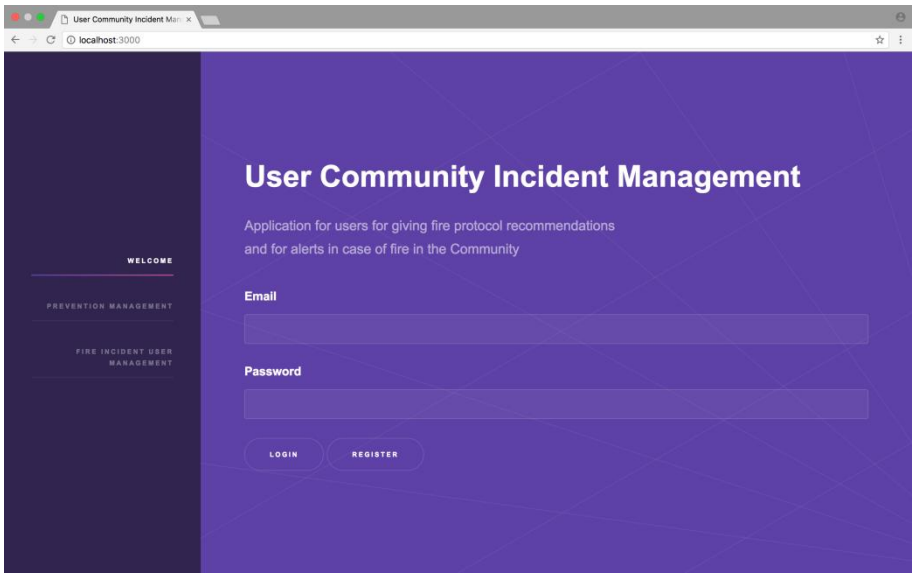
Next the summary with the html files that builds Community Incident Management Console

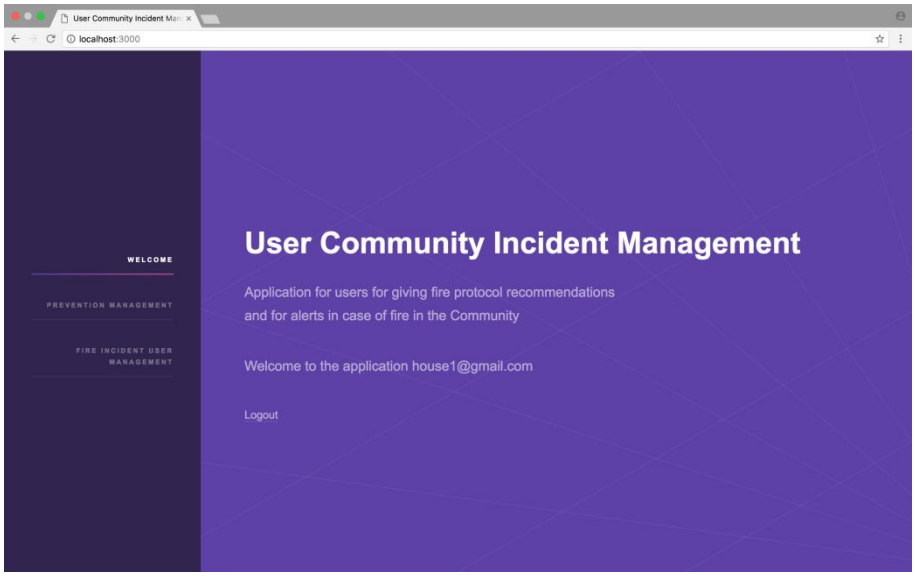
File	Description
cimc.html	Principal web page of the solution
cimc_houses.html	Report of all the houses with their fire risk
cimc_fireload.html	Report of all the houses with the fire load values

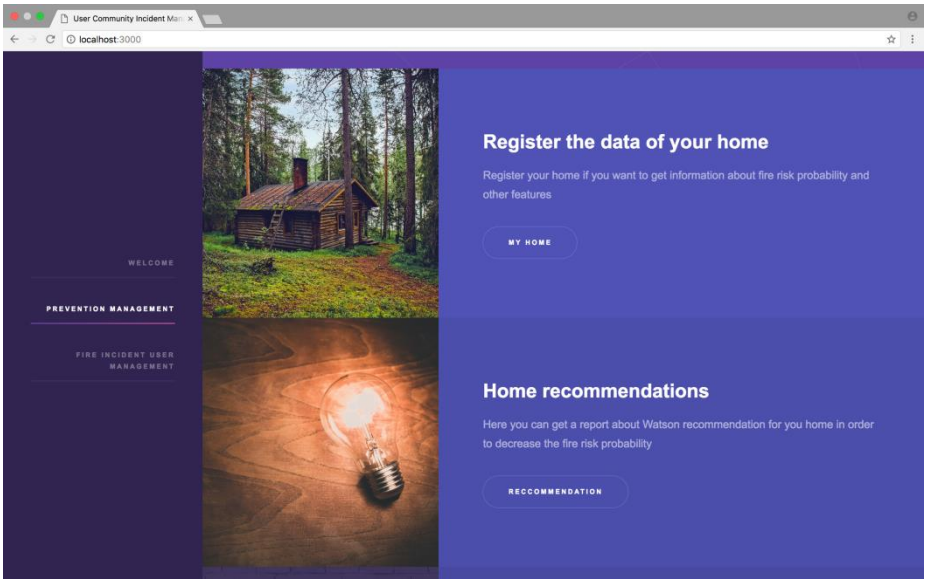
3.10. USER– LOGIN AND REGISTER

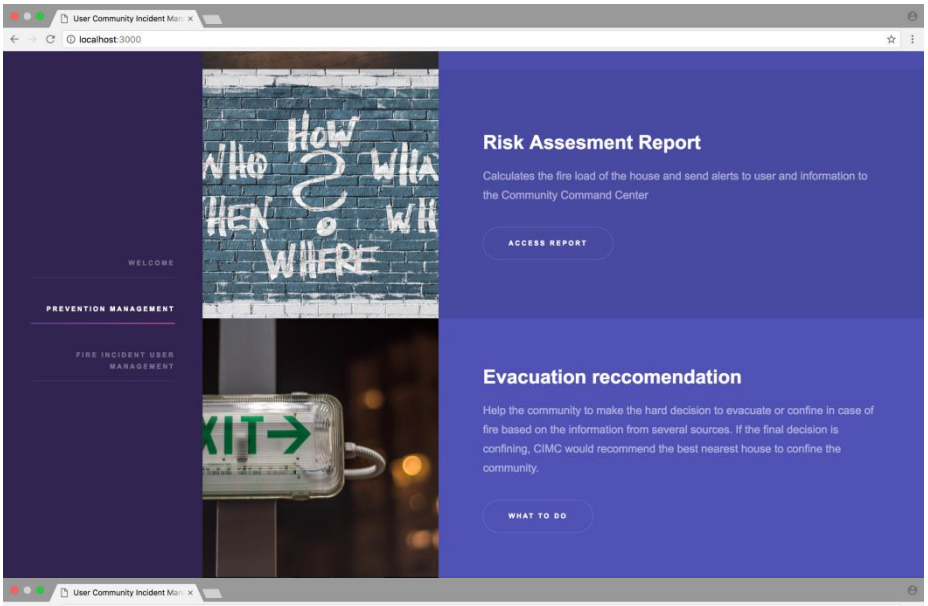
In the principal page is important to login or to register in order to use all the functions of the app.

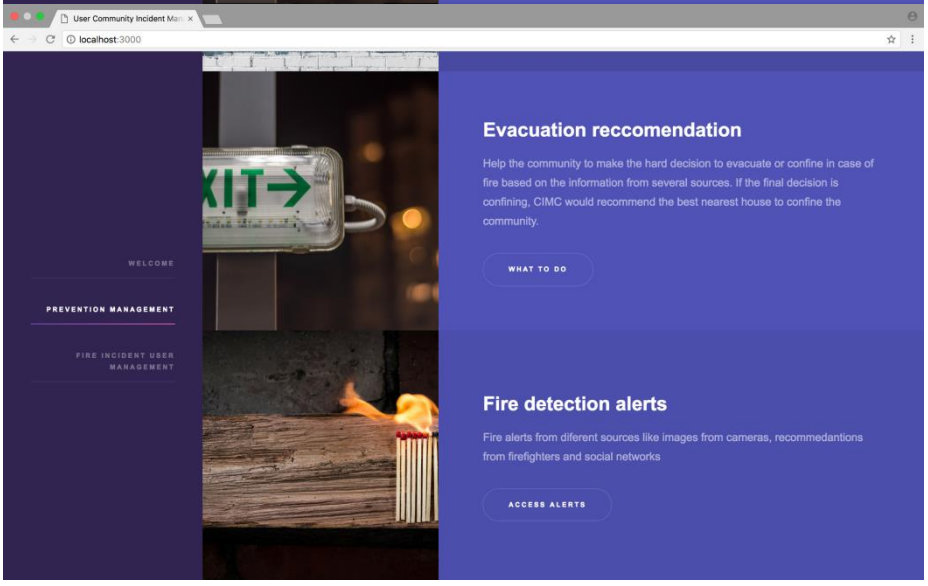
In other case, when a function is selected, the app doesn't do anything.






User Community Incident Mana
localhost:3000
WELCOME
PREVENTION MANAGEMENT
FIRE INCIDENT USER MANAGEMENT
Register the data of your home
Register your home if you want to get information about fire risk probability and other features
MY HOME
Home recommendations
Here you can get a report about Watson recommendation for you home in order to decrease the fire risk probability
RECCOMMENDATION

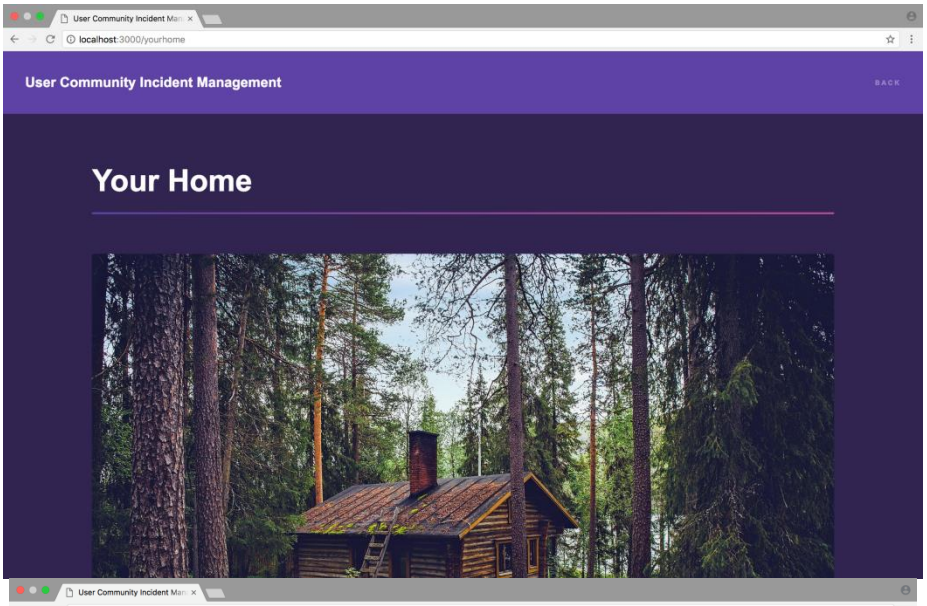

User Community Incident Mana
localhost:3000
WELCOME
PREVENTION MANAGEMENT
FIRE INCIDENT USER MANAGEMENT
Risk Assesment Report
Calculates the fire load of the house and send alerts to user and information to the Community Command Center
ACCESS REPORT
Evacuation reccomendation
Help the community to make the hard decision to evacuate or confine in case of fire based on the information from several sources. If the final decision is confining, CIMC would recommend the best nearest house to confine the community.
WHAT TO DO

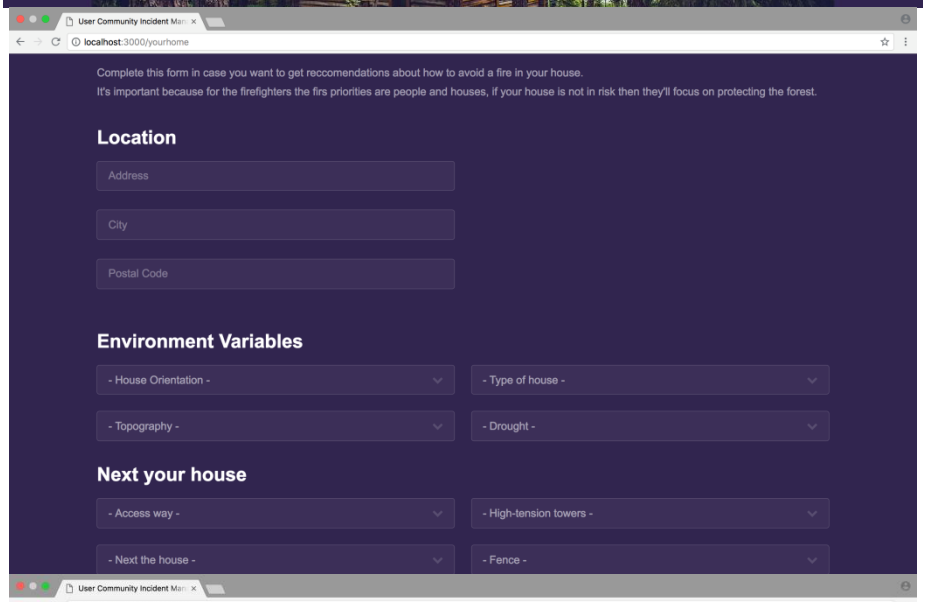

User Community Incident Mana
localhost:3000
WELCOME
PREVENTION MANAGEMENT
FIRE INCIDENT USER MANAGEMENT
Evacuation reccomendation
Help the community to make the hard decision to evacuate or confine in case of fire based on the information from several sources. If the final decision is confining, CIMC would recommend the best nearest house to confine the community.
WHAT TO DO
Fire detection alerts
Fire alerts from diferent sources like images from cameras, recommedantions from firefighters and social networks
ACCESS ALERTS

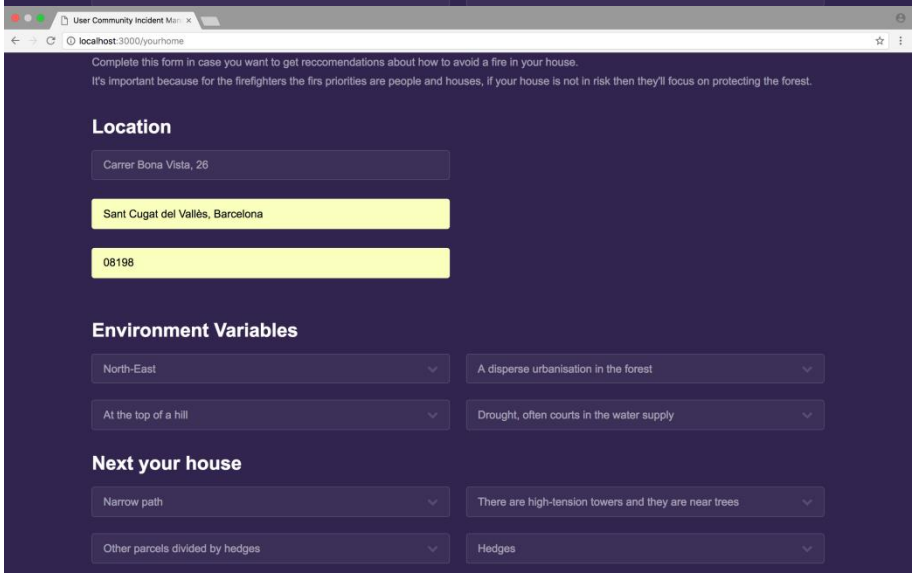
3.11. USER– HOME REGISTER

In this area you can introduce the address of your house. Only one house is allowed per user. You have to introduce the different variables of the house in order to calculate the fire risk of the house.

The fire risk is calculated and saved in the database when all the parameters are completed.

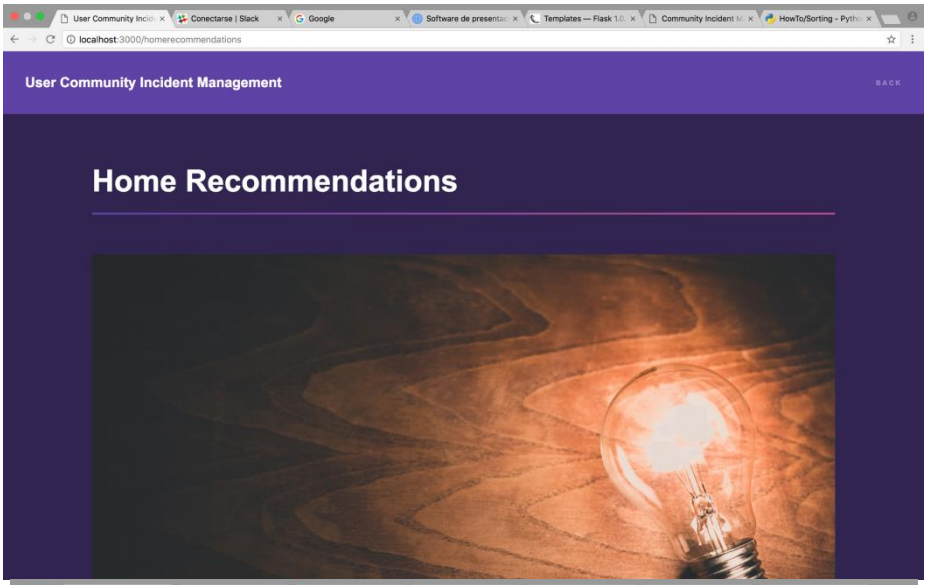

User Community Incident Mar
localhost:3000/yourhome
User Community Incident Management
BACK
Your Home

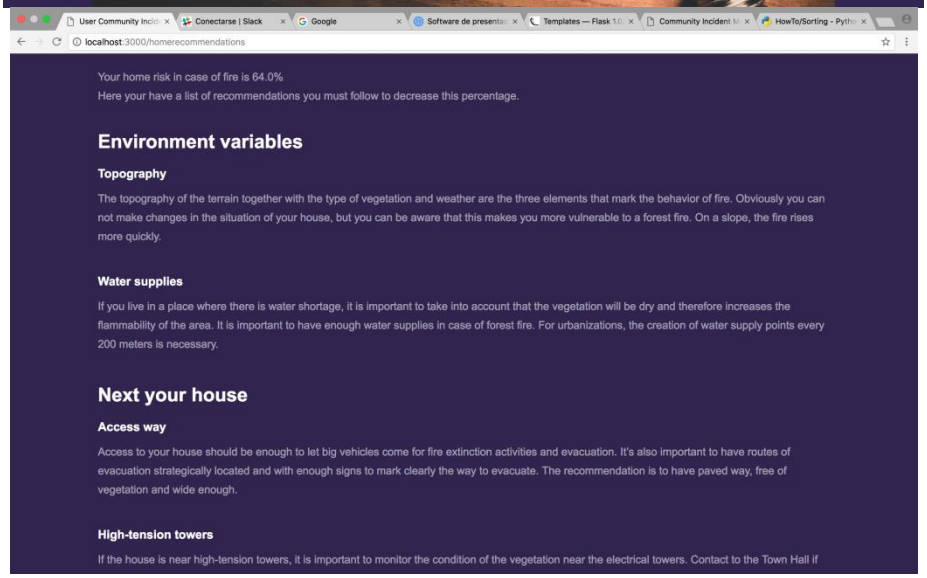

User Community Incident Mar
localhost:3000/yourhome
Complete this form in case you want to get reccomendations about how to avoid a fire in your house.
It's important because for the firefighters the firs priorities are people and houses, if your house is not in risk then they'll focus on protecting the forest.
Location
Address
City
Postal Code
Environment Variables
- House Orientation -
- Type of house -
- Topography -
- Drought -
Next your house
- Access way -
- High-tension towers -
- Next the house -
- Fence -


User Community Incident Mar
localhost:3000/yourhome
Complete this form in case you want to get reccomendations about how to avoid a fire in your house.
It's important because for the firefighters the firs priorities are people and houses, if your house is not in risk then they'll focus on protecting the forest.
Location
Carrer Bona Vista, 26
Sant Cugat del Vallès, Barcelona
08198
Environment Variables
North-East
A disperse urbanisation in the forest
At the top of a hill
Drought, often courts in the water supply
Next your house
Narrow path
There are high-tension towers and they are near trees
Other parcels divided by hedges
Hedges

3.12. USER–HOME RECOMMENDATIONS

Once all the data about is introduced, it's saved in the database. When you select the home recommendations option you can query the risk in case of fire and the different recommendations for you house to be more secure.

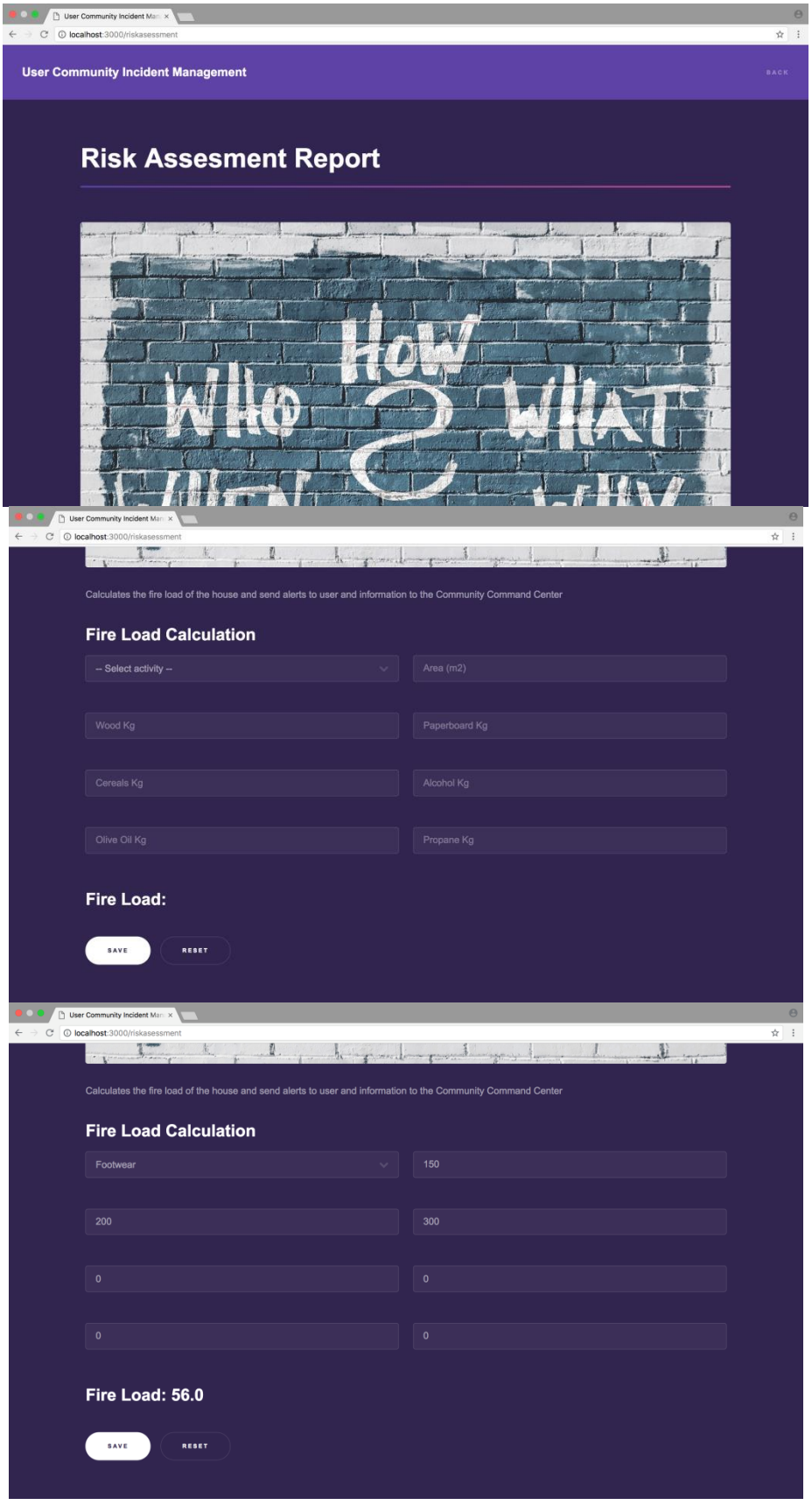




3.13. USER–RISK ASSESMENT REPORT

This form is used to calculate the fire load of your house. You have to introduce the activity of your house (kind of business) and to introduce the area and kilograms you have at home of different materials.

When the information is saved, then the fire load is calculated and saved in the database.


User Community Incident Management
BACK
Risk Assesment Report
How
Who
WHAT
Calculates the fire load of the house and send alerts to user and information to the Community Command Center
Fire Load Calculation
-- Select activity --
Area (m2)
Wood Kg
Paperboard Kg
Cereals Kg
Alcohol Kg
Olive Oil Kg
Propane Kg
Fire Load:
SAVE
RESET
Calculates the fire load of the house and send alerts to user and information to the Community Command Center
Fire Load Calculation
Footwear
150
200
300
0
0
0
0
Fire Load: 56.0
SAVE
RESET

3.14. USER–EVACUATION RECOMMENDATION

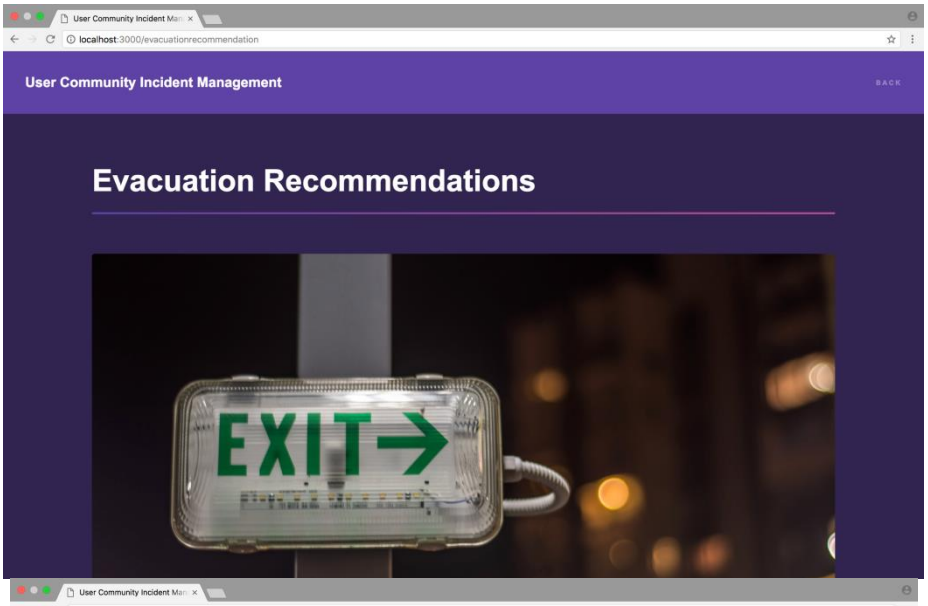
In this page are evaluated different aspects in order to recommend to evacuate or not:

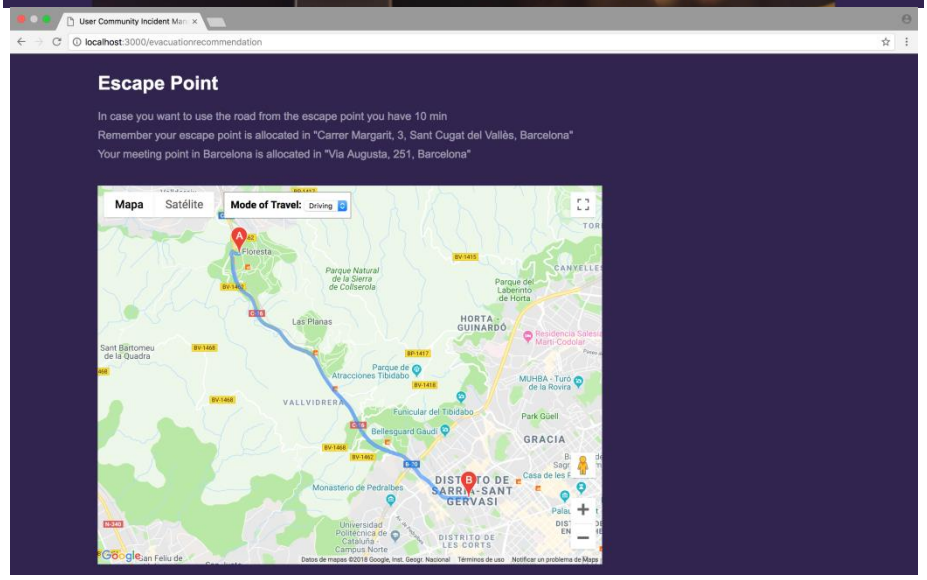
- The time to get to the meeting point from the escape point
- Different texts form Twitter analyzed by Watson in order to evaluate if the escape road is ok or not

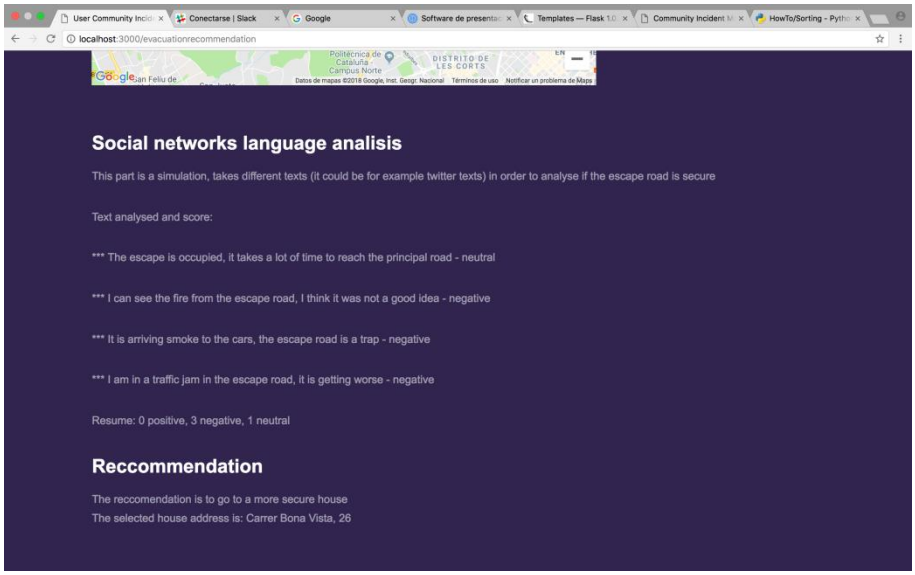
In case the time exceed 20 minutes or the twitter comments about the evacuation road are negative, then the app will recommend you to go to the most secure house in the community.

To calculate the most secure house, the algorithm takes the three houses with less fire risk and takes the one of this group that has less fire load.

The texts are hardcoded to simulate a situation of escaping from the fire.


User Community Incident Management
BACK
Evacuation Recommendations
EXIT

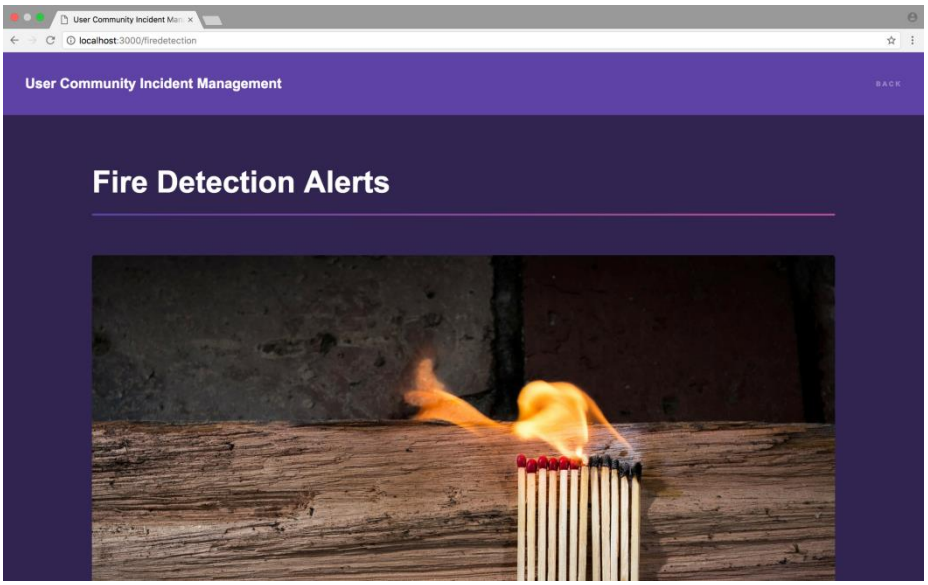

Escape Point
In case you want to use the road from the escape point you have 10 min
Remember your escape point is allocated in "Carrer Margarit, 3, Sant Cugat del Vallès, Barcelona"
Your meeting point in Barcelona is allocated in "Via Augusta, 251, Barcelona"
Mapa
Satélite
Mode of Travel: Driving

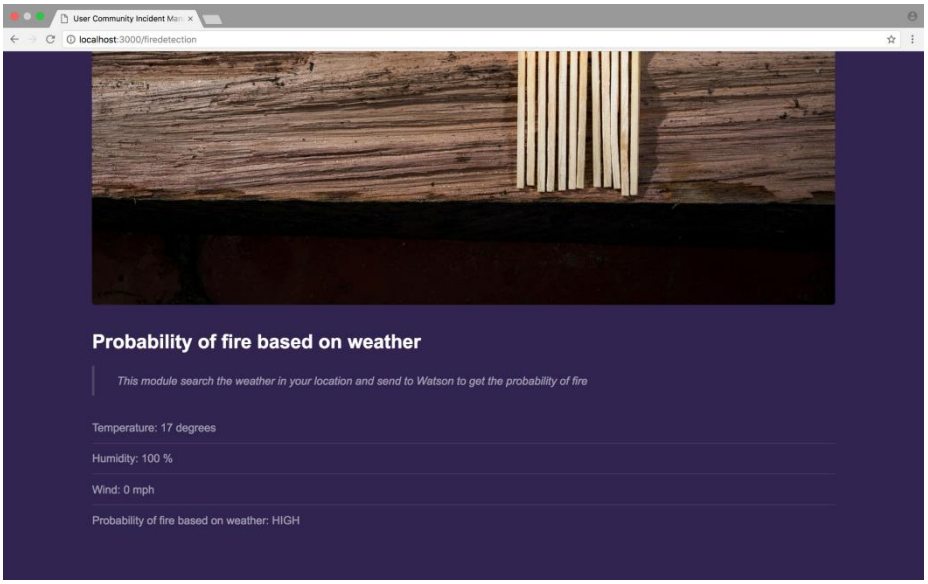

Social networks language analisis
This part is a simulation, takes different texts (it could be for example twitter texts) in order to analyse if the escape road is secure
Text analysed and score:
*** The escape is occupied, it takes a lot of time to reach the principal road - neutral
*** I can see the fire from the escape road, I think it was not a good idea - negative
*** It is arriving smoke to the cars, the escape road is a trap - negative
*** I am in a traffic jam in the escape road, it is getting worse - negative
Resume: 0 positive, 3 negative, 1 neutral
Reccommendation
The reccomendation is to go to a more secure house
The selected house address is: Carrer Bona Vista, 26

3.15. USER–FIRE DETECTION ALERTS

In this page should be all the fire alerts from different sources.

Nowadays only is implemented an alert based on weather conditions after evaluation of Watson.



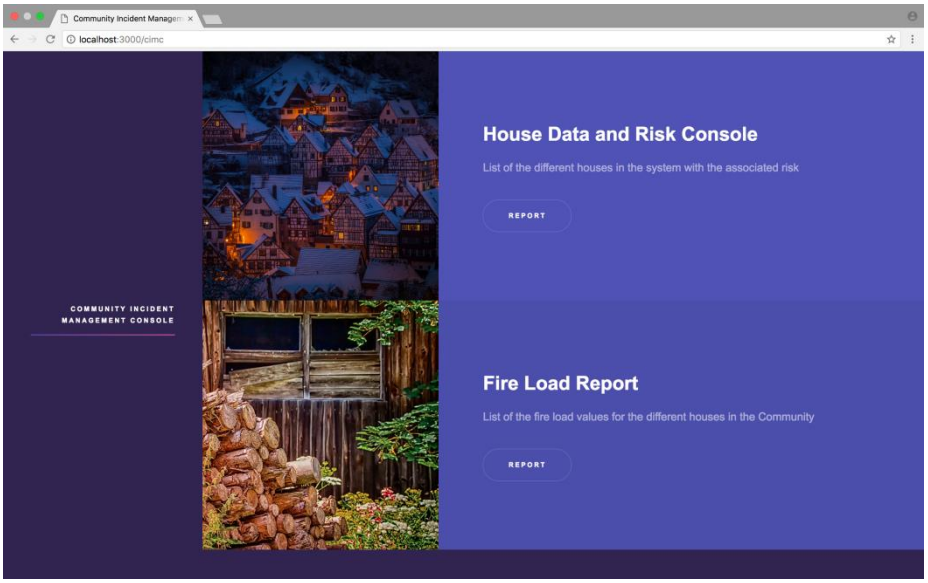


3.16. CIMC-FRONT PAGE

The idea of the Community Incident Management Console is that a group of people designated to take care of the community can check information in a centralized way.

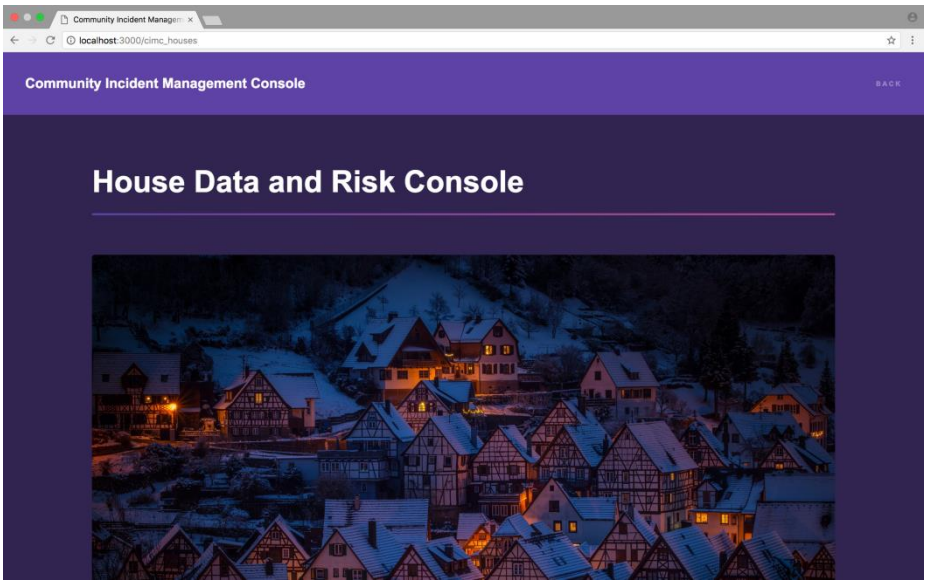
This people can be a firefighter department or Command Center too.

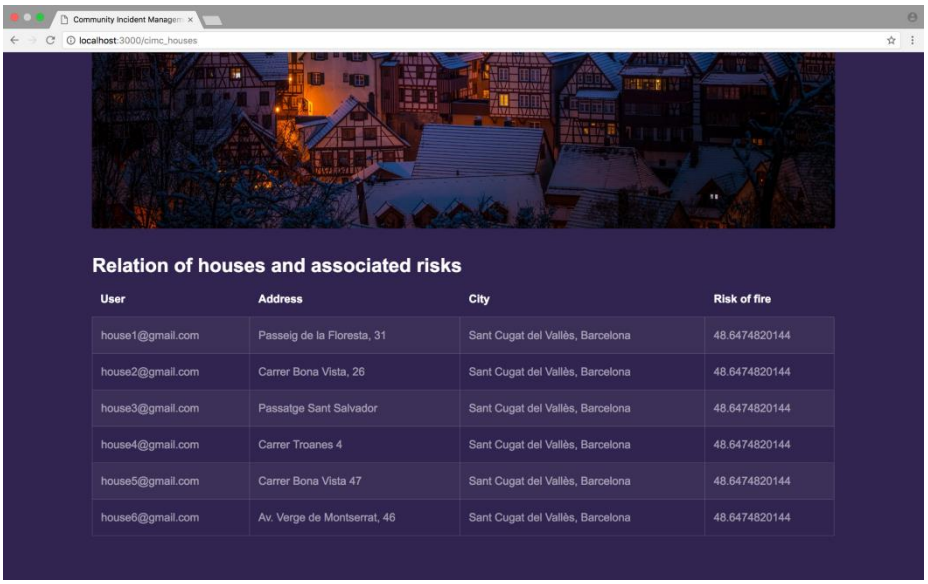
The actual functionality is basic, only reports, but it can be evolved with more functions.



3.17. CIMC-HOUSE DATA AND RISK CONSOLE

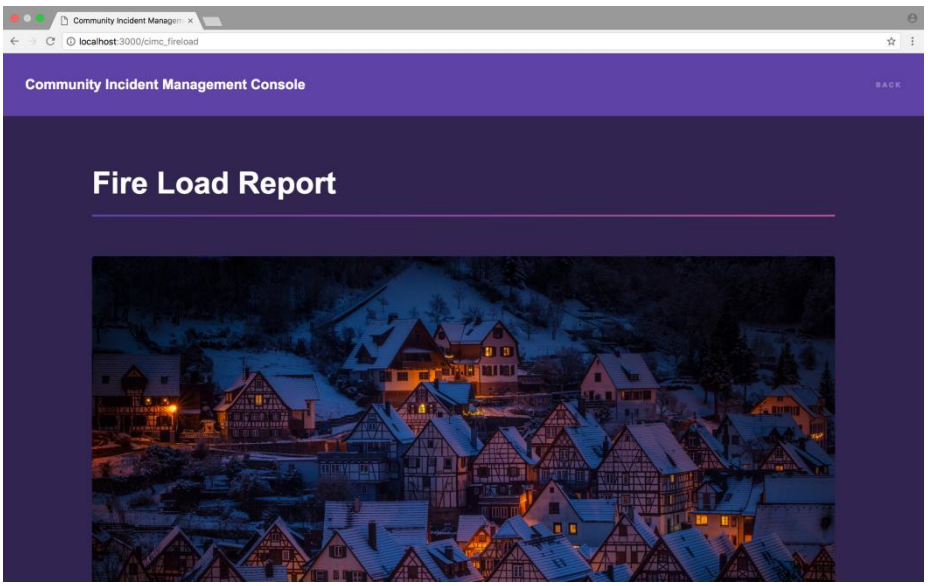
This is a report of the fire risk by house in the community. It can be used to warn the owner to take actions in order to avoid the risk.

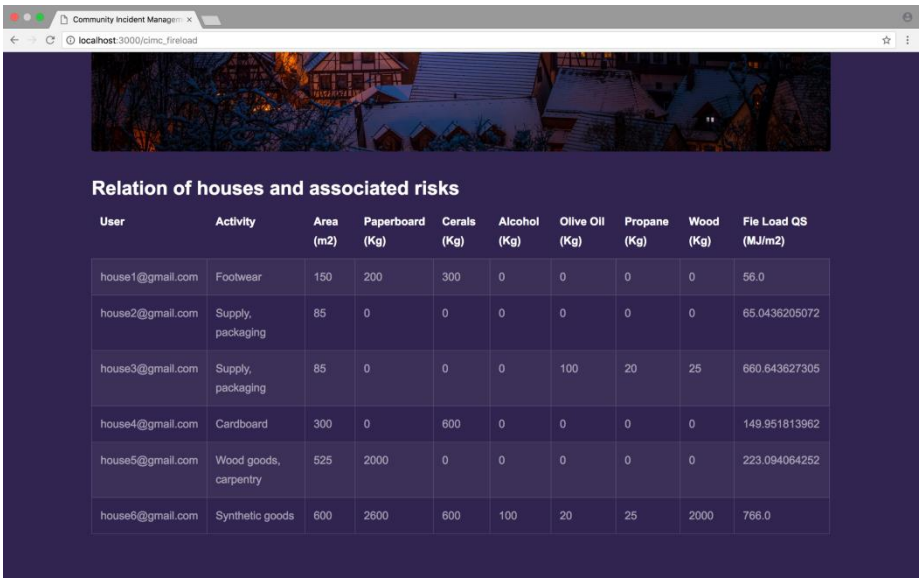




3.18. CIMC- FIRE LOAD REPORT

This is a report of the fire load of the houses in the community. It can be used in order to take actions in order to change the fire load or give more protections to the house. This report is very important for firefighters in order to determine where the fire can be more aggressive.





User	Activity	Area (m2)	Paperboard (Kg)	Cerals (Kg)	Alcohol (Kg)	Olive Oil (Kg)	Propane (Kg)	Wood (Kg)	Fie Load QS (MJ/m2)
house1@gmail.com	Footwear	150	200	300	0	0	0	0	56.0
house2@gmail.com	Supply, packaging	85	0	0	0	0	0	0	65.0436205072
house3@gmail.com	Supply, packaging	85	0	0	0	100	20	25	660.643627305
house4@gmail.com	Cardboard	300	0	600	0	0	0	0	149.951813962
house5@gmail.com	Wood goods, carpentry	525	2000	0	0	0	0	0	223.094064252
house6@gmail.com	Synthetic goods	600	2600	600	100	20	25	2000	766.0