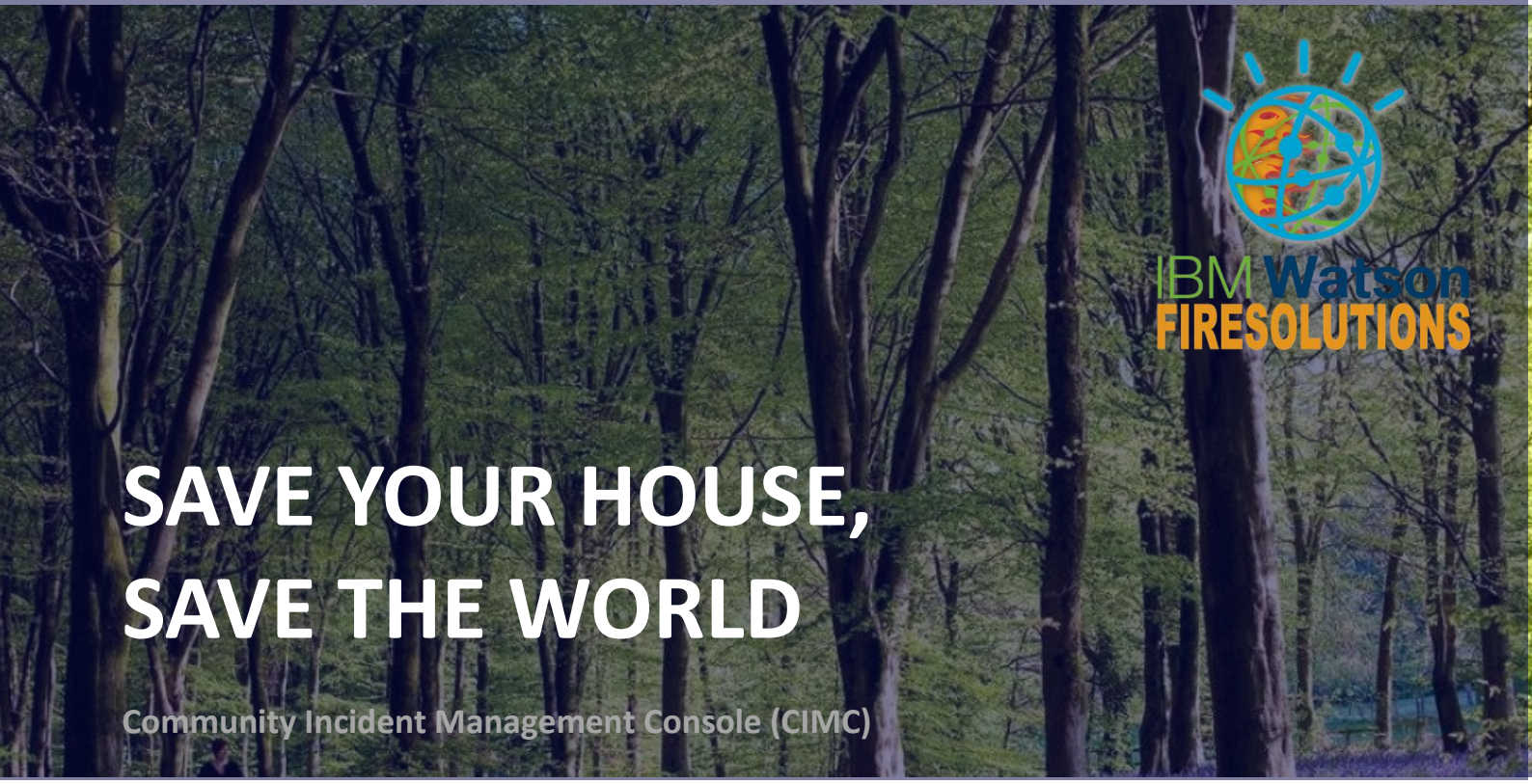


IBM Watson FIRESOLUTIONS

SAVE YOUR HOUSE, SAVE THE WORLD

Community Incident Management Console (CIMC)





Barcelona Firesolutions team

Call for code, September 2018

Thanks to the local emergency team GRAF (Grups de Reforç d'Actuacions Forestals Bombers Generalitat de Catalunya) for their labor against wildfires in Catalonia and their inspiring message.

Thanks to Joan Herrera and Marc Castellnou.

PROJECT GENERAL INFORMATION

IBM Watson Firesolutions
Save your house, Save the World.
Community Incident Management Console (CIMC)

One solution:

Community Incident Management Console (CIMC)

One team:

Barcelona Firesolutions

Team Members

- Marco Rodriguez
- Marta Rovira
- Salomé Valero

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 measure 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. INTRODUCTION

The past decade has been one of the worst periods for natural disasters. Mitigating natural disasters is one of the world's greatest challenges.

That's why IBM launched Call for Code, a worldwide initiative for developers to solve global problems with software solutions. And this year the IBM Challenge is creating applications that improve disaster preparedness, build resilient communities, and safeguard the health and well-being of individuals and institutions.

While weather events may be inevitable, natural disasters don't have to become so catastrophic.

This document is the result of a team from Barcelona (Spain). We're attending the IBM call to contribute to the challenge from the South of Europe.

We want our solution, CIMC Community Incident Management Console, to help communities to become more resilient and more prepared to combat wildfires.

Wildfire is the natural disaster that we consider the first priority in our region Catalonia in Spain, one of the countries in the South of Europe that is suffering more this natural disaster.

2.1. PROJECT PRESENTATION

This project addresses the vulnerability of communities to safeguard the well-being of individuals, houses and forests in case of wildfires.

The outcome of the project is a prototype of technical solution to this problem.

In case of fire the order of priority for firefighters is:

1. people
2. houses and infrastructures
3. forest

Local communities with mountain homes or houses in forests need to revisit, with greater urgency, basic action plans to protect and save their houses and themselves. If they do so, then firefighters can focus on salving forests.

Let's save our house, let's save the world with a solution called Community Incident Management Console (CIMC).

2.2. PROJECT OBJECTIVES

Our main goal is to help communities to combat wildfires with a solution to make it easier for the communities:

1. Identify the key points to protect their houses
2. Measure the risk of fire
3. Decide to evacuate or confine in case of fire.

To reach this principal aim, we have a few general previous aims that help to clarify the topic of investigation and facilitate the result.

General aims:

- Study the local legislation that applies for houses in the forest
- Analyze how to prepare the Housing Development Self-protection plan
- Understand the actions to be done to reduce the vulnerability of a house
- Select the right indicator to manage the level of risk
- Identify variables to take into account to decide to evacuate or confine

This solution 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.

2.3. PROJECT MANAGEMENT

The project management plan followed 5 phases that generated the following document structure:

1. *Phase 1- Conceptual Framework (chapter 3)*

   This phase starts with a bibliographic search related to natural disasters. Then the search focuses on forest fires because it's the worst natural disaster in Catalonia (Spain).

   The team reviews literature about wildfires, fire prevention measures, local legislation, fire auto-protection, variables related to fire load and items to be used in deciding to evacuate or confine.

   During the project we held several meeting with the Firefighter GRAF department in Catalonia to know more about Wildfires and identify the key point to help with technology to combat them.

2. *Phase 2- Model Design (chapter 4)*

   A solution design is proposed as a result of phase 1. The user stories are proposed and ordered by priority. Each user story is written in details with involved variables, inputs, outputs and related technologies.

   A search of IBM services is done to find the right service that fits better for each user story.

3. *Phase 3- Model Validation (chapter 5)*

   With the purpose of validating the solution, several interviews were done with local experts from Greenpeace Spain and GRAF (Grups de Reforç d'Actuacions Forestals/ Bombers/ Departament Interior de la Generalitat de Catalunya).

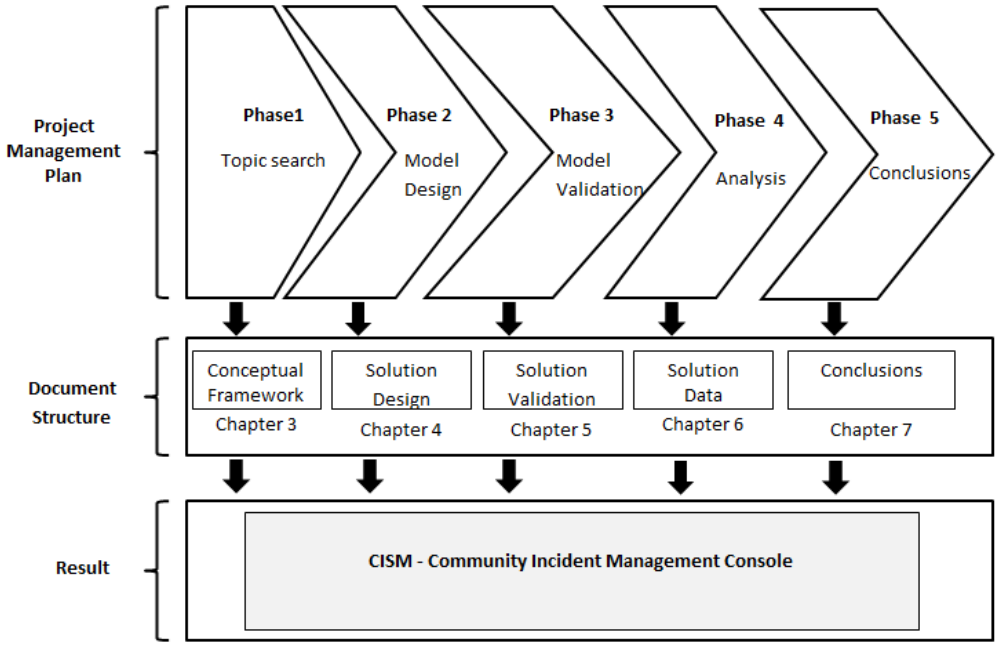
4. Phase 4- Analysis (chapter 6)

A detailed analysis was done for each user story and the team reviewed the variables, the criteria and the used code. The data set was done to prove the selected model in each case. The overall solution was tested.

5. Phase 5- Conclusions (chapter)

The overall solution CIMC Community Incident Management Console was reviewed and the team made conclusions about it, lessons learnt, team findings, solution value, practical implications, limitations, etc.

The following figure shows the project phases, the document structure and CIMC as the result of the project.



Source: 2018 Barcelona Firesolutions project plan / Self-made figure

The main challenge was the team organization. All the team was working full time so there were not a common space and calendar to discuss the topics related to this project.

There was a first meeting to discuss the contest, the main topic, the natural disaster to choose and the roles in the team.

We decided to accept the IBM challenge:

- Investing our free time
- Following Scrum as a framework for developing the solution
- Working all together as a team with our stakeholders
- Have a minimum organization to take the most of the short period of time to develop the solution

Source: 2018 Barcelona Firesolutions Team organization / Self-made figure

3. CONCEPTUAL FRAMEWORK

Large wildfire (LWF) is the worst natural disaster in the south of Europe. A spate of forest fires devastated hundreds of thousands of hectares of forest and uplands in the last ten years in Spain.

In case of fire the order of priority for firefighters is: (1) people, (2) houses and infrastructures and finally (3) forest. Local communities with mountain homes or houses in forests need to revisit, with greater urgency, basic action plans to protect and save their houses and themselves. If they do so, then firefighters can focus on salving forests.

Let's save our house, let's save the World.

3.1. LARGE WILDFIRES EUROPE

Portugal in 2017 and Greece this year suffered the deadliest wildfires in Europe. Increasing knowledge and self-protection capabilities is crucial for effective fire prevention initiatives.

After the large wildfire in Greece (July 2018), European Union committee agreed to reinforce the European system of civil protection for enhancing risk detection and response capabilities to natural disasters such as wildfires. That means the creation of a common reservation of resources to help countries in case of need.

3.2. LARGE WILDFIRES SPAIN

Attached below the graphic that shows the damaged area of forest from 2007 to 2017 in Spain. 2012 was the worst year in the decade related to wildfires in our country.

Source: Damaged area of forest Spain 2007-2017, Greenpeace Spain

Source: The 20 worst forest fires in Spain 2007-2017, Greenpeace Spain

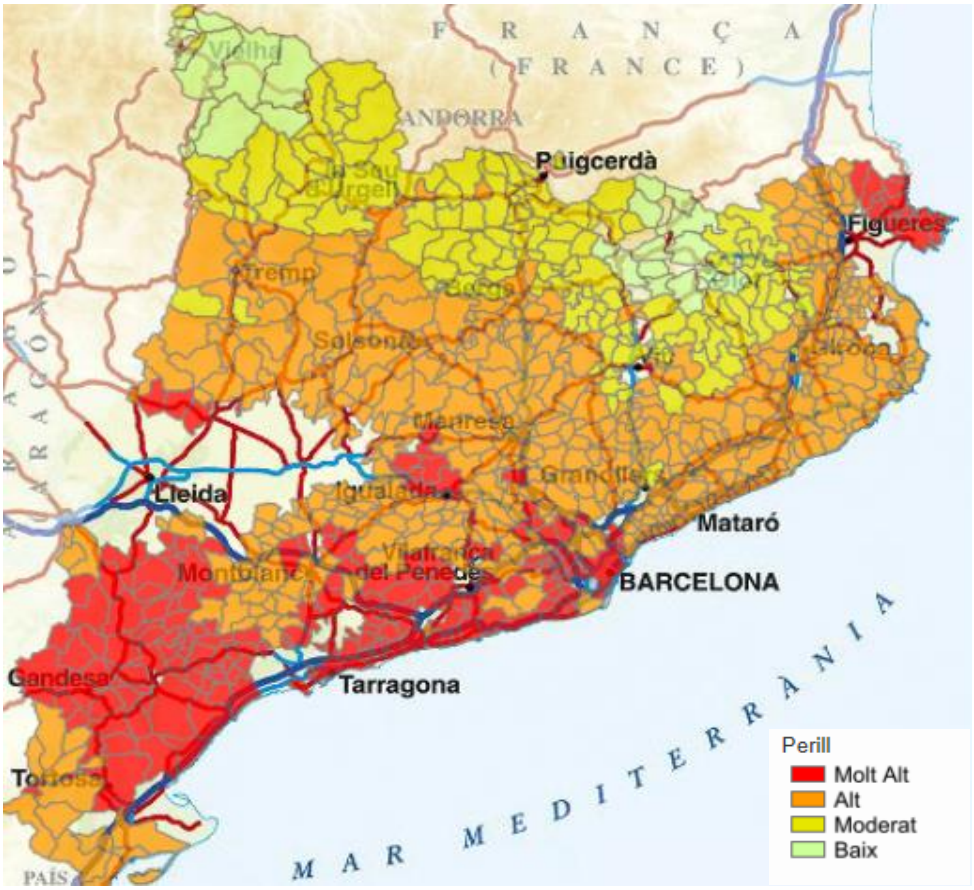
3.3. LARGE WILDFIRES CATALONIA

Forest fires are the biggest natural disaster affecting the Mediterranean area and specifically Catalonia.

This problem is aggravated by climate change, the abandonment of rural and forest environments, the homogenization of the landscape and the accumulation of biomass in forests (Piqué M. et al, 2011).

In response to this vulnerability increase and fire risk, firefighting systems have been improving. Nowadays in Catalonia 96% of forest fires do not exceed 10 hectares but the remaining 4% is responsible for 90% of the area burned in a year (Castellnou M. et al, 2005).

Local fire emergency teams in Catalonia monitor the level of risk related to forest fires. The following graphic shows four levels of risk in the territory: Red-Very high risk (molt alt), Orange-High risk (alt), Yellow-Medium risk (moderat) and Green-Low risk (baix).



Source: 2018 Mapa de Protecció Civil de Catalunya (https://pcivil.icgc.cat)

3.4. WILDLAND-URBAN INTERFACE

Our main goal is to help communities to combat wildfires with a solution to make it easier for the communities:

- ✓ **Identify the key points to protect their houses**
- ✓ **Measure the risk of fire**
- ✓ **Decide to evacuate or confine in case of fire.**

To reach this principal aim, we have a few general previous aims that help to clarify the topic of investigation and facilitate the result.

General aims:

- **Study the local legislation that applies for houses in the forest**
  In Spain:
  - ✓ https://www.mapama.gob.es/es/desarrollo-rural/legislacion/leg-espanola-forestal-incendios.aspx
  - ✓ http://www.boe.es/boe/dias/2014/11/07/pdfs/BOE-A-2014-11493.pdf
  - ✓ http://www.boe.es/buscar/doc.php?id=BOE-A-2013-12823

- **Analyze how to prepare the Housing Development Self-protection plan**

  Items to review by the house owner:

  - ➢ Environment variables

    - House orientation
    - Type of house
    - Topography
    - Drought

➢ Next your house

- Access way
- High-tension towers
- Area Next the house
- Fence
- Water

➢ Your house

- Outer walls
- Accumulation of leaves
- Roof
- Barbeque
- Waterproof
- Water source

- **Understand the actions to be done to reduce the vulnerability of a house**

➢ Environment variables

The topography of the terrain together with the type of vegetation and weather are the three elements that mark the behavior of fire. Obviously you can not make changes in the situation of your house, but you can be aware that this makes you more vulnerable to a forest fire. While on a slope, the fire rises more quickly.

If you live in a place where there is water shortage, it is important to take into account that the vegetation will be dry and therefore increases the flammability of the area. It is important to have enough water supplies in case of forest fire. For urbanizations, the creation of water supply points every 200 meters is necessary.

- Next your house

  - Access way

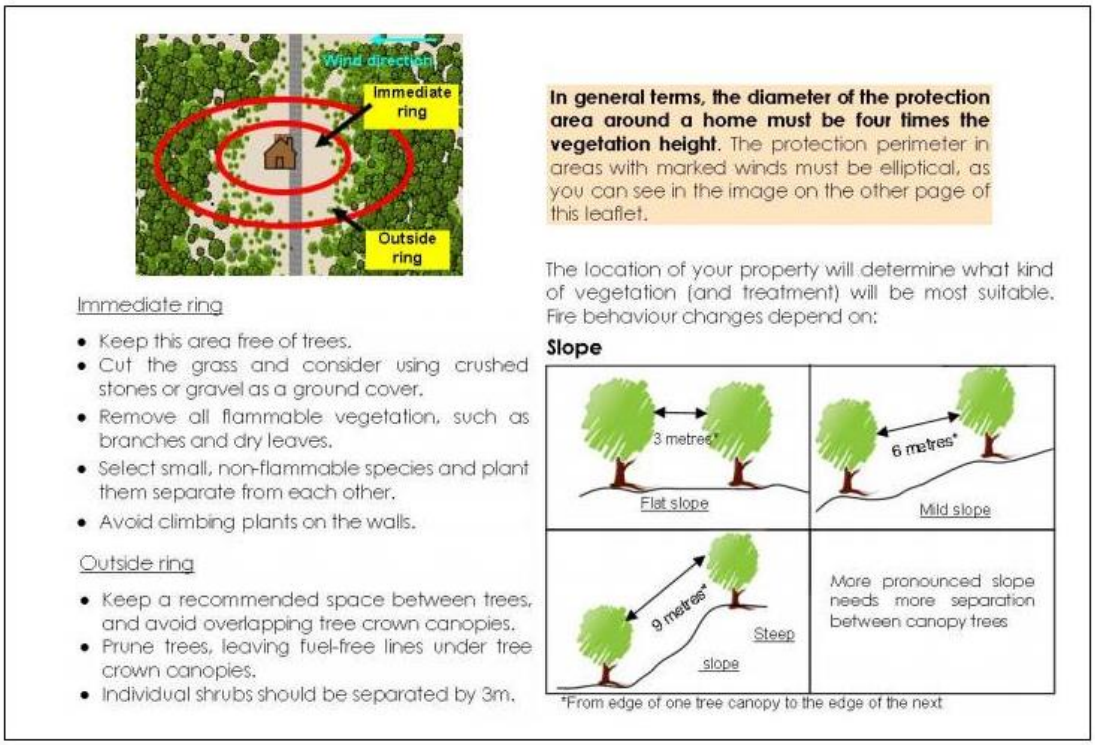
Access to your house should be enough to let big vehicles come for fire extinction activities and evacuation. It's also important to have routes of evacuation strategically located and with enough signs to mark clearly the way to evacuate. The recommendation is to have paved way, free of vegetation and wide enough.

  - High-tension towers

If the house is near high-tension towers, it is important to monitor the condition of the vegetation near the electrical towers. Contact to the Town Hall if there are vegetation near them.

  - Area Next the house

Take care of the surroundings of your house. It's important to follow the recommendations from local emergency teams related to the distances between the house and vegetation (25 meters) and also between trees. The diameter of the protection around a house should be four times the vegetation height. The distance between trees must be 3 meters or more. It depends on the slope and the distance on some cases should be 6 with mid slope or 9 meters for high slope.



✓ Source: 2018 Recommendations GRAF

http://interior.gencat.cat/web/.content/home/030_arees_dactuacio/bombers/foc_forestal/publicacions_tecniques_i_normativa/consells_i_recomanacions/Guide_Preparing_the_property_EN.pdf

- Fence

Avoid the use of highly inflammable species as pines, oaks, palms, etc. Use preventive gardening to create structures of ornamental vegetation to become more resistant to the fire.

➢ Your house

- Outer walls

Avoid combustible material (fuelwoods, butane ...) near the structure of the house and near the weakest points like roof, chimney, doors or windows. If you have gas

tanks or diesel oil, remove them from the house. Avoid the climbing plants.

- Avoid accumulation of leaves

- Roof

It is important to avoid the construction of the roof with inflammable materials. Clean the roof avoiding accumulation of leaves and vegetation. Check it from time to time, specially before summer.

- Barbeque

Be very careful with the use of barbecues. Check the local legislation and recommendations to have them.

- Water source

Increase the protection of your house with an equipment of fire protection. Check your water sources. Make sure that the hose of the garden is enough long to arrive everywhere and even better if you have special hose for fires. Consider to have a water pump of petrol to guarantee water pressure in case of emergency.

- **Select the right indicator to manage the level of risk**

One of the indicators to measure will be based on the previous variables. Using as a reference the recommendations from Greenpeace Spain (https://riesgodeincendios.org/), the level of risk for each house in an urbanization will be calculated by the combination of 15 variables and 3 domains. More details in the model design section.

Another of the indicators to measure will be the Fire load of each house. In this case we use this reference following the recommendation from GRAF, the local emergency team who answered all our questions about forest fires.
The concept of fire load indicates the quantity of heat liberated per unit area when a building and its contents are completely burnt.

The formula for calculating fire load is:

Fire load = (combustibles in kg) x (calorific value in kcal/kg) / (Floor area in square meters)

We'll use a local reference that take into account the local legislation.

CALCULO DE CARGA A FUEGO, PONDERADA Y CORREGIDA

En función a los materiales combustibles que intervienen en la actividad

$$Q_s = \frac{\sum_i^i G_i q_i C_i}{A} R_a \ (MJ/m^2)$$

Donde:

QS= densidad de carga de fuego, ponderada y corregida, del sector o área de incendio, en MJ/m² o Mcal/m².

Gi= masa, en kg, de cada uno de los combustibles (i) que existen en el sector o área de incendio (incluidos los materiales constructivos combustibles)

qi= poder calorífico, en MJ/kg o Mcal/kg, de cada uno de los combustibles (i) que existen en el sector de incendio.

Ci= coeficiente adimensional que pondera el grado de peligrosidad (por la combustibilidad) de cada uno de los combustibles (i) que existen en el sector de incendio.

Ra= coeficiente adimensional que corrige el grado de peligrosidad (por la activación) inherente a la actividad industrial que se desarrolla en el sector de incendio, producción, montaje, transformación, reparación, almacenamiento, etc.

A= superficie construida del sector de incendio o superficie ocupada del área de incendio, en m².

Source: 2018 Formula Fire Load based on local legislation (R. D. 2267/2004) (http://www.konstruir.com/contraincendios/incen3.php)

- **Identify variables to take into account to decide to evacuate or confine**

  Following instructions from GRAF, our local emergency team reference:

  http://interior.gencat.cat/web/.content/home/030_arees_dactuacio/bombers/foc_forestal/publicacions_tecniques_i_normativa/consells_i_recomanacions/Guide_Surviving_a_forest_fire_EN.pdf

  To decide to evacuate your house:

  - Evaluate the time it will take to follow the evacuation route from the safe areas and where you want to arrive. Taking the evacuation-decision at the last moment without considering all pro's and con's carefully can carry a very high risk with fatal consequences.
  - Know and understand evacuation routes and safe areas
  - Follow fire-fighter recommendation
  - Avoid alternative routes that could be blocked by trees
  - Escape in the direction opposite the direction of the wind and if possible go into in an area already burned

  To decide to confine yourself at home

  - Confinement should not be carried out in a wood building
  - Try to advise the authorities of the situation and where you are
  - Seal your home, close doors and windows and puut wet towels under them. Remove the curtains from the windows
  - Turn off the supply of butane gas, natural gas, gasoil…
  - Ensure an adequate water supply
  - Remove all combustible objects
  - Lie on the floor and breathe at floor level

  Which house is the best one to confine yourself

  - The house with the smallest number for fire load indicator. Know-how in villages: go to the church because it was built with stone, think walls and high ceilings.

3.5. NEW VALUE NO COLAPSE

The great forest fires have become a problem beyond the impact on forests. Wildfires are a global emergency and when they affect housing and industry, the firefighter system can collapse quickly. We are in the fourth generation of fires in a generalized manner.

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.

At an intensity level, fires above 10000 kw/m are unbeatable for extinction technology. In 2017 we have seen in Europe fires that surpass 130000 kw/m in Portugal with affectation to houses and people.

In Europe between 2017 and 2018, forest fires have caused more civil mortality than the whole terrorist problem: 146 deaths in Portugal and 90 in Greece.

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.

4. MODEL DESIGN

4.1. 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

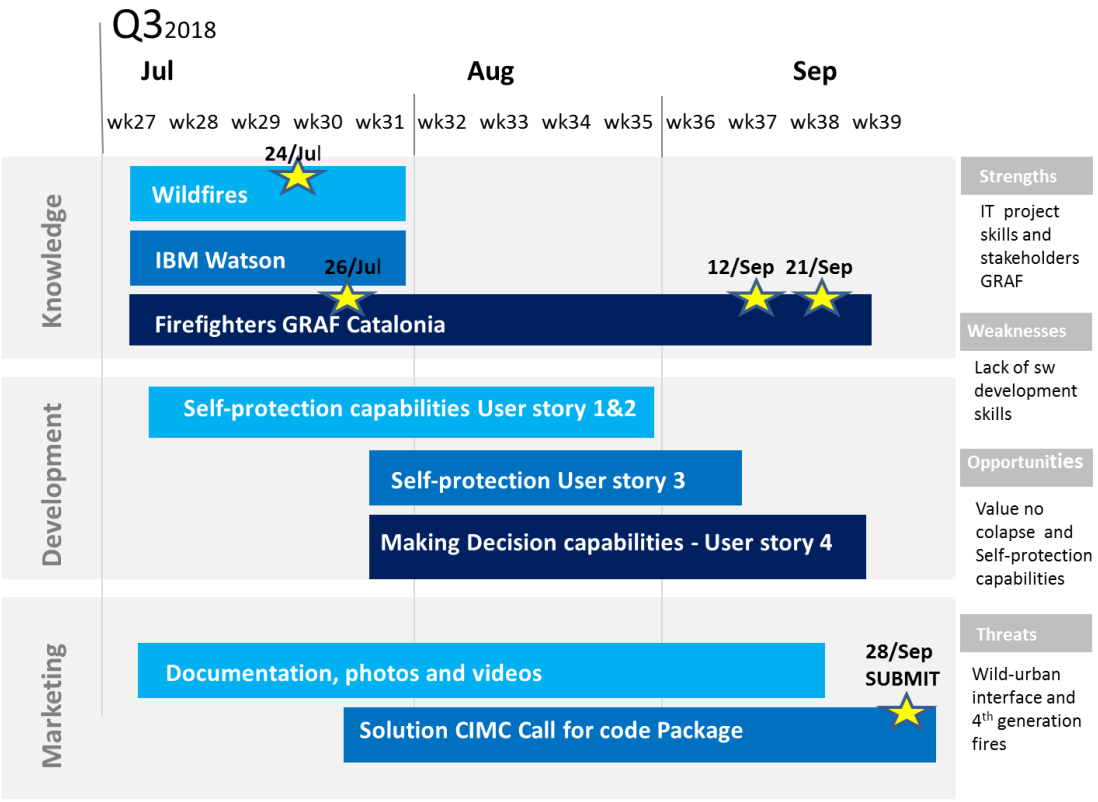
Making Decision Capabilities:

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			

4.2. ROADMAP Q3'2018

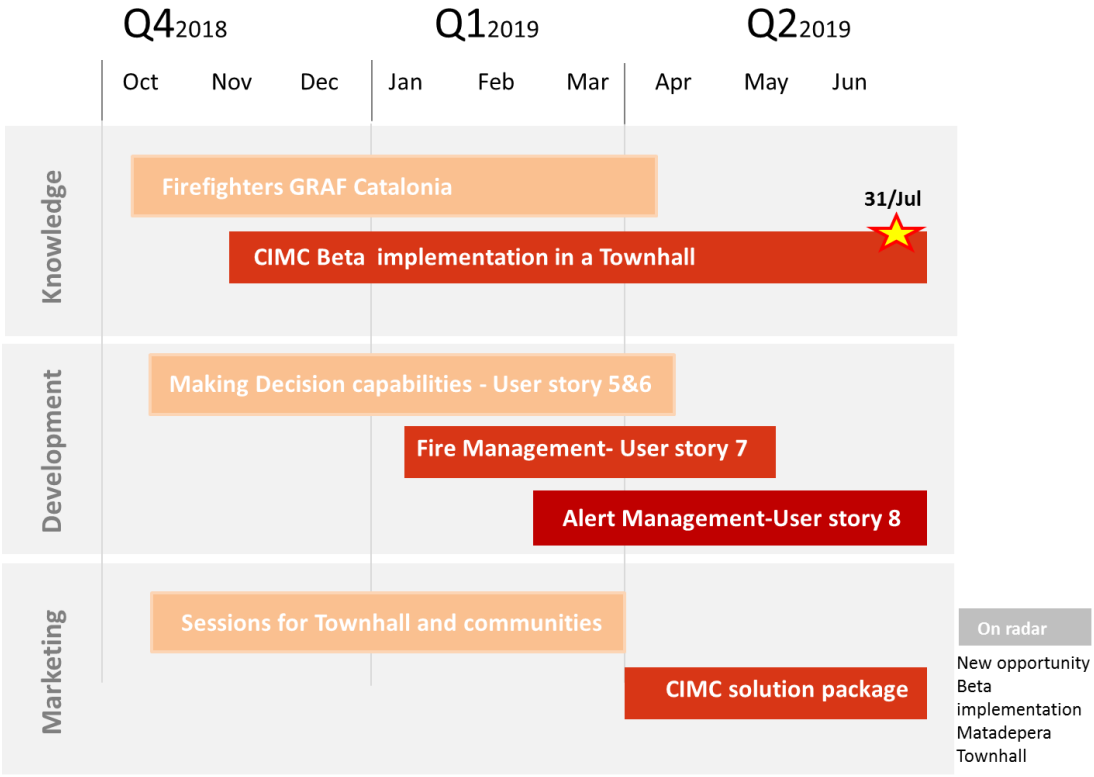


The team organized the workload in 3 areas: (1) Knowledge, to recollect all the information about Wildfires, IBM Cloud Services and main topics to work with our Stakeholders Catalonian Firefighters GRAF unit; (2) Development, to design and implement the technical solution with IBM Cloud services; (3) 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.

4.3. 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.

4.4. REGISTER VARIABLES

Attached below the table for the domain about environment variables and values.

Domain description	Domain name	ID variable	Variable	Values
Domain 1. Need to evaluate the environment of your house There are variables which increase the risk of forest fire	Environment variables	Variable1	House orientation	North
				North-East
				East
				South-east
				South
				Southwest
				West
				Northwest
		Variable2	Type of house	An isolated house
				A disperse urbanisation in the forest
				A mix with houses and trees
				A village house
				Other
		Variable3	Topography	On a hillside
				At the top of a hill
				Exit of a ravine
				Other
		Variable4	Drought	It is a very dry zone, rains little
				Drought, often courts in the water supply.
				Drought, there are no water endowments in case of fire
				Other

Source: 2018 House environment variables / Self-made figure

In addition there are two tables for the other domains with their variables. In total there are 15 variables with this aggrupation:

- 4 variables for domain 1 (environment)
- 5 variables for domain 2 (next your house)
- 6 variables for domain 3 (your house)

Attached below the tables for the domains next your house and your house.

Domain 2. Need to evaluate a distance of 10 meters next your house to avoid the spread of a fire and to facilitate the labors of extinction.	Next your house	Variable5	Access way	Through a road or wide path
				Narrow path
				No access for vehicles
				It's difficult providing indications to arrive my house
		Variable6	High-tension towers	There aren't high-tension towers
				There are high-tension towers and they are near trees
				There are high-tension towers but they are isolated
		Variable7	Next the house	Abandoned arable land and dry vegetation
				Other parcels divided by hedges
				Open area
				A road
		Variable8	Fence	Wooden fence
				Hedges
				Fence of of rushes
				Fence of of fire-resistant materials
				Without fence
		Variable9	Water	Water tanks available
				Well known evacuation routes
				Easy acces to my house for big vehicles

Source: 2018 Next your house variables / Self-made figure

Domain 3. House variables with impact on the degree of spread of the fire	Your house	Variable10	Outer walls	Stacked wood
				Fuel tank
				Wooden shed
				Accumulation of vegetation
		Variable11	Accumulation of leaves	Often accumulation of leaves
				No accumulation of vegetation
		Variable12	Roof	Wooden roof
				Horizontal roof with accumulation of leaves
				Fire-resistant material
				Other
		Variable13	Barbeque	No
				Barbeque following applicable legislation
				Barbeque but without knowledge about applicable legislation
		Variable14	Waterproof	Windows with double glazing and hermetic closure
				Windows shutters
				Vents with woven Wire Cloth
				Clean chimney
		Variable15	Water source	Water source available
				Swimming pool
				Hose
				Without water source available

Source: 2018 Your house variables / Self-made figure

5. MODEL VALIDATION

5.1. 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

5.2. 2 WEB APLICATIONS

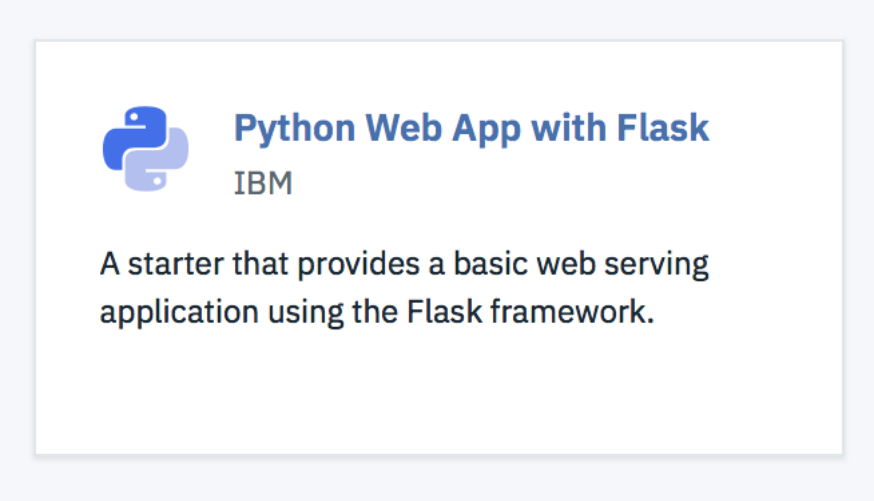
The CIMC solution is based on two web applications:

- *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.

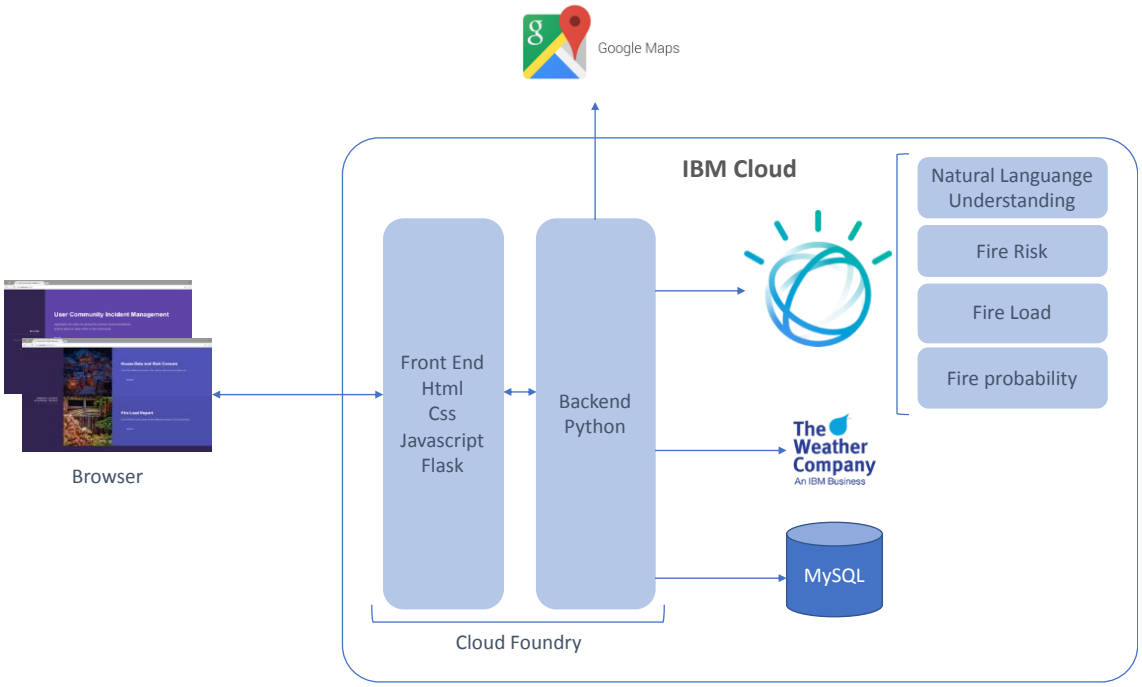


5.3. IBM CLOUD SERVICES

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

5.4. SCHEMA



5.5. 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.

5.6. 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

5.7. 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

5.8. 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

5.9. 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

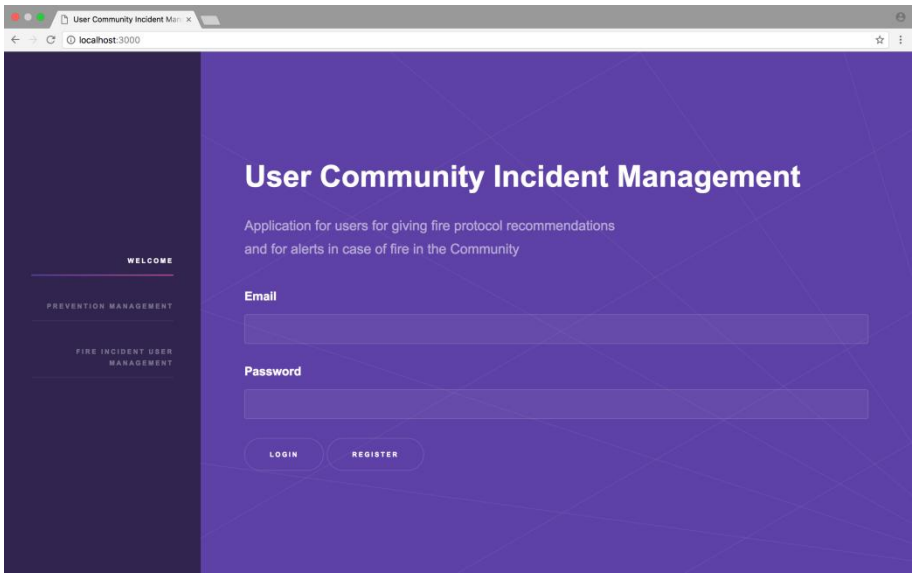
Next the summary with the html files that builds Community Incident Management Console

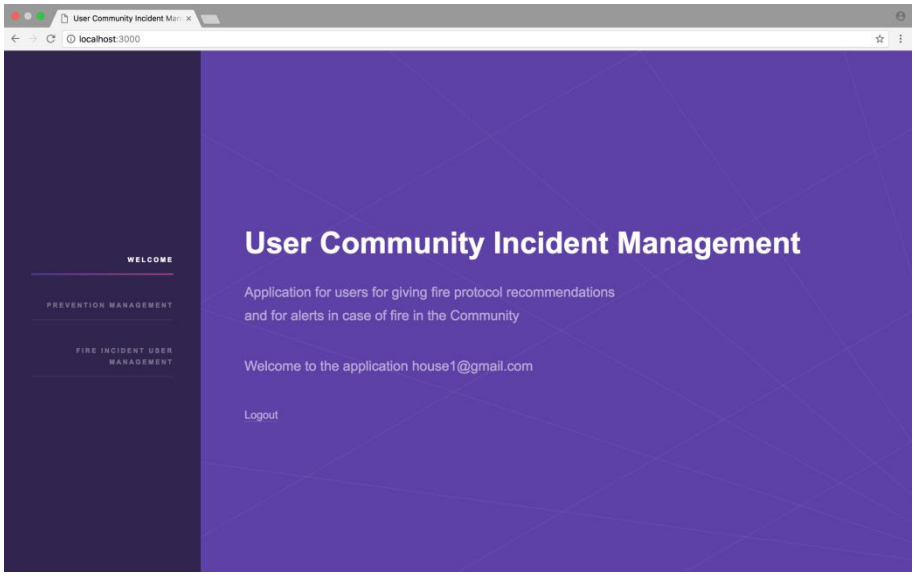
File	Description
cimc.html	Principal web page of the solution
cimc_houses.html	Report of all the houses with their fire risk
cimc_fireload.html	Report of all the houses with the fire load values

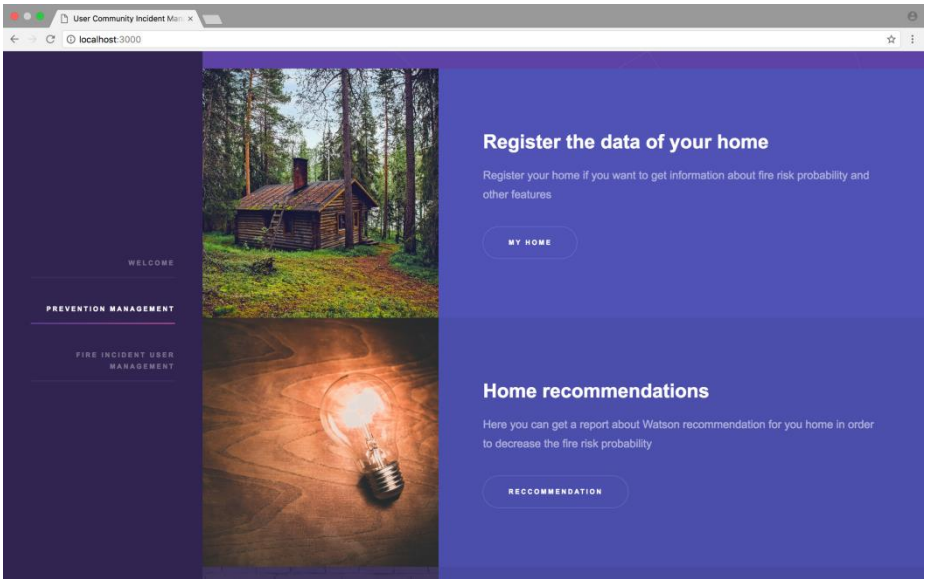
5.10. USER– LOGIN AND REGISTER

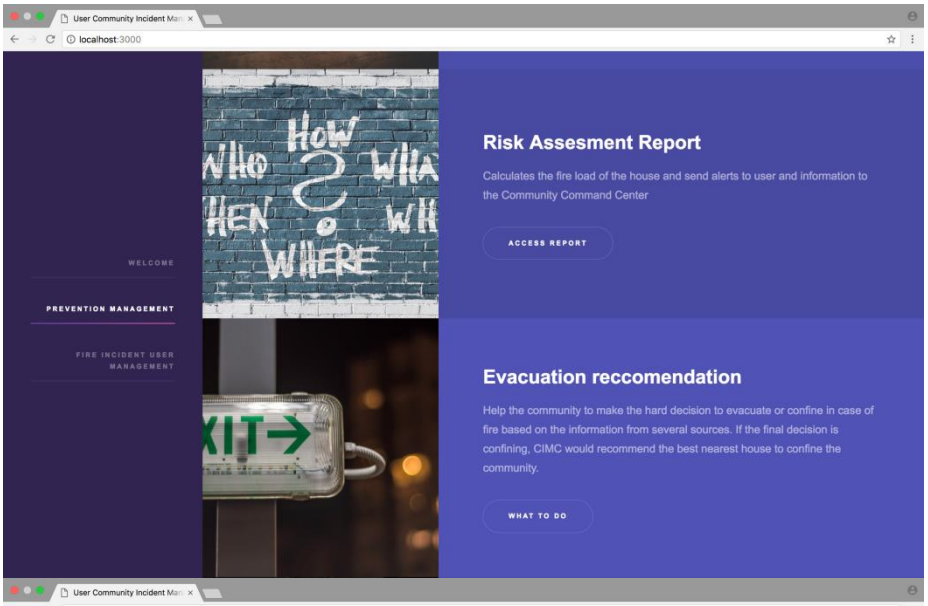
In the principal page is important to login or to register in order to use all the functions of the app.

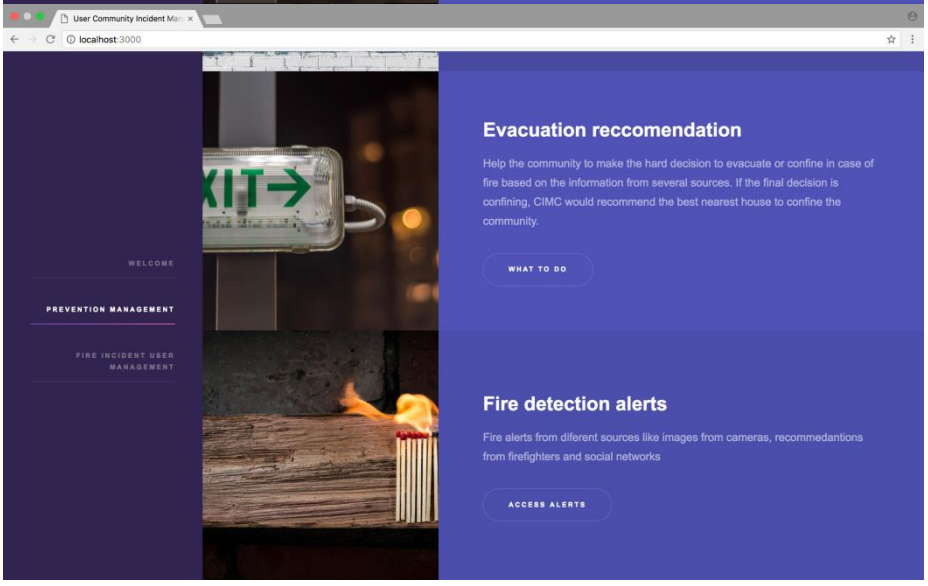
In other case, when a function is selected, the app doesn't do anything.






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

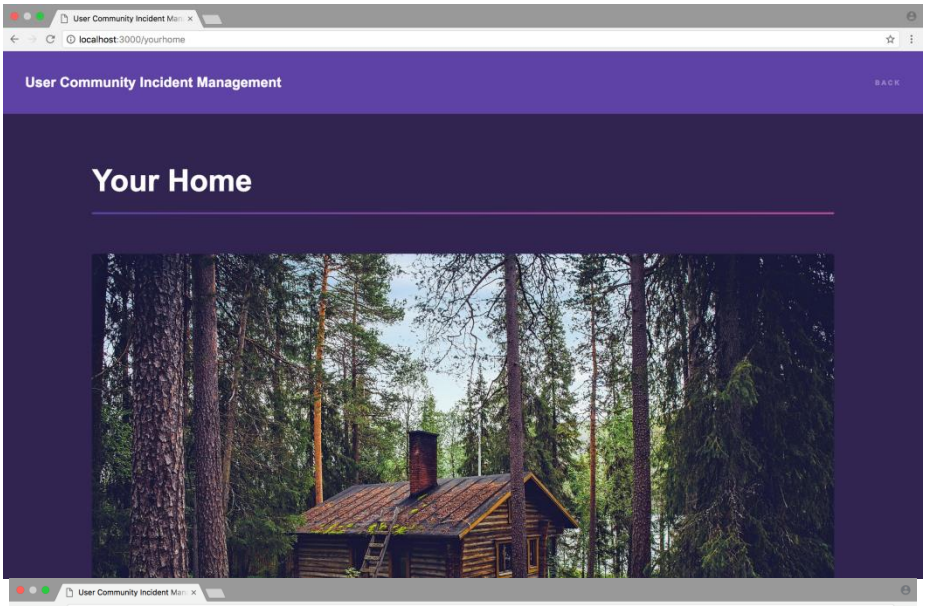

User Community Incident Mana
localhost:3000
WELCOME
PREVENTION MANAGEMENT
FIRE INCIDENT USER MANAGEMENT
Risk Assesment Report
Calculates the fire load of the house and send alerts to user and information to the Community Command Center
ACCESS REPORT
Evacuation reccomendation
Help the community to make 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

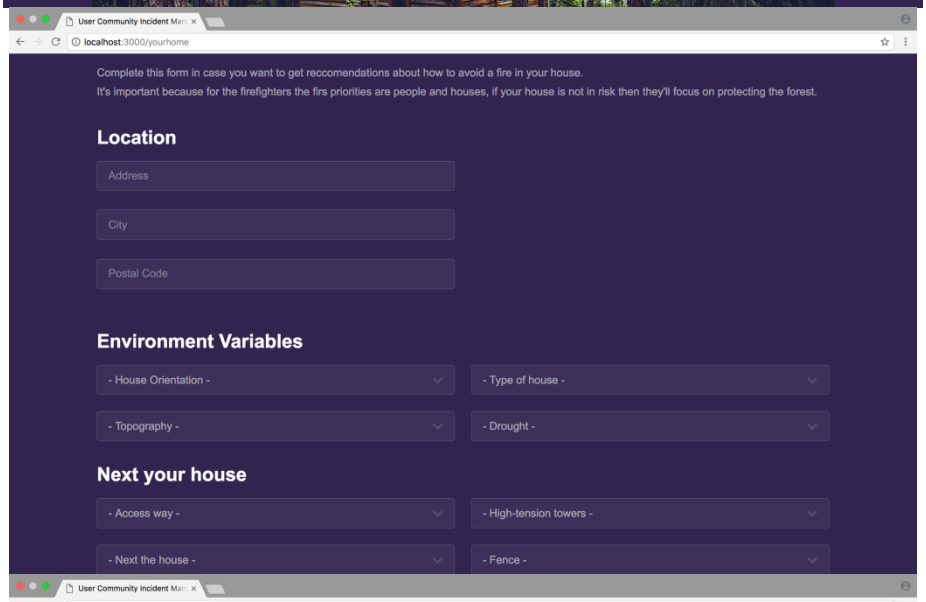

User Community Incident Mana
localhost:3000
WELCOME
PREVENTION MANAGEMENT
FIRE INCIDENT USER MANAGEMENT
Evacuation reccomendation
Help the community to make the hard decision to evacuate or confine in case of fire based on the information from several sources. If the final decision is confining, CIMC 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

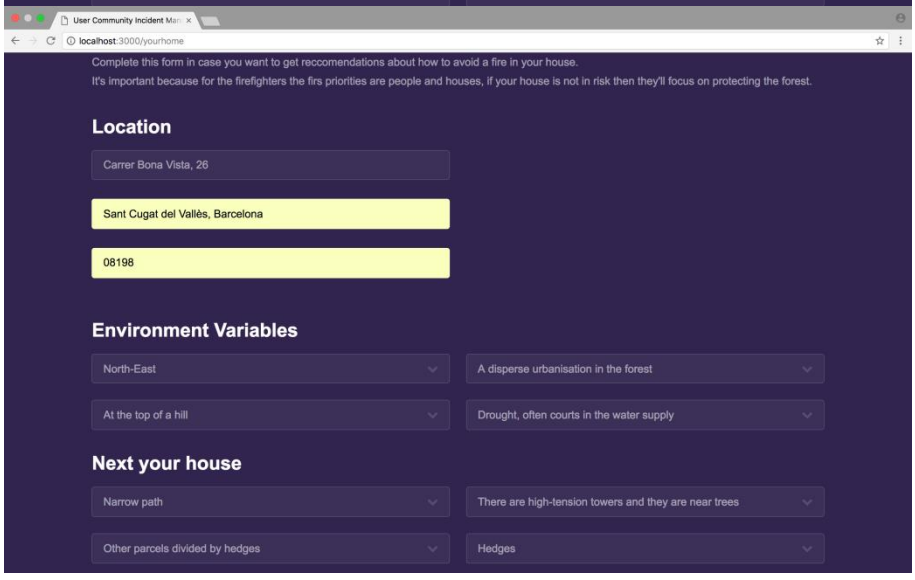
5.11. USER– HOME REGISTER

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.

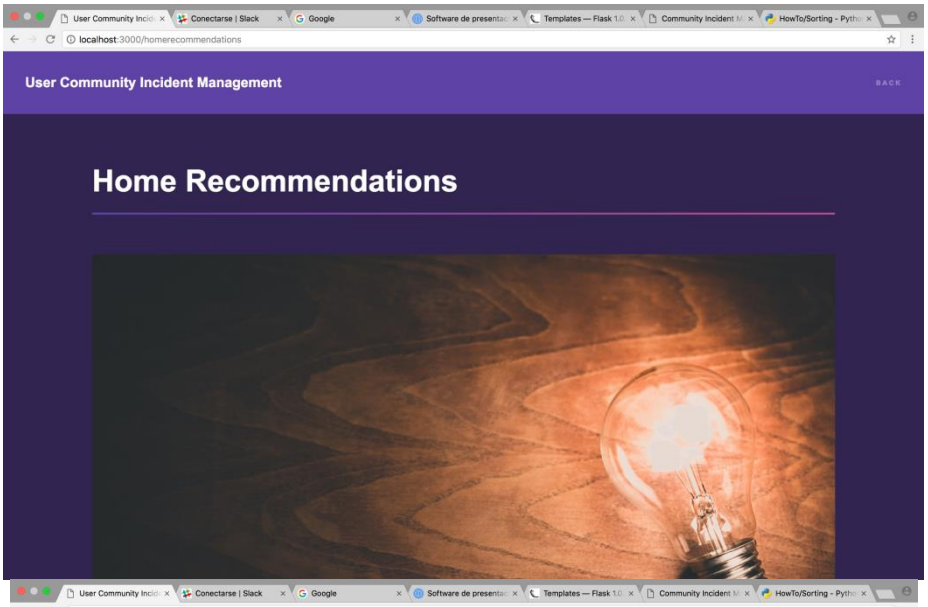

User Community Incident Mar
localhost:3000/yourhome
User Community Incident Management
BACK
Your Home

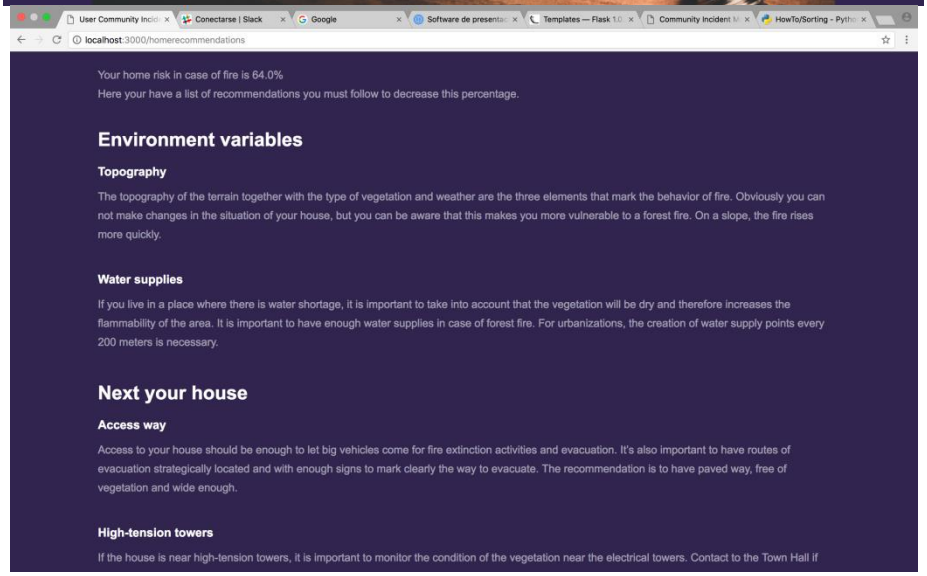

User Community Incident Mar
localhost:3000/yourhome
Complete this form in case you want to get reccomendations about how to avoid a fire in your house.
It's important because for the firefighters the firs priorities are people and houses, if your house is not in risk then they'll focus on protecting 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

5.12. 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.

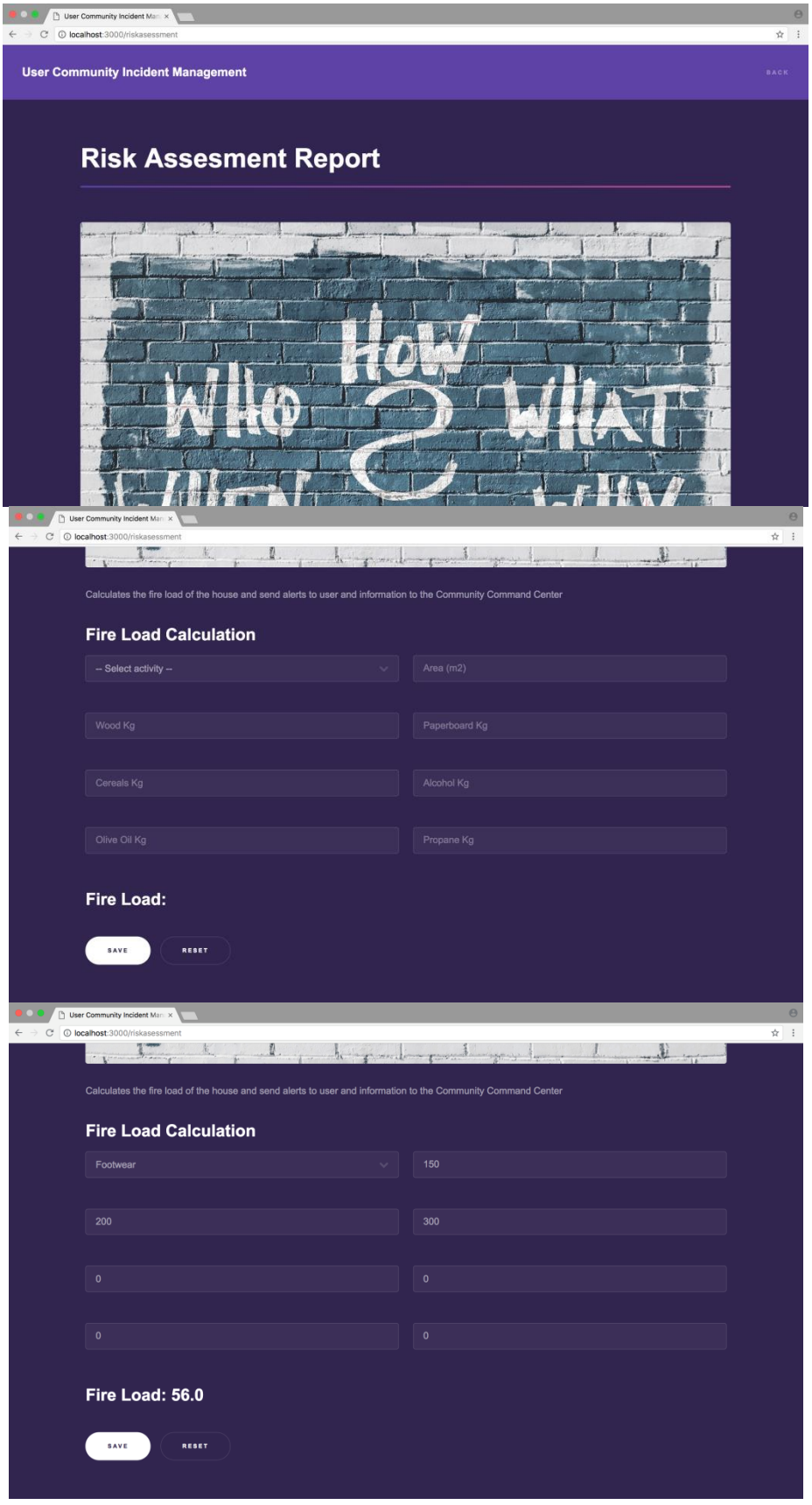




5.13. USER–RISK ASSESMENT REPORT

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

5.14. USER–EVACUATION RECOMMENDATION

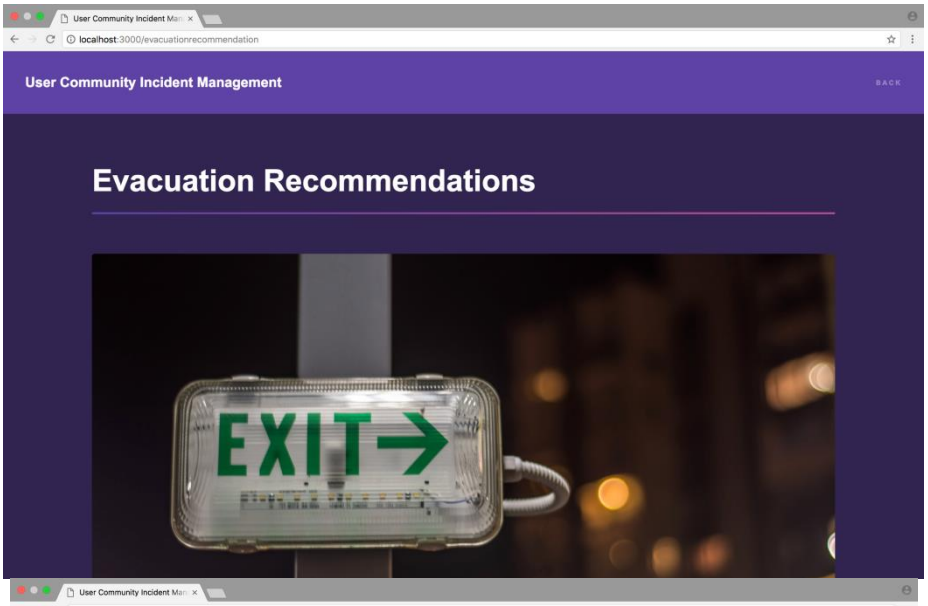
In this page are evaluated different aspects in order to recommend to evacuate or not:

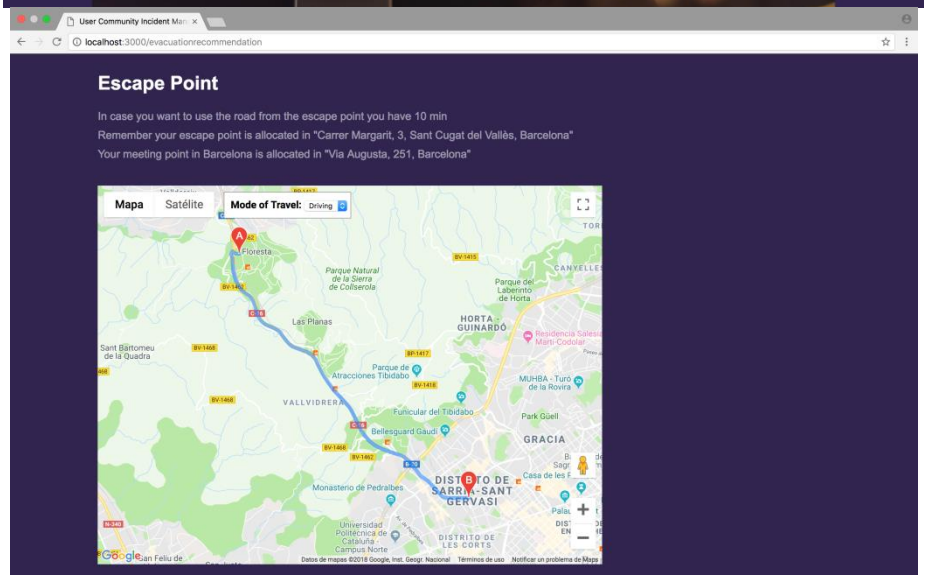
- The time to get to the meeting point from the escape point
- Different texts form Twitter analyzed by Watson in order to evaluate if the escape road is ok or not

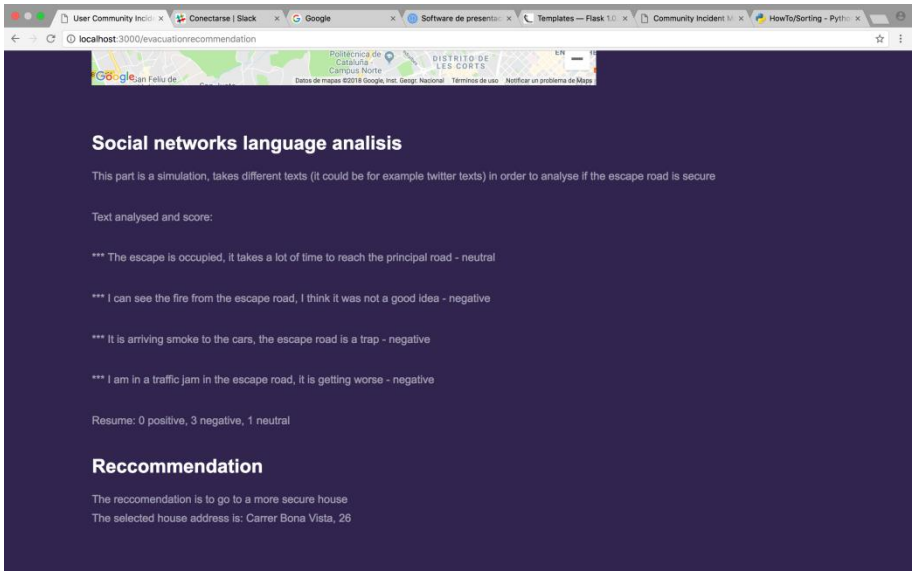
In case the time exceed 20 minutes or the twitter comments about the evacuation road are negative, then the app will recommend you to go to the most secure house in the community.

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

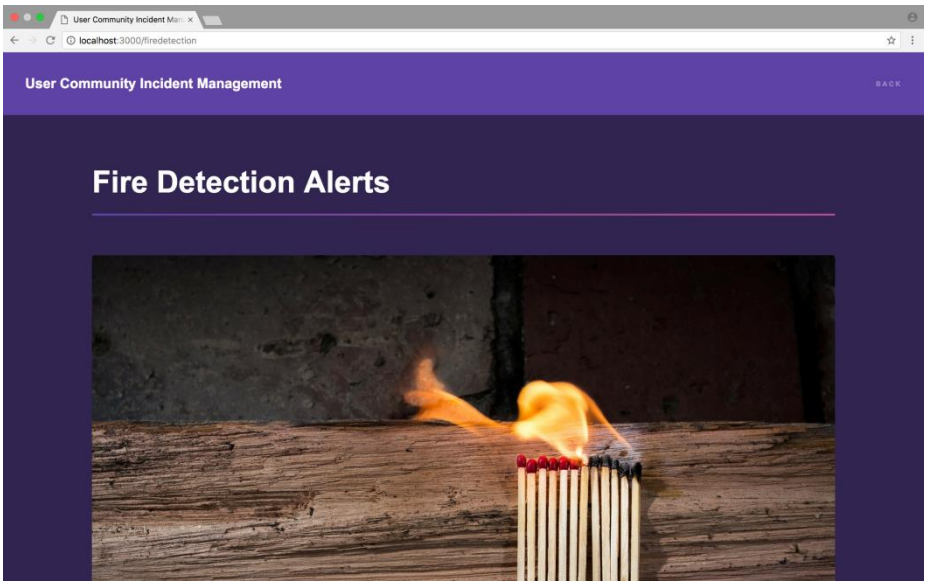

Escape Point
In case you want to use the road from the escape point you have 10 min
Remember your escape point is allocated in "Carrer Margarit, 3, Sant Cugat del Vallès, Barcelona"
Your meeting point in Barcelona is allocated in "Via Augusta, 251, Barcelona"
Mapa
Satélite
Mode of Travel: Driving

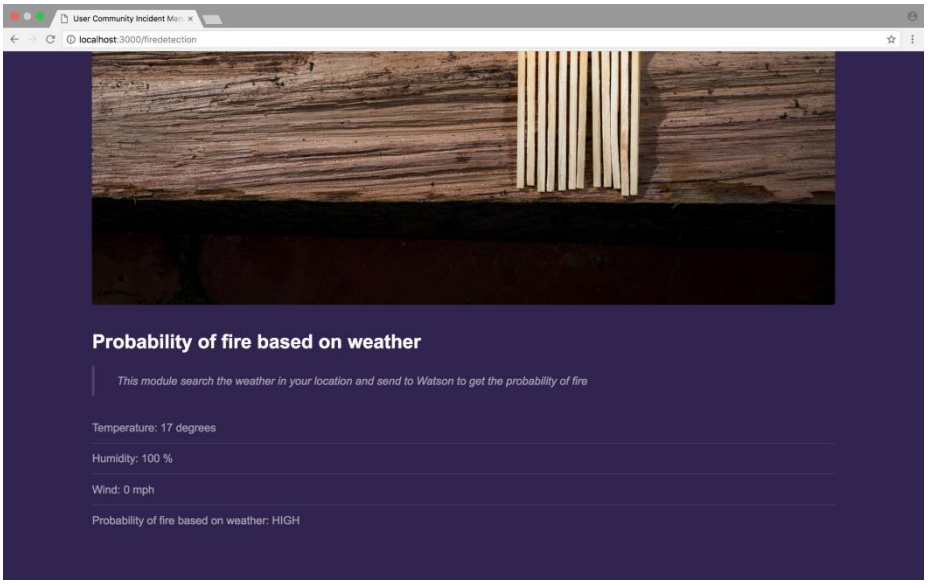

Social networks language analisis
This part is a simulation, takes different texts (it could be for example twitter texts) in order to analyse if the escape road is secure
Text analysed and score:
*** The escape is occupied, it takes a lot of time to reach the principal road - neutral
*** I can see the 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

5.15. 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.



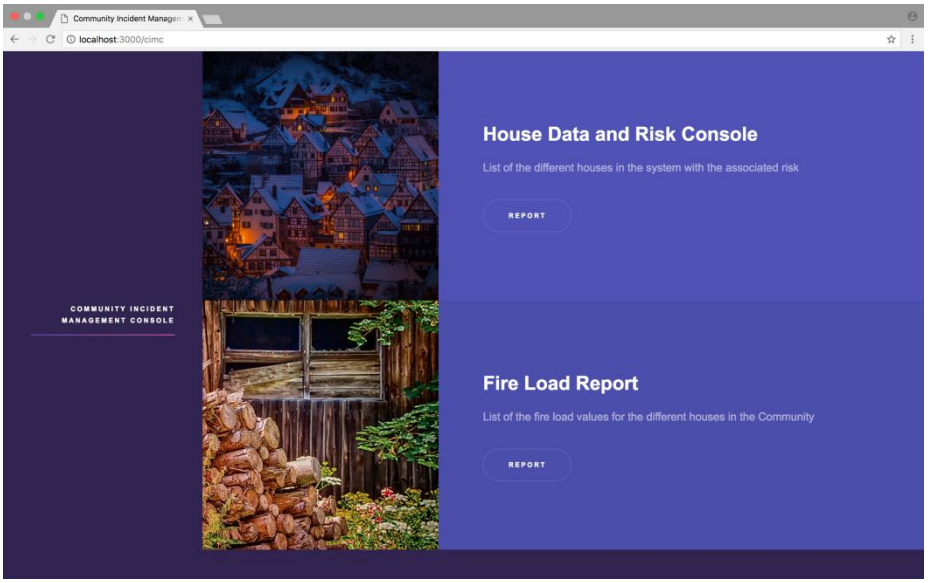


5.16. CIMC-FRONT PAGE

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.

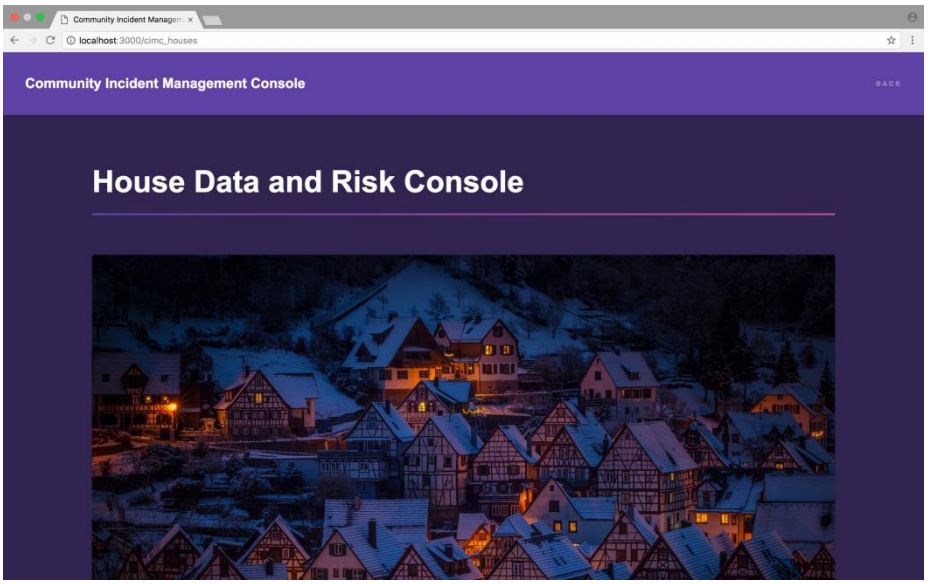
This people can be a firefighter department or Command Center too.

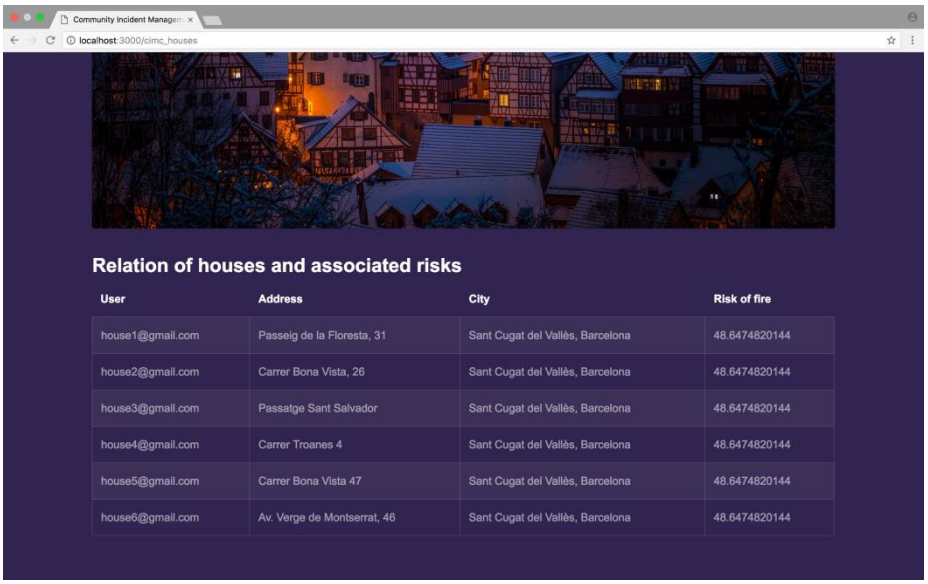
The actual functionality is basic, only reports, but it can be evolved with more functions.



5.17. CIMC-HOUSE DATA AND RISK CONSOLE

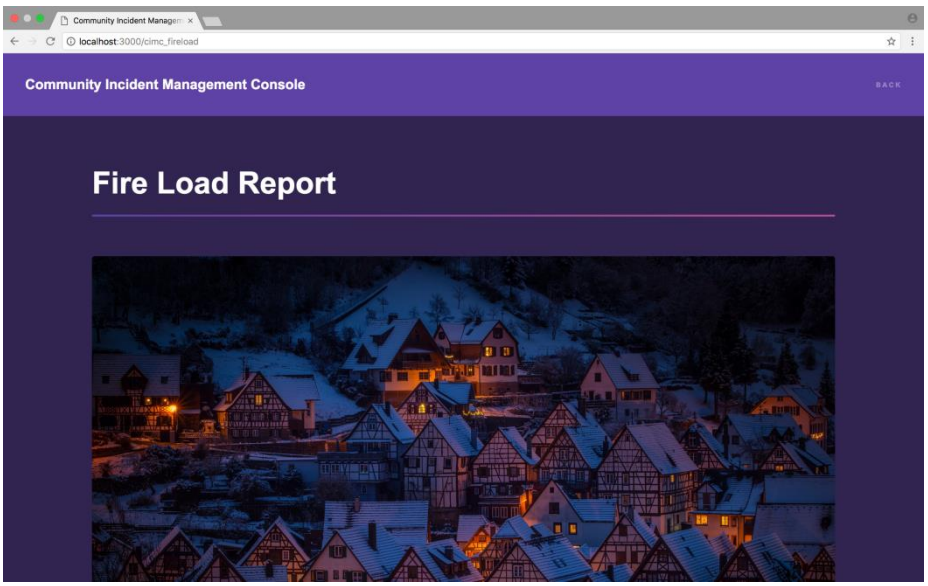
This is a report of the fire risk by house in the community. It can be used to warn the owner to take actions in order to avoid the risk.

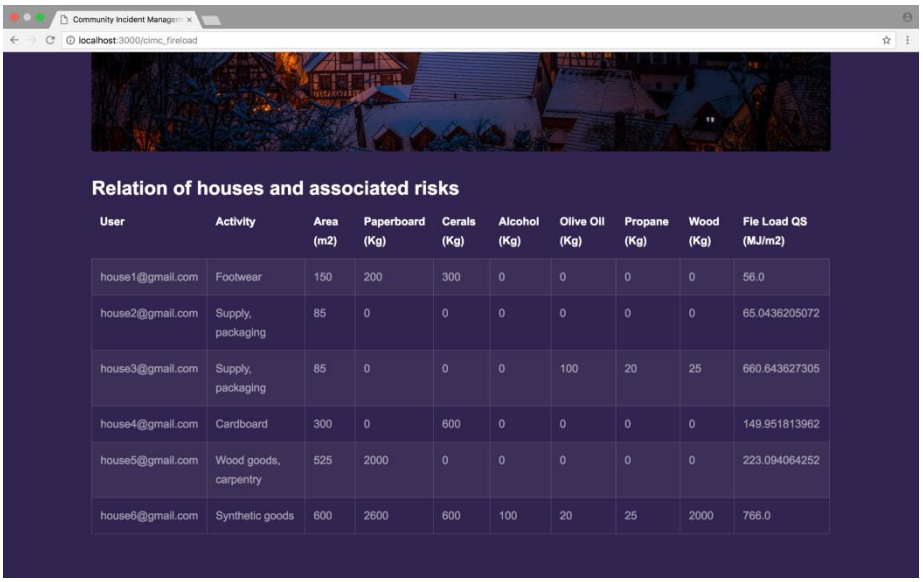




5.18. CIMC- FIRE LOAD REPORT

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

6. ANALYSIS

- CIMC is a **decentralized system** of fire control that is connected to the local emergency services
- This solution helps to reinforce the **culture of self-defence**
- CIMC solution and its recommendations are based on **local regulations** and technical documentation from local emergency services.
- CIMC can be used by different kind of **WUI communities** (Town Halls in towns that are surrounded by a forest, mountain resorts, urbanizations on the cost that are surrounded by heavy vegetation, etc.)
- 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.

7. CONCLUSIONS

Completeness and Transferability:

- The idea has been partially implemented, fully documented and it has a **detailed roadmap**
- It can achive an impact in the **Self-protection culture and No Colapse value** in the South of Europe
- It can be transferred to everywhere with **Wildland-Urban Interface (WUI) Communities** that can assume their responsabilities saving their houses and theirselves.

Effectiveness and efficiency

- Self-protection capabilities and people empowerment **to make the right decision** with information in real time is key in case of wildfires
- The solution addresses a high priority area because the decision **evacuation or confinement** is critical and in Greece it was demonstrated that evacuation is not always the right decision due to the overload of the evacuation road

Design and usability

- It can be put to use quickly. It's **easy to use**. The idea is simple and **the scope is really high for WUI Communities**.

Creativity and innovation

- The approach about **self-protection capabilities and no colapse value is original**. Our solution is a good approach to solving this long-standing problem. We have our responsibility to save our houses and ourselves.

8. WITH OUR STAKEHOLDERS

9. OUR CHILDREN STORIES

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