Team: FireWatch Community

Team members:

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Space App International Hackathon

About us

FireWatch Community is a multidisciplinary team, made up of students from different universities in Mexico, who study different engineering, such as mechatronics, aerospace, systems, etc. This team emerged during the inauguration of the NASA space apps CDMX Hackathon, to take on the challenge: “Fire management: increasing opportunities for community-based fire management”.

Challenge

We chose the challenge of "Fire management: increasing opportunities for community-based fire management" because of our deep concern for environmental sustainability and the pressing issues associated with wildfires. By addressing this challenge, we aim to contribute to the reduction of wildfires and their associated environmental consequences, working towards a cleaner and more resilient planet for current and future generations. Our mission aligns with the urgent need to combat these destructive wildfires and their cascading effects on our ecosystems and daily lives.

As the frequency, size, and impact of wildfires continue to rise, there is an escalating demand to expand the utilization of this data to a broader spectrum of stakeholders. The challenge before us is to craft inventive solutions that address fire detection and natural resource monitoring. We will leverage technology and publicly available data to empower local communities in Mexico City and its adjacent regions to report and monitor wildfires, with a focus on areas prone to forest fires due to agricultural activities, sun, or any other source it comes from. Importantly, while we initially target Mexico City and nearby areas with a predisposition to forest fires, our vision is to develop a solution that can be employed globally once the model and apps are tested and there are the necessary resources and infrastructure to support worldwide use.

With the escalating prevalence and widespread consequences of wildfires, there is an amplified call for an array of stakeholders, particularly those residing in local communities near forested areas, to comprehend and make use of this invaluable data.

Wildfires engender a multitude of adverse effects, including biodiversity depletion, deteriorating air quality, heightened soil erosion and landslides, encroachment by non-native species, pollution of watersheds, and the emission of greenhouse gases. These repercussions often disproportionately affect communities located in proximity to or within forested regions. To facilitate community-based forest management, we must explore innovative methods for accessing, adapting, and applying active fire data.

Mission/Vision

Our mission is to establish a comprehensive and interconnected system that leverages both a mobile application and a web platform to identify potential wildfire scenarios in Mexico City and surrounding areas. Our goal is to empower individuals within these communities to actively contribute to wildfire detection and monitoring.

To achieve this mission, we propose a user-friendly mobile application that allows individuals to capture images in the vicinity of suspected wildfire events. These images will serve as critical inputs to our system. Upon submission, these pictures will undergo rigorous analysis using cutting-edge machine learning algorithms.

Our system will rely on a robust dataset provided by a trusted third-party source named Nyckel. This dataset will serve as a reference to verify the presence of an actual wildfire in the images captured by users. The machine learning algorithms will compare the submitted images to the dataset, employing pattern recognition and other advanced techniques to determine whether a wildfire is indeed occurring.

By involving the local community in the process of wildfire detection, we aim to enhance the speed and accuracy of response efforts. This participatory approach not only encourages timely reporting of potential wildfires but also strengthens the network of individuals and organizations dedicated to environmental preservation and safety.

In summary, our mission is to develop a holistic and technology-driven solution that harnesses the power of community engagement, machine learning, and data analysis to identify and respond to potential wildfire scenarios effectively. This initiative aligns with our commitment to promoting the well-being of local communities and safeguarding the natural resources in the region.

Objectives

Our project is driven by clear objectives aimed at addressing wildfire and natural resource monitoring in the Mexico City area initially, with the aspiration to expand globally as the project progresses. These objectives encompass:

Mobile Application Development: Our primary goal is to develop a user-friendly mobile application that enables community members to easily capture images of potential wildfire events in their vicinity.

Environmental Education: We are committed to providing educational resources that promote wildfire prevention, emphasize the importance of biodiversity conservation, and underscore the significance of preserving species in the region.

Impact Monitoring: We will closely monitor the impact of our project, measuring key metrics such as reductions in wildfires, biodiversity preservation, and the extent of community engagement and participation.

These objectives serve as the bedrock of our mission, which is centered on empowering communities, harnessing technology, and safeguarding the environment by addressing the pressing issue of wildfires in the Mexico City area initially, and with an eye towards expanding our efforts worldwide as the project evolves.

Challenges we experienced

In the absence of being able to use an API to extract the wildfire data map provided by NASA, we created a map on Google Maps that contains the same information as NASA's map. We used an iframe to make the request on the website.

Additionally, we investigated implementation of tooltip for the web page, this to be able to display the information when clicking the buttons and make the page more dynamic

For the deployment, we struggled to upload the files to the webpage, so we investigated and discovered the 000webhost page, which allowed us to upload the files corresponding to the web page, this in order to upload it to a server on the network to have a link in which anyone can access it.

We also had the challenge to find a dataset to train with fire/wildfire images with IR, we considered several options such as Azure and Google Cloud, however we opted for Nyckel, since for the purposes of optimizing time, training and labeling the images was faster and easier.

Improvements

One potential challenge we anticipate is the need for larger datasets and an extended localization scope to ensure scalability. To address this, we aspire to broaden the project's scope, encompassing not only Mexico City but also other regions within Mexico and, eventually, countries worldwide. Our aim is to make a substantial and lasting impact, starting with Mexico City and progressively extending our reach to benefit communities and ecosystems globally.

Webpage Implementation: We are dedicated to integrating NASA's wildfire dataset into our project to provide both historical and real-time insights into wildfires and fire-prone areas. By doing so, we aim to enhance our AI models by incorporating community reports, enriching NASA's dataset, and enabling the broader community, including individuals and organizations, to access valuable information through a user-friendly webpage. This webpage will feature an interactive map for real-time visualization of historical wildfires, offering a comprehensive tool for communities and interested parties to monitor and respond effectively to wildfire events.

However, NASA's webpage has the presence of CORS restrictions, which poses a challenge for direct integration into our webpage. Nevertheless, we are actively exploring several alternative approaches to ensure seamless access to this critical data. One option under consideration is the implementation of a proxy server, which would act as an intermediary, allowing us to fetch the required data securely without violating CORS restrictions. Another avenue we are exploring is API integration, which involves accessing NASA's wildfire data through their provided Application Programming Interface. This approach may provide a streamlined way to retrieve the information we need while adhering to data access protocols.

Community Training: We recognize that not all community members may be tech-savvy. We also consider offering training sessions or user guides to help individuals effectively use the app and platform.

Language Options: Mexico City is a diverse place with multiple languages spoken, and as we are planning to upscale this worldwide, we want to offer different language options within the app and on the website to accommodate various linguistic preferences.

Data Privacy: We want to address data privacy concerns by implementing robust data protection measures, by clearly communicating how user data will be used and stored, and ensure compliance with relevant data protection regulations.

Collaboration with Local Authorities: We can find ways to work with local fire departments, emergency services, and relevant government agencies to ensure a seamless flow of information and response to wildfires. By establishing partnerships with these entities, we can enhance the effectiveness of our solution.

Fire Prediction: We can consider incorporating predictive modeling into our solution. Machine learning algorithms can analyze historical data to predict potential wildfire-prone areas, enabling proactive prevention measures.

Feedback Mechanism: We can create a feedback mechanism within the app and web page to collect user suggestions and insights. This can help to continuously improve the user experience and the effectiveness of our solution.

Community Empowerment: Beyond wildfire management, we can explore ways to empower communities in other aspects, such as environmental conservation, sustainable agriculture, or disaster resilience.

Drone: For further enhancement, we can consider implementing a drone patrolling system, where drones proactively patrol high-risk areas to detect wildfires in their early stages. This would provide a more proactive approach to fire detection and could potentially reduce response times.

Issues

We were unable to save the infrared (IR) model we trained. It's currently accessible on the website Nyckel we used, but not available for download. It's ready for implementation, but due to time constraints, we couldn't integrate it into the app yet.

We have various drone models at our disposal for continuous monitoring. In cases where users send an image via the app, there will be an alert sent to the drone, which will confirm the situation and assess the extent of the disaster to determine the stage of the wildfire.

What did we learn?

ills to publish web pages and honed our expertise in JavaScript, a programming language that we had the opportunity to delve into deeply for the development of an application. The intensity of the project days, especially within a 24-hour timeframe, pushed us to utilize actions, commands, and even terminal programming techniques we had previously been unaware of.

One of the most enlightening aspects of this experience was understanding the sheer scale and complexity of databases, especially when dealing with critical issues like forest fires. We learned about the vast array of variables and scenarios involved and the paramount importance of timely and effective responses. The potential of artificial intelligence (AI) in this domain became abundantly clear. AI's capability to process extensive datasets, analyze images, and aid in decision-making is revolutionary. It offers invaluable assistance in early detection, monitoring, and even predicting wildfire behavior, underscoring its role in enhancing firefighting efforts.

Additionally, we ventured into the realm of image recognition, learning how to train models and comprehend their labeling processes. Another exciting facet of this hackathon was our hands-on experience with a 3D printer. Starting from the basics, we progressed to a point where we could independently print a piece without supervision.

In conclusion, this hackathon was not just about acquiring new skills but also about understanding the broader implications of technology. It emphasized the significance of staying at the cutting edge, continuously refining our response mechanisms, and leveraging AI's power to address challenges, such as the devastating impact of forest fires.

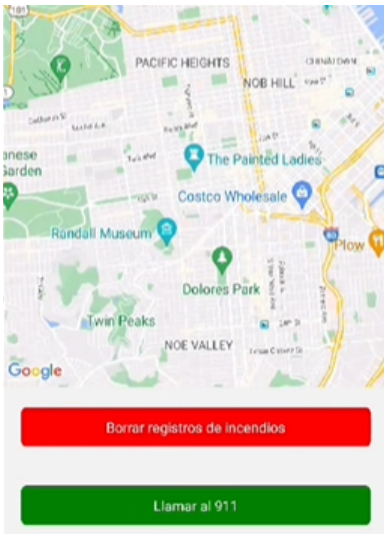
Developments

Mobile Application

Application Function:

Our application serves as a tool that empowers users to report wildfires within a specific area through an interactive map. Users can capture photographs, and an AI system analyzes these images to assess the severity of the wildfire event. ThiDuring this hackathon, we embarked on a transformative journey of technological exploration and learning. We acquired sks information is then communicated to the relevant authorities. Additionally, the application incorporates an alert system that activates when a minimum of three reports is registered within a particular zone. This immediate alert is also transmitted to the appropriate authorities. The photo capture feature is automatically activated when an alert is triggered.

Image 1: App Home Screen



App design:

For the App design, we utilized the Expo tool, creating a project and saving it directly from the terminal. We imported properties such as 'camera' and 'map' to precisely manage location. What the application does is employ an existing world map to mark and store records of wildfires. The data remains in the database until the tentative event is addressed, at which point the marker is updated

Image 2: Interactive map

Web page

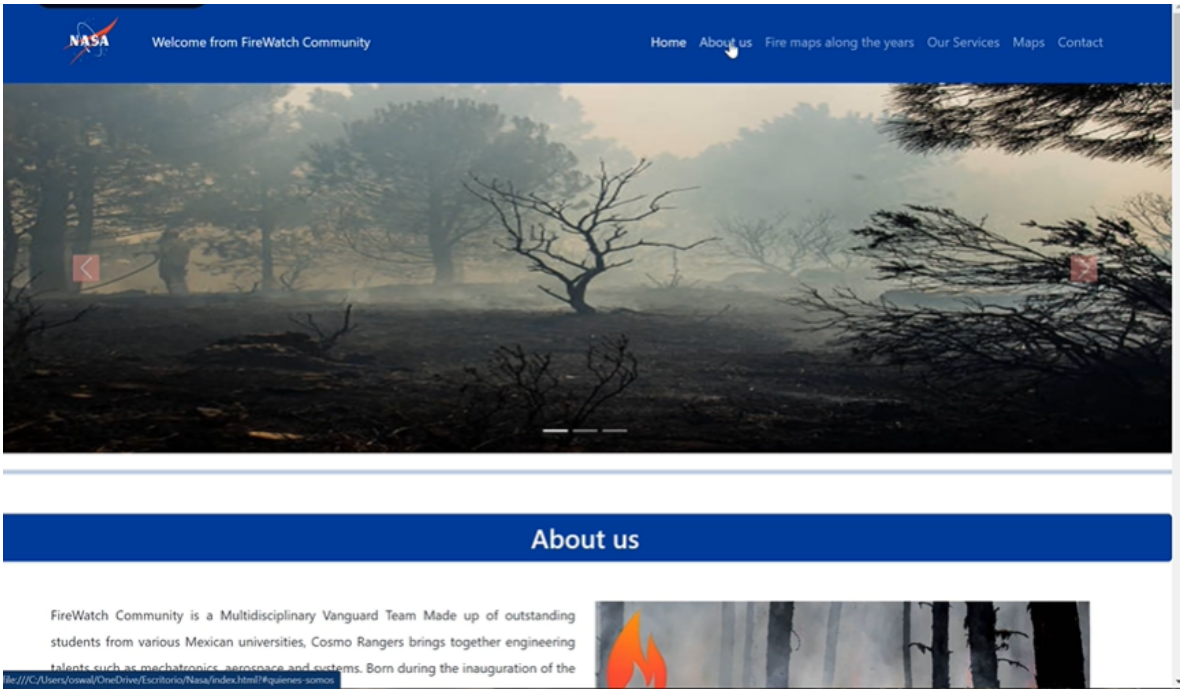


Image 3: Principal page view

Image 4: Educational and additional information

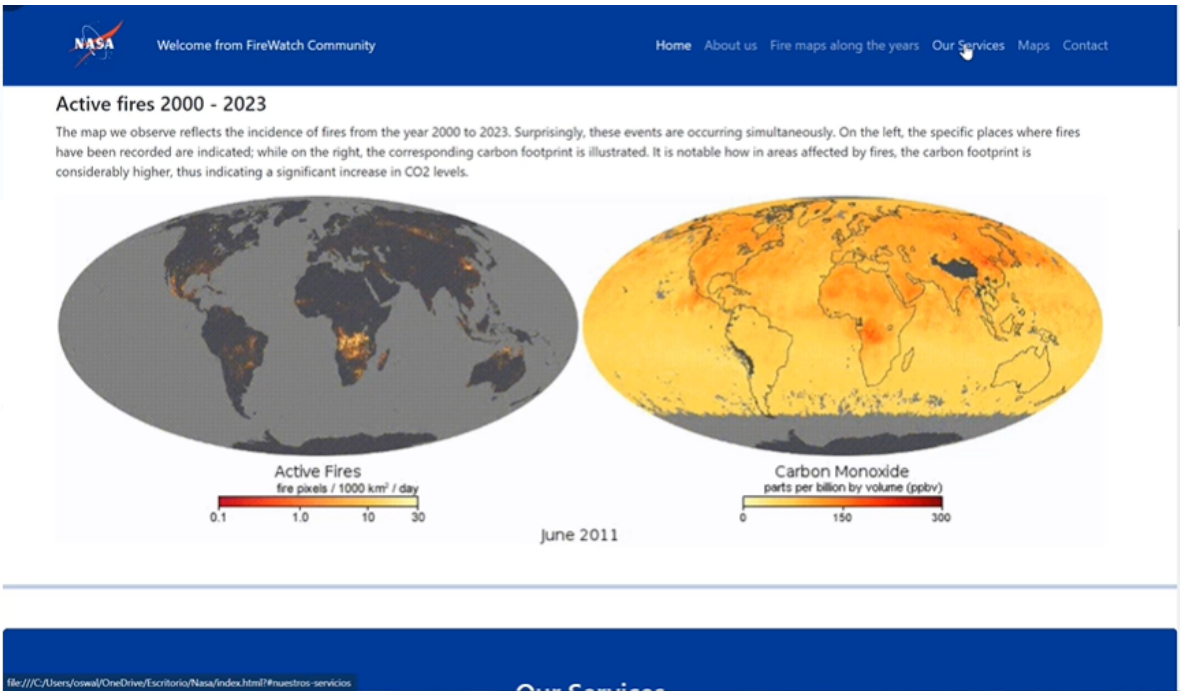


Image 5: Maps of active fires

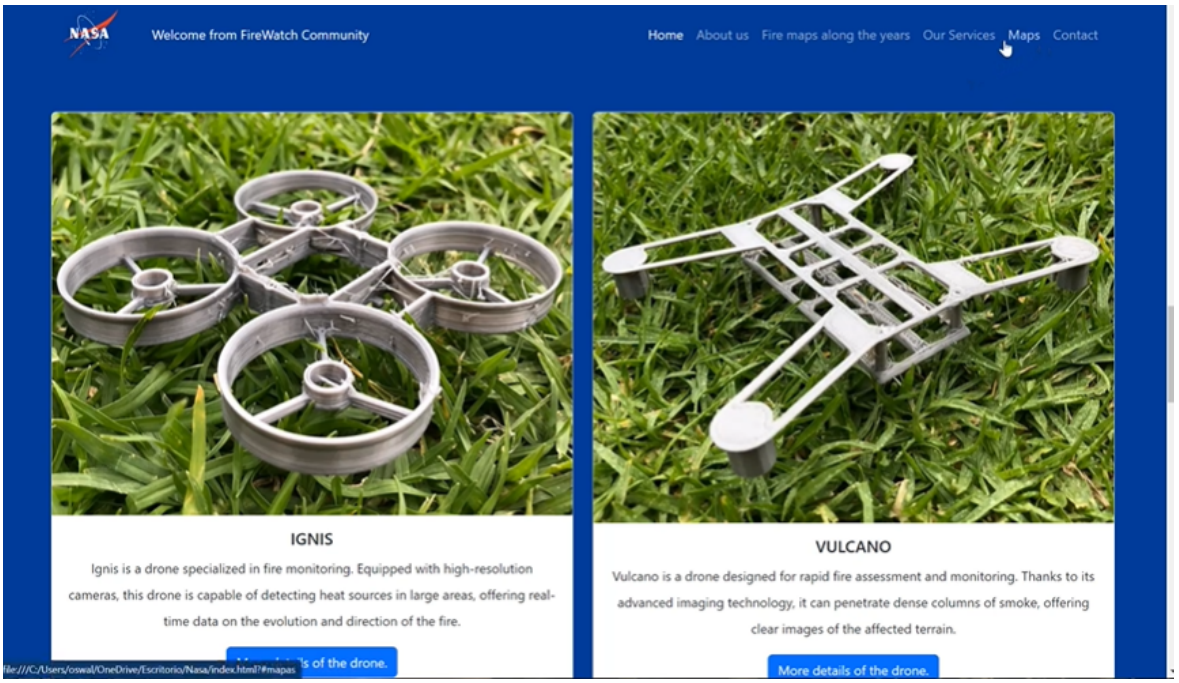


Image 6: Models of our drones

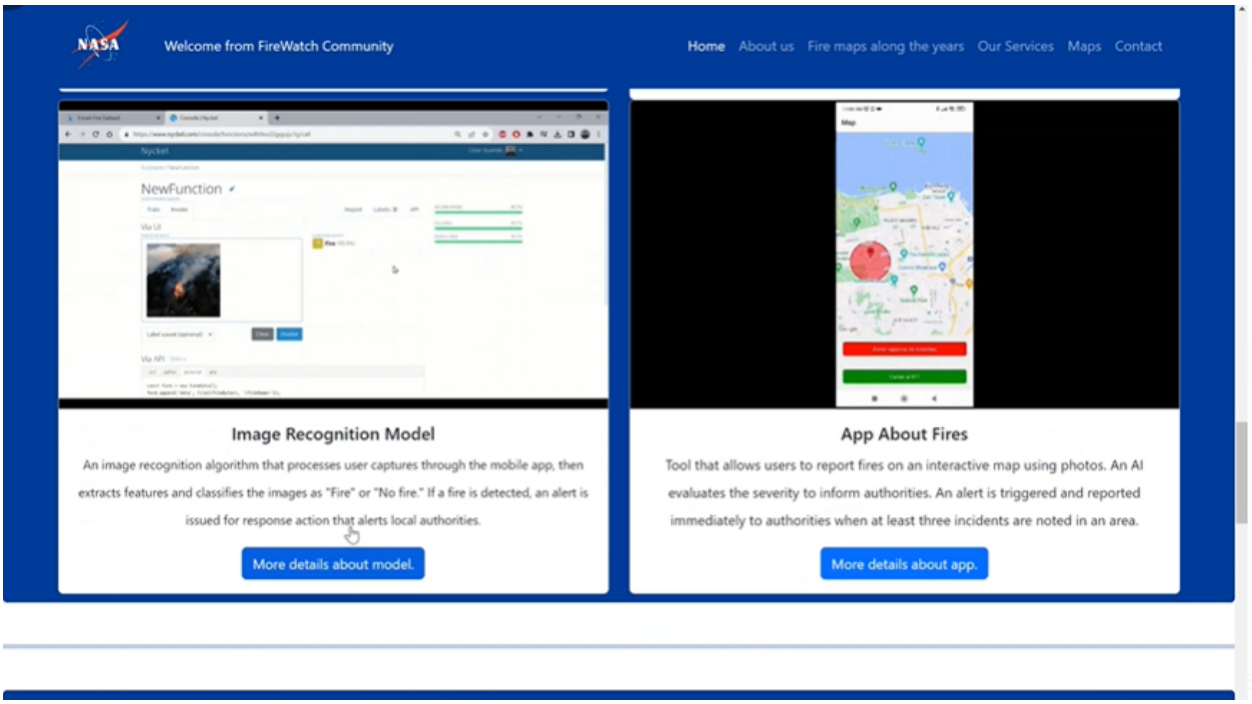


Image 7: Image Recognition and app descriptions

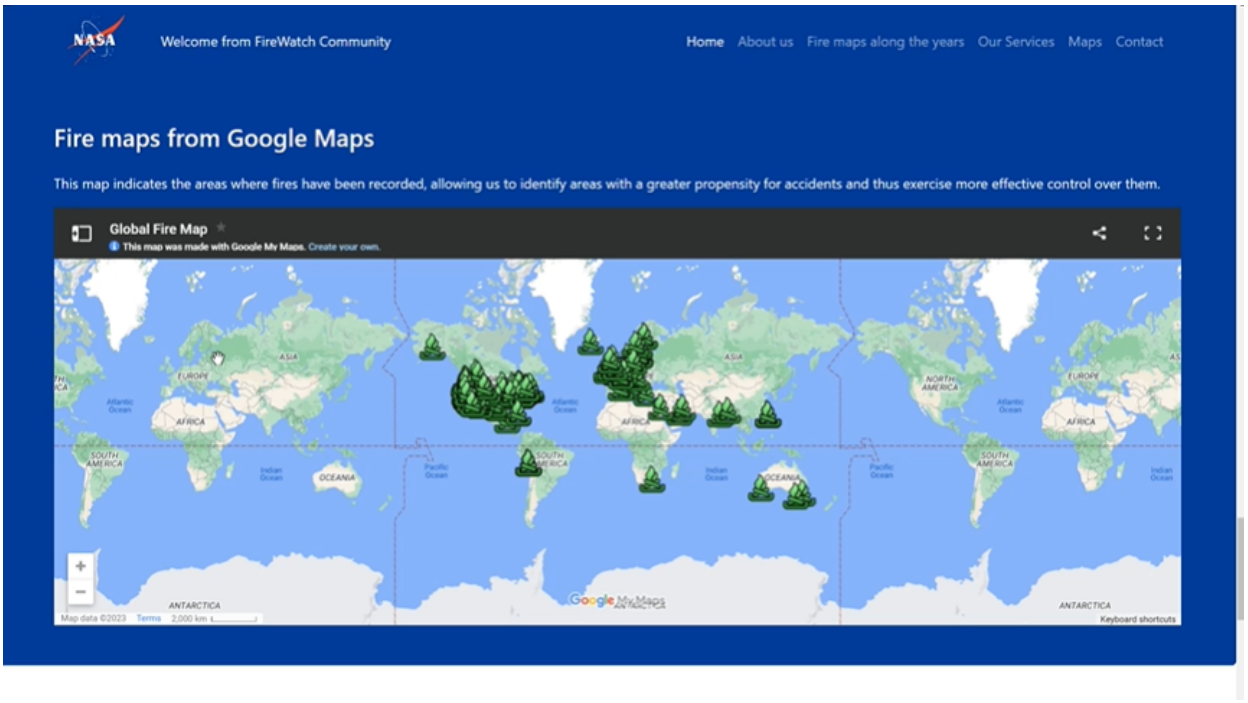


Image 8: Fire maps grom Google Maps with Nasa's information

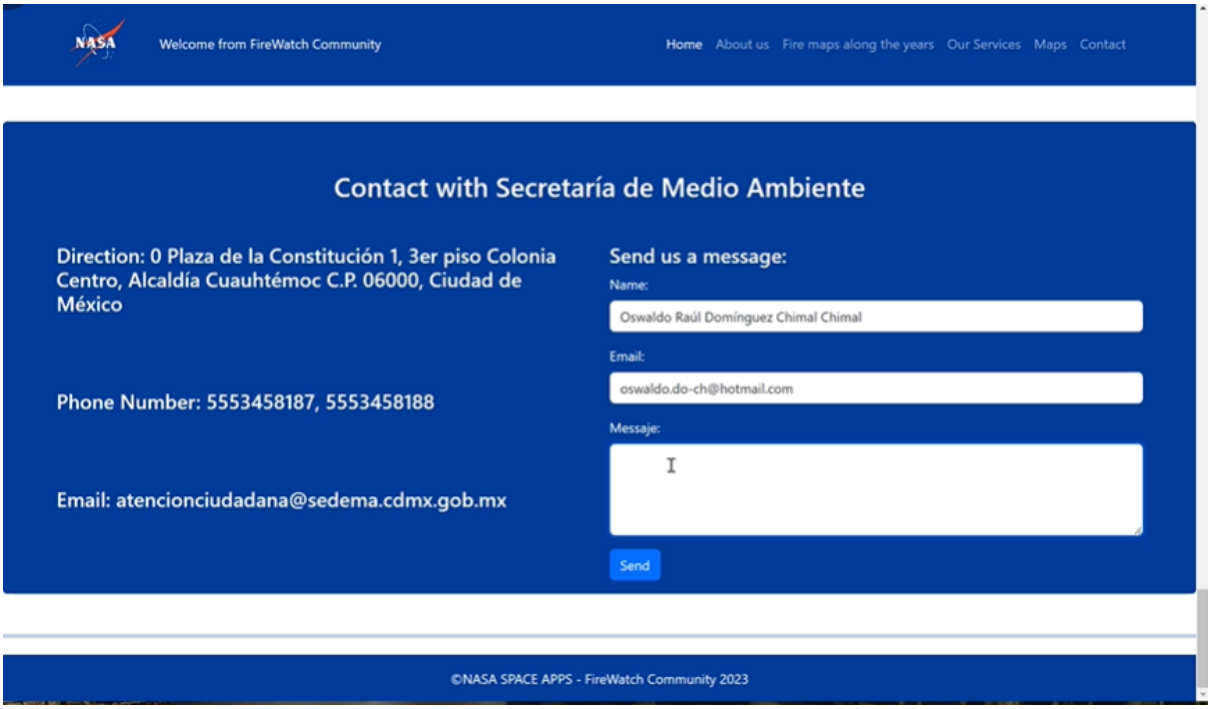
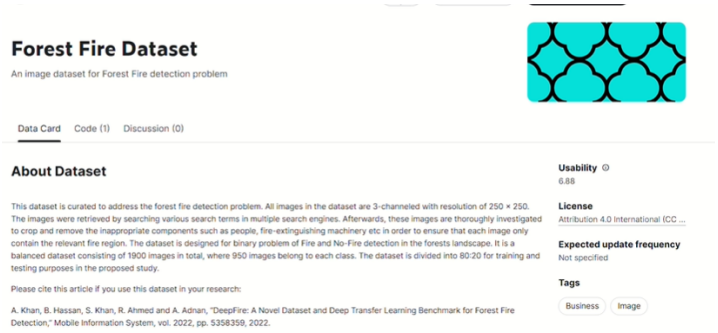


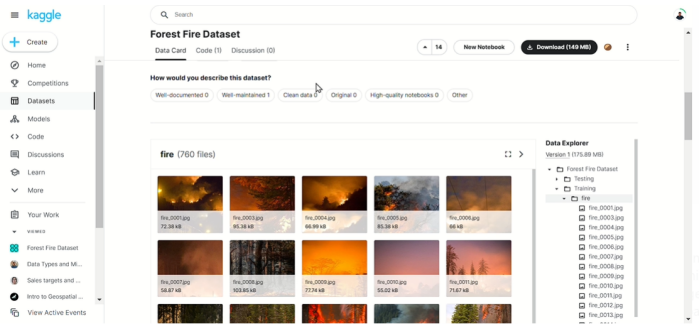
Image 9: Contact information

Image Recognition



For the design of the image recognition model, we utilized 1400 photographs from a forest image dataset, divided into 700 with fire and 700 without fire. Additionally, the samples were split into 'Training,' 'Validation,' and 'Testing' sets.

Image 10: Home screen page of Nyckel



Two labels, 'Fire' and 'NoFire,' were created to manually tag the initial samples. Subsequently, the model was further trained automatically using the Nyckel program.

Image 11: Data and images about fire forest