ACCESSIBILITECH

Solutions improving lives

This project has received funding from the European Union's Rights, Equality and Citizenship Programme (2014-2020)

ACCESSIBILITECH

Advanced methodologies to identify, assess and transfer innovative solutions for the accessibility of people with disabilities

Deliverable 2.3

Active listening tool and on-line mapping tool on inclusive & accessible technologies final assessment of results and functioning

Fundación ONCE · Inserta Innovación · DIGITALEUROPE · EASPD · European Disability Forum · Social Economy Europe · Philea Philanthropy Europe Association

ACCESSIBILI TECH

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Table of content

Funded by the European Union

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1. Introduction

One of the main products to be developed within Accessibilitech (Action 2) was the Active listening tool on inclusive and accessible technologies and solutions focused on three thematic areas: eLearning, telework and telecare (Deliverable 2.1), the results of which are published in an online mapping tool (Deliverable 2.3).

The main tool under action 2 is the Active Listening Tool, which has made it possible to discover the advances related to inclusive and digital solutions in three areas totally related to the covid-19 pandemic and how different projects in different stages of maturity have helped to improve the lives of people with disabilities.

Some aspects of this developed tool are briefly explained below, such as: explanation of the algorithm, manual insertion, review, and acceptance of solutions, as well as the criteria used to include a solution in the tool or not. This tool belongs to Work Package 2 inside the Accessibilitech project.

The active listening tool is inside of the work package 2 in the Accessibilitech project, the specific objectives of this WP2 are:

- To set-up a European technology surveillance team specialized in identifying, analyzing, and disseminating accessible technologies with the capacity to detect those that could potentially be scalable, replicable or transferable at EU level.
- To establish a listening tool combining electronic and human capacities to systematically capture and analyze data gathered from internet about accessible technologies developed for telework, e-learning and telecare. This tool will be based on:
    - Upgrading the existing identification method to map inclusive and accessible technology and solutions.
    - Validating the identification method and data collection tool with around 100 solutions by area (300 in total) to assess its effectiveness.
    - Establishing a set of criteria to determine technologies or solutions that could potentially be scalable, replicable or transferable at EU level.
- Design and launch an online mapping tool specialized in three thematic areas: telework, e-learning and telecare.

Actions 2.1 (development of the Active Listening Tool), 2.2 (selection of 100 and 30 solutions) and 2.3 (development and updating of the Online Mapping Tool) are all related actions under the main umbrella of Work Package 2 and this document details the processes and learnings in each.

This report will detail the different procedures followed in Work Package 2 explaining the objective, as planned, the results and, very importantly, the learnings from these processes.

In an innovation project like this with such a clear objective as to improve the quality of life of people with disabilities in e-learning, telework and telecare environments, it is important to be able to value the successes and errors, especially concerning the use of emerging technologies providing accessibility solutions and the barriers that have been discovered that had not been raised before.

2. Implementation description

2.1. Establishing the active listening tool (algorithm operation)

2.1.1. Aim of action

At all times it has been requested that it be a semi-automatic project search, this forces the use of emerging technologies that can use automatic data search procedures, for this a custom machine learning algorithm is created, which can carry out this type of search. searches automatically in different repositories. The requirements are:

- Use exponential technologies for the algorithm
- Filter projects throughout Europe
- Use public or private databases
- It can be used in machine learning supervised or unsupervised learning
- It is important to have keywords that facilitate the search
- The algorithm must have support or improvement measures in case it does not achieve efficiency on its own
- Algorithm Relearn Capability
- Ability to remove duplicates
- Being able to automatically classify projects in the three areas of interest

The algorithm will be the basis of the application's behaviour and the most important component within the core to extract the information and be able to work with it for the desired purpose.

2.1.2. As planned

The tool and the algorithm were defined by Inserta Innovación and has been developed by BigML under their supervision and total cooperation. The project focuses on divulging initiatives to support telework, telecare and e-learning that can be useful for the public but are especially helpful for people with disabilities.

Given the number of projects that were expected to be collected, a Machine Learning classification algorithm was needed, for which, as we said before, the company BigML was used as a service provider in the development of the map.

BigML is a consumable, programmable, and scalable Machine Learning platform that makes it easy to solve and automate Classification, Regression, Time Series Forecasting, Cluster Analysis, Anomaly Detection, Association Discovery, and Topic Modelling tasks. BigML is helping thousands of analysts, software developers, and scientists around the world to solve Machine Learning tasks "end-to-end", seamlessly transforming data into actionable models that are used as remote services or, locally, embedded into applications to make predictions.

More than 182,000 users from all over the world enjoy BigML. They also play an active role in promoting Machine Learning in academia through our education program, reaching over 700 universities.

Inside the tool we collect projects. The project will be defined by its associated properties, mainly its name and description, but also the country of the company leading it (and any others that may contribute to it). Other information was valued to be of interest like the URL of a web page describing the project, the start and end dates, and, of course, the labels that will classify it as related to one or many of the three categories. To get the algorithm up and running, BigML asked Inserta Innovación for the following agents to get the machine learning up and running:

- Repositories containing collections of projects.
- A set of example projects that correspond to the categories of interest properly labelled.
- A list of keywords per category that could be used as starting point to filter projects that could be associated to the categories.

2.1.3. In practice

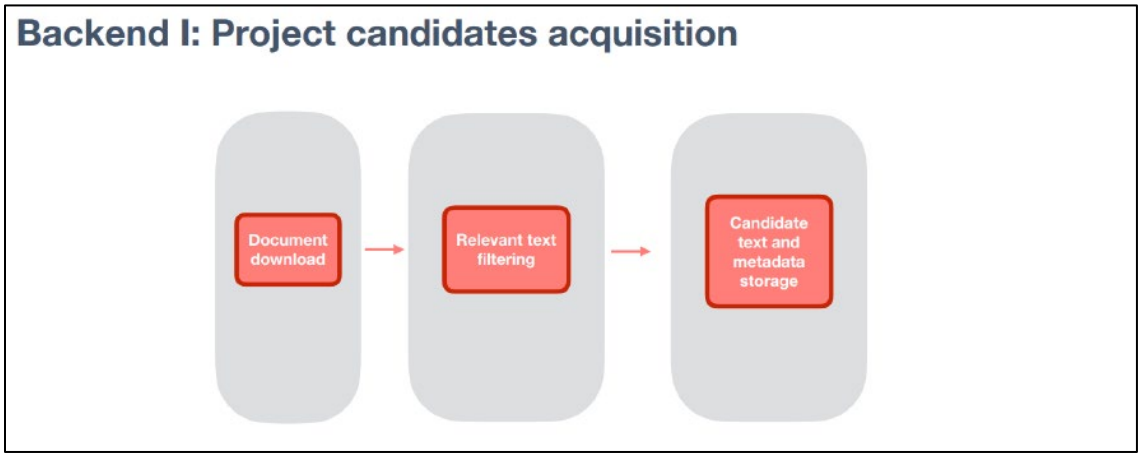
The repositories containing collections of projects were (a connector was created for each one):

- **CORDIS database:** Community Research and Development Information Service. It provides information on all EU-supported research and development activities, including programs, projects, results, publication
- **SACCES:** Database of accessibility-related projects provided by Inserta Innovación.
- **CHAFEA:** The Consumers, Health, Agriculture and Food Executive Agency was an executive agency of the European Union, set up by the European Commission to manage four programmes on its behalf, in the domains of health, consumer protection, food safety, and the promotion of European agricultural products.

- **Online form:** Many projects were directly added through the Accessibilitech project form. We will discuss this topic in more detail in the next section.

Projects could be retrieved from more than one source, and we could not assume beforehand that the publication interface, the data dictionary or the export format used in each source would be similar. Therefore, each added source needed a customized connector to ingest its data. Every time an external source is included, there's an associated connector that needs to be built to ingest that data. As the time available for this project was limited, BigML's advice was to use the most populated source available as seed data to build a first draft of the framework. It would be easy to create the rest of connectors to add other sources while the application has already been tested. Inserta Innovación informed that they were still retrieving the external data sources but told BigML to use an API that was still being developed: SACCES. It should provide projects related to accessibility topics, so it looked like a good source for the kind of projects of interest.

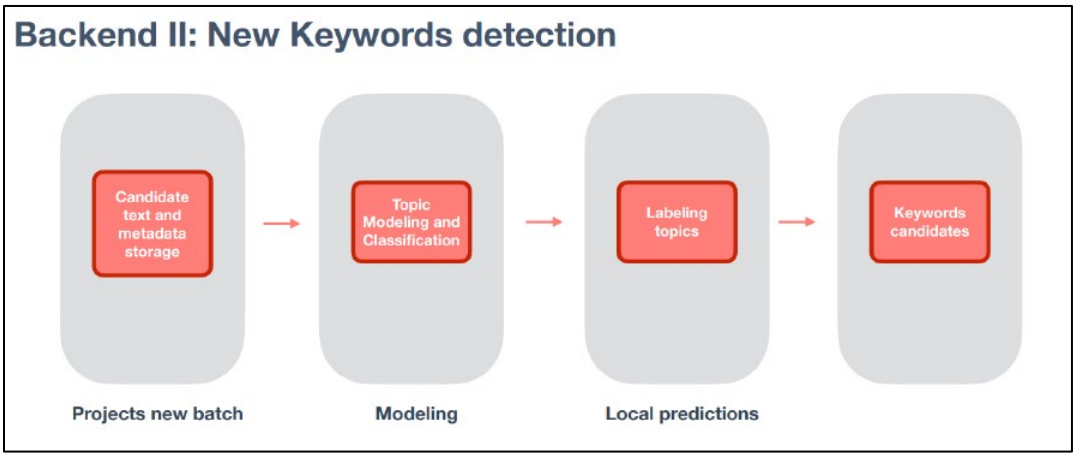
This API is included since in the early stages of the project it was difficult for the algorithm to select projects related to people with disabilities and accessibility when the information was very scarce. Therefore, this API could provide useful information or at least good examples, for the algorithm to refine the search, since the keywords of the three themes and the generic ones on the collective were not enough.

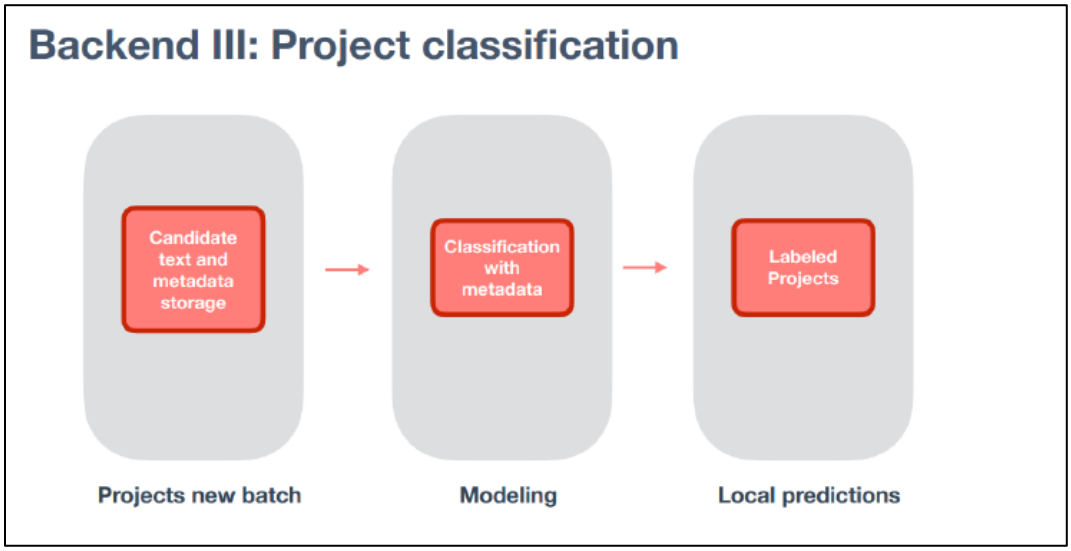


During the first months of the development, Inserta Innovación and BigML agreed that the development of the machine learning workflows should be held until more data was available. We focused on developing a scaffold where the different parts of the application could be added and the form to enable manual addition of projects. Thus, the Inserta Innovación team could promote the existence of the project and start receiving feedback from other companies and institutions. That being done, BigML's work shifted to building the intranet for reviewers, that should be useful to label and publish or reject the project candidates once the data was provided.

The number of projects to be obtained from the external repositories was expected to be too high for the team of reviewers to check them all. Therefore, automated labelling was needed to filter those projects that might be related to one of the categories shown in the tool. In fact, the number of projects was expected to be so high that the data would have a very high unbalance, as only a few of the recollected projects would be related to the classes of interest.

Having all this information, BigML proposed to use Unsupervised machine learning models, like Topic Modeling to find keywords and topics or Clustering to look for similar projects and reduce the number of projects to be reviewed. Anyhow, a module should use an automated procedure to select some of the collected projects and assign them an automated label and some score to help the reviewers in their classification. Despite everything, the team felt that they were losing a lot of new projects, for this reason the annotated manual form was put in place.





The different types of supervised and unsupervised learning used in the algorithm have been:

- The Topic Model is used as a feature extractor. The probability that it returns for each project and topic is added to the dataset. This is the information that the following models will use to classify the projects.
- An Ensemble Model will filter out projects that doesn't look like potential candidates. Usually, these are projects that doesn't have any kind of relation with accessibility or the topics we are focusing on.
- Projects that passed the previous filter are then scored with three different Decision Trees (one for each topic: telecare, telework, e-learning). Each one of them will decide if the project belongs to a specific topic. A project could belong to more than one topic (or none of them)

This workflow considered as candidates, approximately, 3600 projects, 7% of the total number of collected projects.

Finally, regarding the workflows:

- An initial group of Projects has been loaded in the database.
- An initial group of Reviewed Projects have been used to create some Predictive Models to select candidates and label them as e-learning, telework or telecare.
- An initial Predictive Workflow has been set up to do the scoring (selection + labelling) automatically either periodically or on demand.
- An import + scoring process has been scheduled monthly to automatically retrieve any project updates of the chosen sources.

The automatic algorithm has required good examples of projects and solutions to improve its search based on data that is occasionally correct and with which it could start to make more efficient searches in each interaction. For this, a manual form was created within the tool to feed these good examples.

2.1.4. Manual form

At the beginning of the development of the tool, the Inserta Innovación team detected that there would be many projects that did not reach the large sources that the automatic algorithm was going to consider, for this reason the proposal became a semi-automatic option, where a manual form would be included to complement the algorithm´s automatic entries with the manual entry of information and projects by the different agents:

- Individuals
- Companies
- Public administrations
- research teams
- universities

- NGOs

Among others, they could include their project on the map, giving it dissemination and recognition throughout Europe, which is why in very early stages of development this form was opened to be able to load the different solutions and, in this way, the automatic algorithm could also learn of good examples or valid examples according to the scope of the project and the three areas of knowledge.

The call for participation included the following message: "*This mapping tool is a system that gathers accessible and inclusive technological solutions, at all levels of maturity, with potential to improve the quality of life of people with disabilities. It will offer a source of information on accessible technologies for persons with disabilities. Whether you are a research group from a university, a company, a non-profit organization or even an individual, do not hesitate to send us information on your product, service, tool, project, or initiative.*"

The fields that were requested for each solution to be able to be evaluated and registered on the map are the following:

- Project name
- E-mail from someone of the institution o related with the solution
- Project Category
- Project URL
- Country
- Project logo
- Project Description in English, It is very important to be able to standardize the information in the most common language within the European Union in order to better disseminate information on all solutions.
- Company URL
- Accept the Terms and Conditions

This meant additional support to feed the algorithm and give them good examples, but it was not enough just to collect, the algorithm also had to be told what was good and what was bad. For this reason, criteria were established so that the reviewers would know whether they could accept the solution or not, in order to show it in the mapping tool and improve the algorithm.

2.1.5. Results

The results of this Mapping Tool reflect both the automated selection and scoring of the projects that have been retrieved during the last year and the work done by reviewers after several iterations of import plus scoring cycle.

The algorithm had detection problems in its first iterations as despite giving it project repositories and keywords, most projects:

- They were NOT related to the disability

- They were NOT related to accessibility
- They did NOT speak or were not directly related to the three themes of this project, e-learning, telework and telecare.

Little by little, the algorithm was better filtering the solutions thanks to the manual insertion and the work of the reviewers who were including the projects in the categories or rejecting them. At the beginning, a very large number of projects arrived since there was not enough information to filter conveniently.

On many occasions, the reviewers who were accessibility professionals linked to the world of disabilities, without there being a need for them to have a disability, could know whether the project had any involvement with these issues, although many times it was not easy. that the information was scarce.

It's been proved that successive iterations have increased dramatically the imbalance of the first filtering model. This model, and the entire labelling Workflow was built when no examples of Projects of interest were provided. Thanks to the Accessibilitech team effort, we already have a remarkable collection of examples of projects of interest now. That collection enables some strategies that were not possible at the beginning of this project and could help improve the filtering of candidates, so that less projects appeared to be reviewed.

The Mapping Tol hosts **more than 50,000 solutions** that have been identified by the Active Listening tool algorithm. These included automatic and manual solutions that were analysed by the team of accessibility and disability professionals (European Technology Surveillance Team) and categories into those rejected, those pending evaluation and those selected for the public section of the mapping tool having passed the establish criteria. The process of selection and inclusion of manual solutions have aided in optimising the algorithm for the improvement of its automatic filtering. **810 of the solutions found by the Active Listening Tool were approved and included in the mapping tool**, of which **144 came from the manual entries**. Regarding the three areas of interest, **354 solutions were approved in telework, 462 in telecare and 348 in eLearning** (it is important to note that some of these solutions apply to several themes).

The **solutions cover 32 countries**, 5 more than the Member States of the European Union in 2023, this is due to the variations that have occurred in the years since the beginning of the project.

The main groups of stakeholders whose solutions were published on the mapping tool were third sector, disability-focused associations, technology companies and public administrations, among others.

2.1.6. Learnings

Regarding developing algorithm and machine learning for the Active Listening Tool, it was learnt that it is important to first have some data sources that you know can give you results that are worthwhile for the project you are developing the tool for. In this case, for the Accessibilitech team before including the API of SACCESS in the project it was quite difficult for the algorithm to collect solutions within the expected scope.

This is also because, in general, the different agents that carry out these projects often do not know how to present the information or the value proposition of their project that reflects accessibility or the benefit for the population under a design-for-all approach.

It has been detected that the different companies, research groups, individuals or institutions do not adequately describe the usability and accessibility characteristics of their products. In many instances, this leads to: loss of quality, ignorance or depriving society of the use of these new products or services related to e-learning, telework and telecare. Not because the products are not prepared for people with disabilities, but because these works or adaptations are not specifically mentioned.

For the moment, human evaluation is necessary to guarantee a quality filter that maintains the technologies at the expected level of accessibility and accuracy. It has often been a challenge for reviewers to search within the mapping tool because of the sheer volume of solutions, which could be fixed by seeking greater efficiency in the algorithm and optimising it. A category called “other” was created for projects that are related to accessibility and improve the lives of people with disabilities outside the three areas of this project to help the algorithm and not lose interesting projects. That would allow the tool to break its limitation to the e-learning, telework and telecare categories. Users could find by themselves projects related to any kind of subject of interest.

It would be necessary improving searches inside the mapping tool, for that reason:

The intranet and public search have been built on the properties of the projects and there's a free-text search that is only supposed to match the title of the project. A new search could be built using more sophisticated models (BERT) to allow reviewers and public users to get the list of projects of interest.

That would allow the tool to break its limitation to the e-learning, telework and telecare categories. Users could find by themselves projects related to any kind of subject of interest.

The automatic algorithm has required good examples of projects and solutions to improve its search based on data that is occasionally correct and with which it could start to make more efficient searches in each interaction. For this, a manual

entries form was created to complement the algorithm´s automatic entry with the manual entry of information and projects.

For the manual entries form, there is a need for a lot of dissemination and encouragement of entrepreneurs and developers to introduce their own solutions.

2.2. Working with 100 solutions

2.2.1. Aim of action

The hackathon, the beta testing and the study were objectives of the project beyond determining that the tool and the algorithm found good solutions. For this, a first phase or exercise was carried out to select the 100 best solutions among the 3 categories. With the aim of processing the data and obtaining the best results for future objectives or actions within the project. Some requirements of these 100 solutions were:

- Select a similar number of solutions for each category
- These must be related to the disability within their category
- These must be related to accessibility within their category
- If it is not mentioned clearly and precisely, design for all or the improvement of the lives of people with disabilities must be inferred.
- Apply the requirements of the methodology objectively

2.2.2. As planned

All the solutions on the map were reviewed by professionals from the disability or accessibility world who knew the purpose of the project and which projects were sought after according to Accessibilitech's main objective. Over 50,000 projects were initially identified by the mapping tool. To narrow down such number, a preliminary review was carried out using the following rejection criteria:

- The project is not accessibility-related
- This is not a project
- Project is duplicated
- Other reason. Please, describe

For the reviewers of the solutions the criteria to be considered were:

The score assigned by the algorithm. The closer that score was to 1, the greater the probability that a project was relevant to Accessibilitech’s keywords and objectives. This score is called the BigML score (BigML is the company that developed the algorithm). Projects obtained from the manual feed were given a score of 1.

Following that approach, the other criteria were:

- Type of disability
    - Vision disability (blind, low vision, color blind)

  - Hearing disability (deaf, hard of hearing)
  - Dexterity disability (limited manipulation or strength)
  - Physical disability (limited reach, short stature, short arms, etc.)
  - Limited comprehension skills (cognitive, intellectual disabilities)
  - Does not specify

  Projects that were addressed at more than one type of disability or that could be used by many people with disabilities were prioritized.

- Relevance with Accessibilitech's focus area (telework, eLearning or telecare): Yes/No. Only projects that were designed for these three areas or that could be used to improve experience in these areas were prioritized.
- Is it a technological product or service? Yes/No
  Only projects that were technological products or services were selected.
- Project maturity level
  - Launched or commercialized product
  - Finalized but not launched
  - Prototype
  - Conceptual design, idea

  Projects launched or finalized were prioritized. Those that were prototypes or conceptual ideas, or design were rejected.

- Accessibility
  - Accessibility features are available and described
  - Accessibility features are not available
  - Includes limited accessibility features
  - Does not specify
  - Not applicable. The product is an assistive device or technology for specific types of disabilities.
- Scalability
  - Scalable
    - Free of cost or open-source product
    - Compatible with other technologies and operating systems
  - Scalable with limitations
    - Requires some payment
    - Compatible with some operating systems
    - Closed functionality (cannot be customized)
  - Not scalable
    - Cannot be used in other contexts
    - Too expensive
  - There is not enough information to determine scalability

  Projects that were scalable or scalable with limitations were selected.

- Transferability

- Product can be used in other contexts (software developed for telework can be used for e-learning)
- Product can only be used in a specific context

2.2.3. In practice

The selection of these solutions was made by several reviewers. Carrying out the reviews with these criteria led to evaluating the solutions and the projects as follows (two projects are included below, one accepted and one rejected).

Accepted project: MOODLE

MOODLE is a learning platform that offers educators, managers and students an integrated system to create personalized learning environments.

Reasons for acceptance:

- Addressed to one or several types of disabilities
- Developed to improve e-learning but can also be used for telework and telecare related activities
- Include accessibility features
- Launched and commercialized project
- Scalable (free of cost and open source)
- Can be used for other contexts (telecare and telework)

Rejected Project. LabVanced

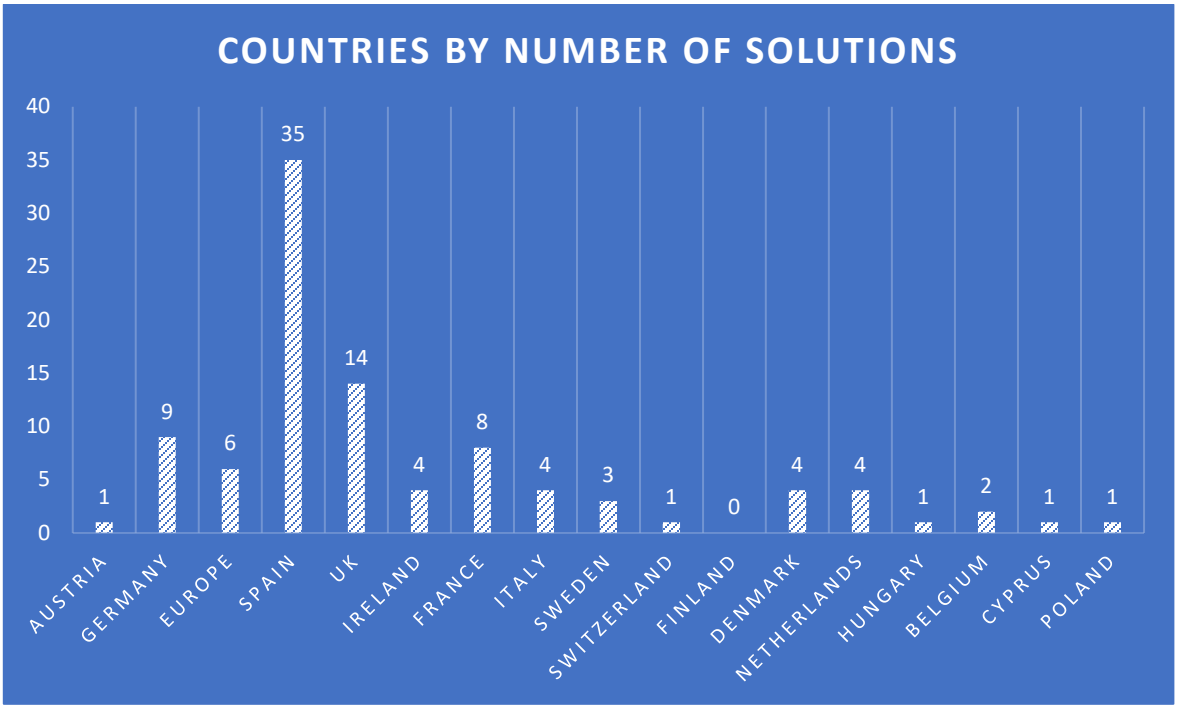
The Labvanced platform designed to design, carry-out and share experiments online. It allows researchers to design studies simultaneously to speed up the implementation time and prevents errors that individual users may overlook. The Labvanced platform is compatible with mobile/touch-screen devices.

- Not addressed to people with disabilities or with other similar needs
- Does not include accessibility features
- Not relevant with ACCESSIBILITECH's purposes (developed for uses other than telework, e-learning or telecare)
- Requires payment
- Not compatible with other technologies or operating systems

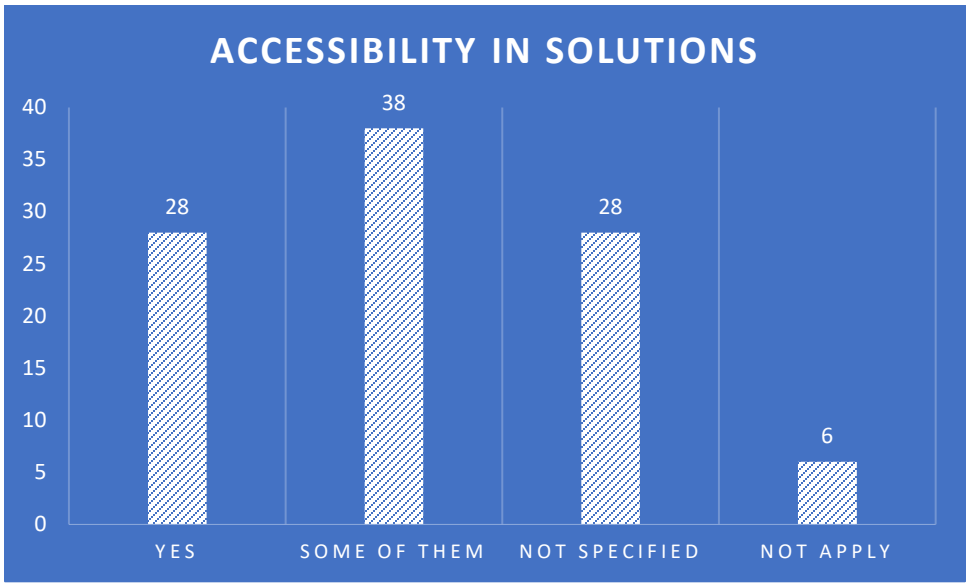
Finally, 33 e-learning solutions, 33 teleworking and 34 telecare solutions were selected. In the results section some more detailed aspects about them are discussed.

2.2.4. Results

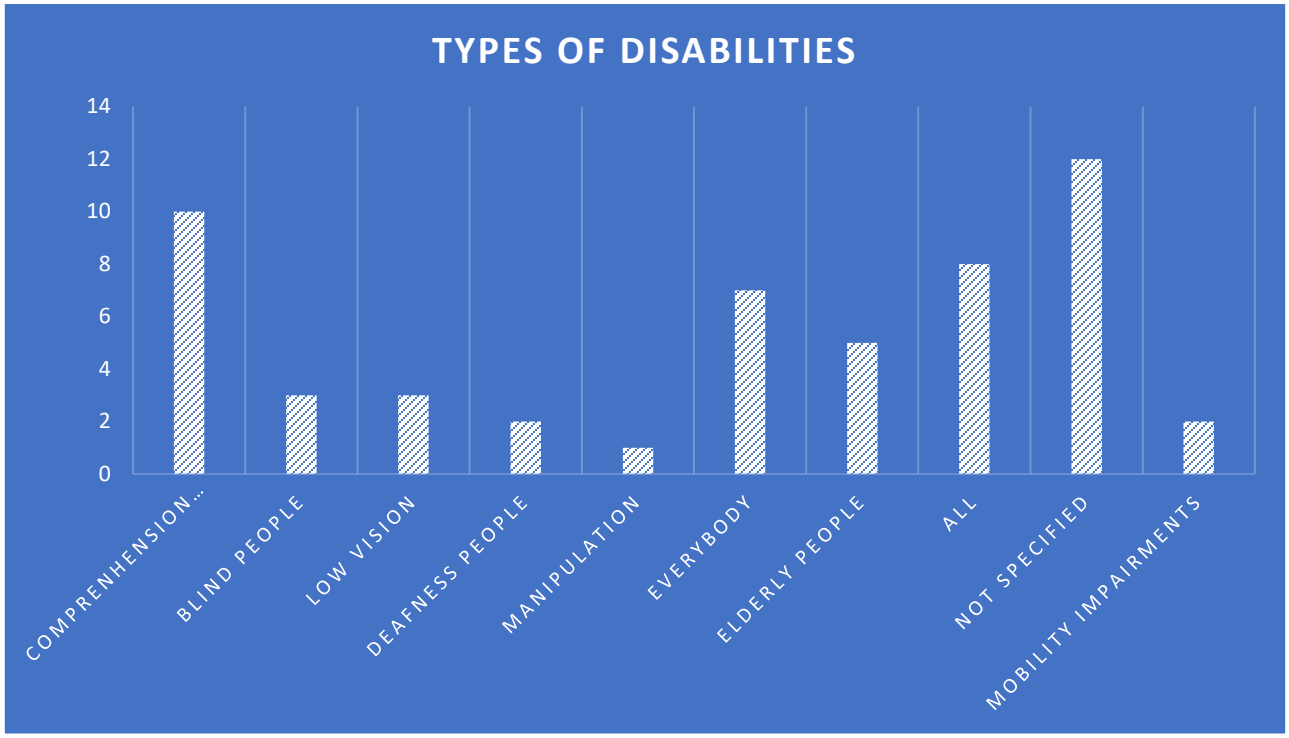
Regarding the 100 solutions chosen in the first phase, the following aspects can be commented in more detail:



The countries with the most solutions were Spain (35), UK (14), Germany (9), France (8) and the rest of Europe (34), you can see a category called Europe which is for projects within the union but does not indicate the leading country.



Regarding accessibility, 28 solutions out of 100 do cover accessibility, 38 only have some measures, while 34 solutions do not specify accessibility although they have it or do not apply accessibility.



This last graph shows an extract of the types of disability, most of the solutions are mainly focused on people with visual or cognitive disabilities, with hearing and physical or motor disabilities to a lesser extent. A large percentage of the solutions do not indicate the type of disability to which they apply.

2.2.5. Learnings

In the process of selecting 100 solutions, the main take-away was that there is no homogeneity in the data, i.e. there is no standard for solution developers to indicate disability profiles or accessibility, the information in the database is written in very different ways, which makes it difficult to group it or to get clear results.

This confusing information or that each solution will provide the data in a different way created a barrier for the reviewers who had to manage the information by pointing it in additional resources in order to structure the results, this was also tried to be solved from the algorithm, but only blind people could have 5 different ways in which people mentioned it.

Also, accessibility is still often neglected for different reasons: lack of information, lack of knowledge to apply accessibility, false beliefs about design for all, not understanding the terms accessibility and usability, not knowing how to disseminate accessibility, among other issues.

After selecting 100 solutions, 30 were to be filtered out, leaving only 10 solutions per category. This phase is specified below:

2.3. Working with 30 solutions

2.3.1. Aim of action

Last phase of the selection of solutions for the actions related to the hackathon, beta testing and optimization of the tool. In this phase the requirements were:

- All categories had to have only 10 solutions
- These solutions had to be balanced and be from several countries
- A vote would be made with all the partners at the end of this phase to select the best 3 (1 per category)
- The partners should have some comments on how the process of going from 100 to 30 had been done
- The criteria had to be ordered in such a way that the importance of some over others was understood.

2.3.2. As planned

In this last phase before the final vote, it was planned that the criteria would have a weight from highest to lowest as they are ordered below:

- **Criterion 5. Accessibility**
- **Criterion 1. Type of disability the product is targeted at**
- **Criterion 2. Relevance with Accessibilitech's focus area (telework, eLearning or telecare).**
- **Criterion 6. Scalability**
- **Criterion 3. Is it a technological product or service?**
- **Criterion 7. Transferability**
- **Criterion 4. Project maturity level**

2.3.3. In practice

In this last phase before the final vote of all the partners, the filter from 30 solutions per category to 10 was made by a group of accessibility professionals from various countries and various types of institutions (public, private, NGO, etc). In practice there were no big differences in what was planned since the errors or barriers were detected and how to solve them in this phase of the project as well.

2.3.4. Results

In e-learning the 10 solutions chosen for partner voting in the e-learning category were:

- Buddy from Austria
- BigBlueButton from Germany
- Atutor from different countries of Europe
- Tleo from Spain

- PlatformQ Education from different countries of Europe
- Moodle from different countries of Europe
- Open LMS from UK
- Etraining4all from Spain
- Accessjobs from Spain
- Increasing Communication Rates Through a Tactile Phonemic Sleeve (TAPS) from different countries of Europe

The solution selected by the partners of the project in the final vote was Accessjobs. You can see the complete evaluation in deliverable 3.2.c Evaluation report of the beta transfer of the eLearning solution.

In telework, the 10 solutions chosen for partner voting in the telework category were:

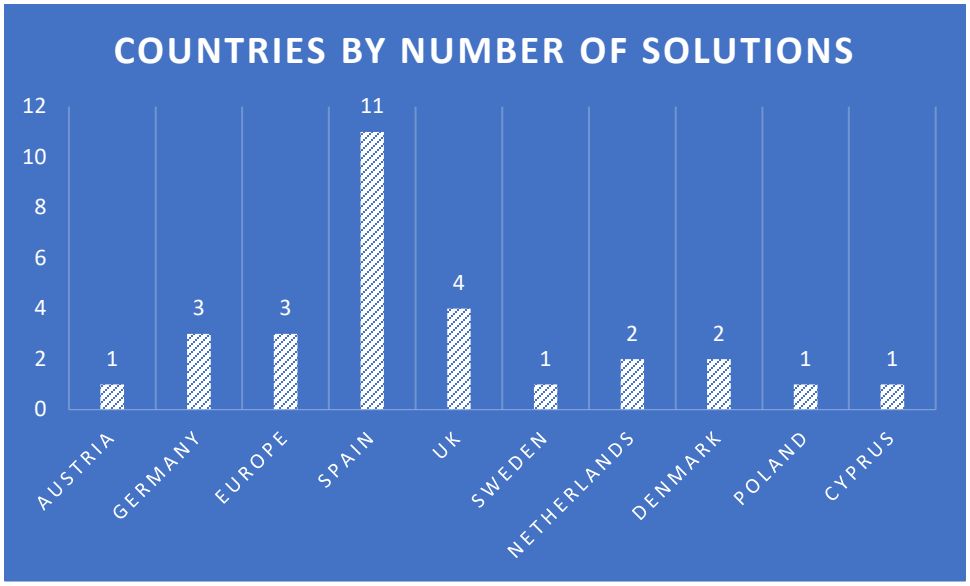
- Easy Reading: A Framework for Personalised Cognitive Accessibility when using Original Digital Content from Sweden
- Accessjobs from Spain
- Lucidspark from Netherlands
- Nextcloud Talk from Germany
- Teamtalk 5 Classic from Denmark
- Viadesk from Netherlands
- Webex Meetings from Denmark
- Microsoft Teams from different countries of Europe
- Zoom from different countries of Europe
- Confluence from Europe

The solution selected by the partners of the project in the final vote was Microsoft Teams. You can see the complete evaluation in deliverable 3.2.d Evaluation report of the beta transfer of the telework solution.

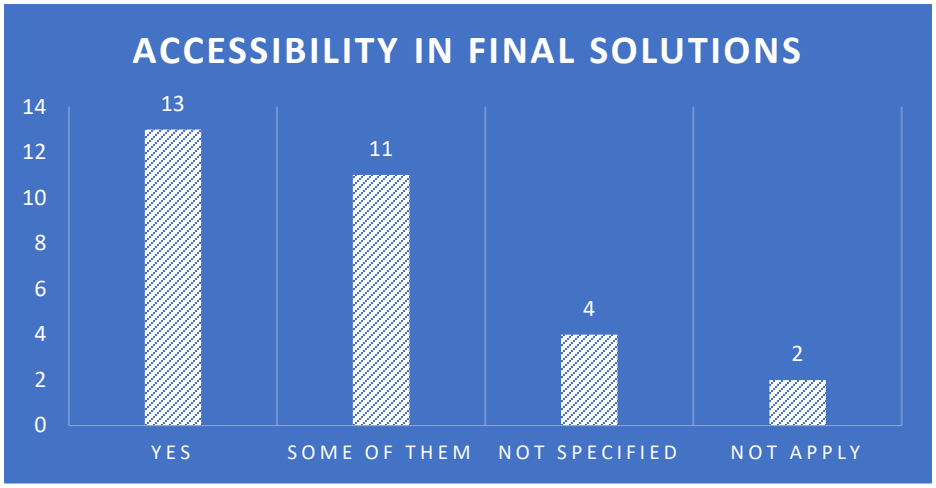
And finally, for telecare, the 10 solutions chosen for partner voting in the telecare category were:

- Talkitt from different countries of Europe
- SBIR Phase I from different countries of Europe
- Pauto from Spain
- I4case from Spain
- Good Support from Poland
- Brainbeat from Rusia
- Care Hub Package from UK
- Maximiliana from Spain
- Visualfy Places from Spain
- Smart Assist Project from Spain

The solution selected by the partners of the project in the final vote was Visualfy Places. You can see the complete evaluation in deliverable 3.2.e Evaluation report of the beta transfer of the telework solution.



In relation to the countries of these 30 solutions, more than 30% of them are for Spain, followed by the UK, Germany, and the rest of Europe



The order of the criteria is evident since, as planned, more than 75% of the final solutions have considered accessibility or some measures, the number of solutions that do not specify it or do not apply accessibility drops considerably.

Due to the heterogeneity of the information, a graph will not be included on this occasion, but in 95% of the final solutions the type of disability is specified, with most solutions being for everyone. Going back to highlight cognitive and visual disability, when the framework is not all.

2.3.5. Learnings

In the process of selecting 30 solutions, It was observed that more than 30% of the final solutions in this case belonged to the same country Spain, it was being debated and it is believed that in part it is due to the dissemination that the project was made in the country and it is also thanks to the number of entities dedicated to disability in the country that have wanted to show what they are doing in favour of disability, as well as the number of policies that public institutions implement.

This led us to ask ourselves to what extent there is homogeneity in the countries of the European Union about policies related to disability, especially:

- The European accessibility act is a directive that aims to improve the functioning of the internal market for accessible products and services, by removing barriers created by divergent rules in Member States. Businesses will benefit from: common rules on accessibility in the EU leading to cost reduction.
- EN 301 549 “Accessibility requirements for ICT products and services” is a European Standard. It defines the requirements that products and services based on information and communication technologies (ICT) should meet to enable their use by persons with disabilities.
- Web Content Accessibility Guidelines (WCAG) 2.1 defines how to make Web content more accessible to people with disabilities. Accessibility involves a wide range of disabilities, including visual, auditory, physical, speech, cognitive, language, learning, and neurological disabilities.

2.4. Design and update of the mapping tool

2.4.1. As planned

The initial definition of requirements was to create a web-based mapping tool to reflect the projects that can contribute to improve any of these categories and associate each one with the country where the company leading the project is located. This information should be represented then on a map to show the European Union (EU) contribution to these initiatives. With the help of some machine learning workflows, the tool would ensure to show the most relevant project candidates to the reviewers that would decide what projects should be shown in the tool.

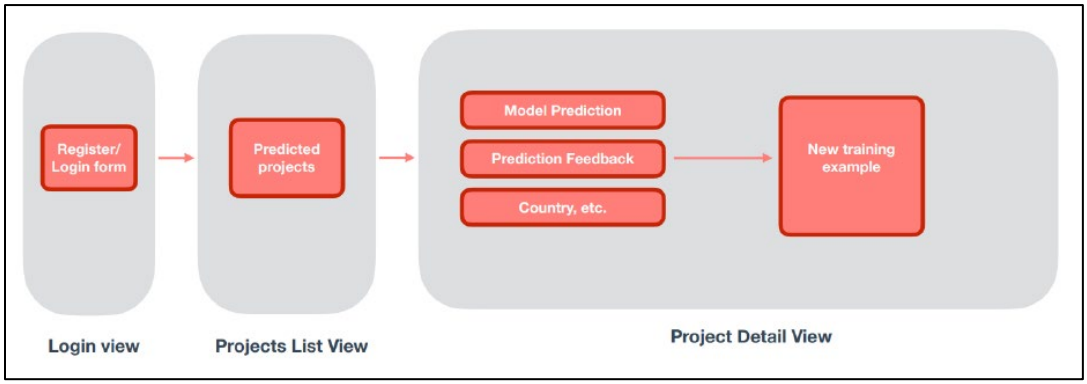
Later, due to accessibility needs, it was seen that other visualizations were necessary, such as being able to filter the projects in a list.

The Accessibilitech Mapping Tool was conceived as a web-based application that should be easily deployed in a public machine in the cloud. BigML has developed bmlapp, a library that uses some powerful frameworks and tools and creates a scaffold for a generic ML application. The main components used in that library are:

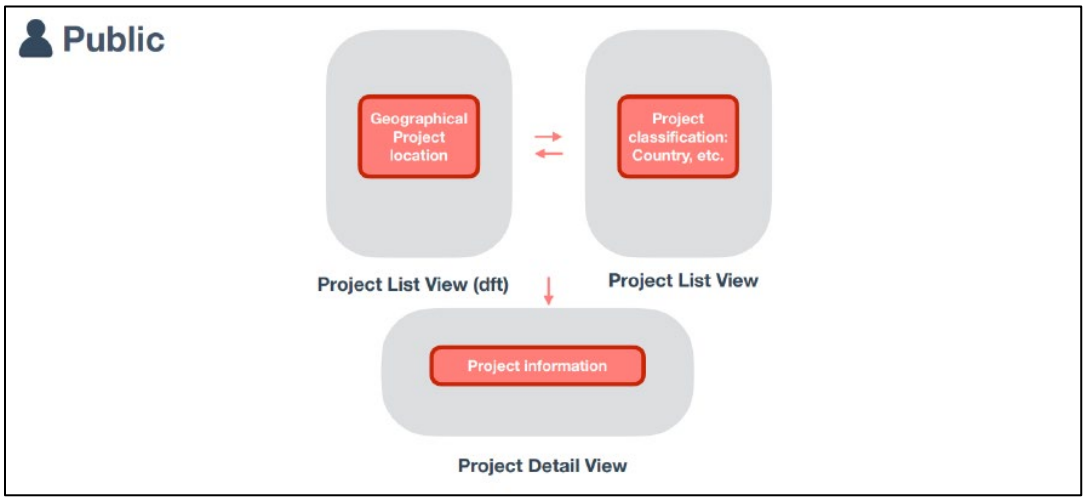
- Docker as deployment orchestrator
- Django as http application framework
- PostgreSQL as database
- Other utilities like Silk, Celery and Swagger to handle a synchronicity and monitoring.

The first development weeks were spent adding the required dependencies, environment variables and configurations needed for the current application and generating a minimal working app prepared to add the different modules mentioned in the previous section.

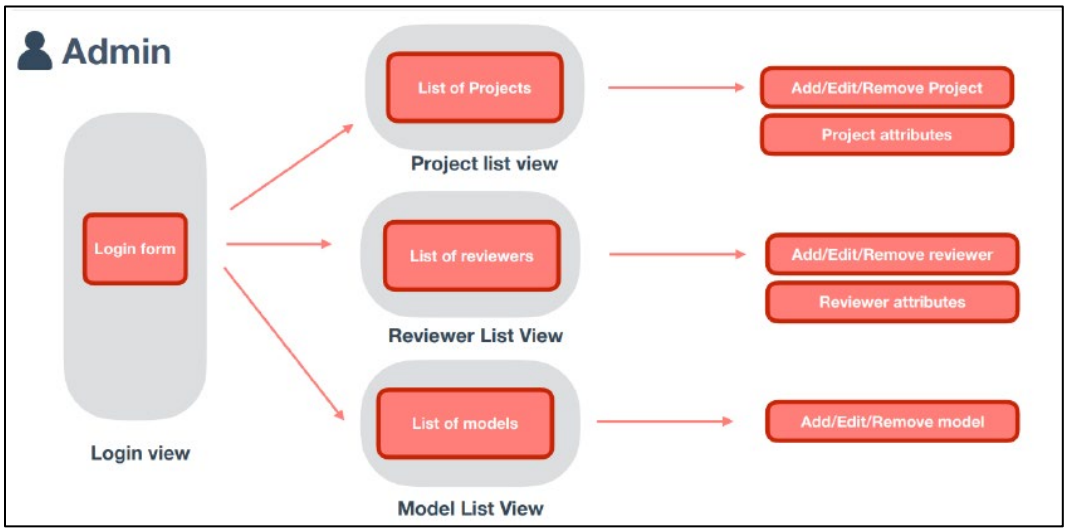
Inserta Innovación asked for a back office for their team that enabled them to review the projects automatically collected and labelled and edit some of their properties (keywords, related types of disability, etc.). The back office should only be available to authorized people and would have access to all the projects in the database (allowing reviewers to filter just the ones that require a review). Therefore, a new module was needed to manage user's authorization and project editing.



Finally, the main part of the application needed a web-based Mapping Tool that could be used to locate the projects in the EU map as well as listing a summary of their properties when selected. This, of course, should be a public interface, where only EU-related and reviewed projects should be displayed.

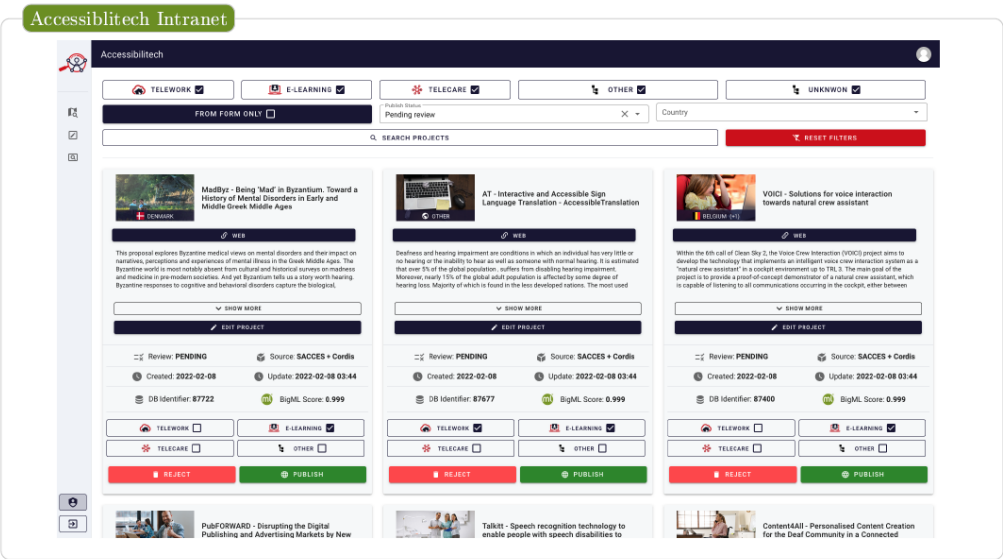


Additionally, some administration views should be added to allow adding new reviewers and monitor the labelling process results.



2.4.2. In practice

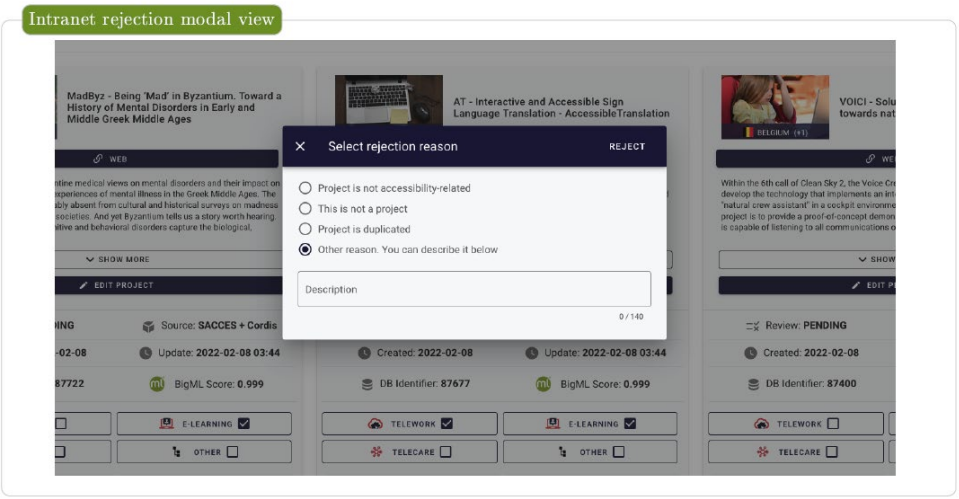
The intranet allows reviewers to check project candidates and publish or reject them. If there is some information missing or incorrect, they will be able to modify it before publishing the project.



To ease daily work, reviewers can apply different kinds of filters so that they can focus on a specific subset of projects. With the default filters value, reviewers will see all candidate projects, ordered by the score that the automated labelling workflow assigned to them (in descending order).

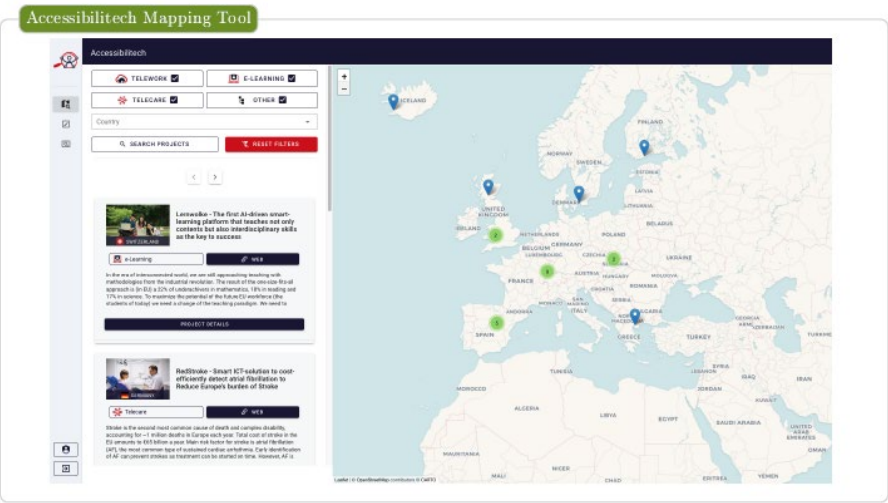
For each project, reviewers will be able to publish it, reject it, change its topics, or even modify its information. If a reviewer rejects one project, the system will ask him for the reason.

For traceability reasons, information about the user that published, modified or rejected each project will be stored in the database.



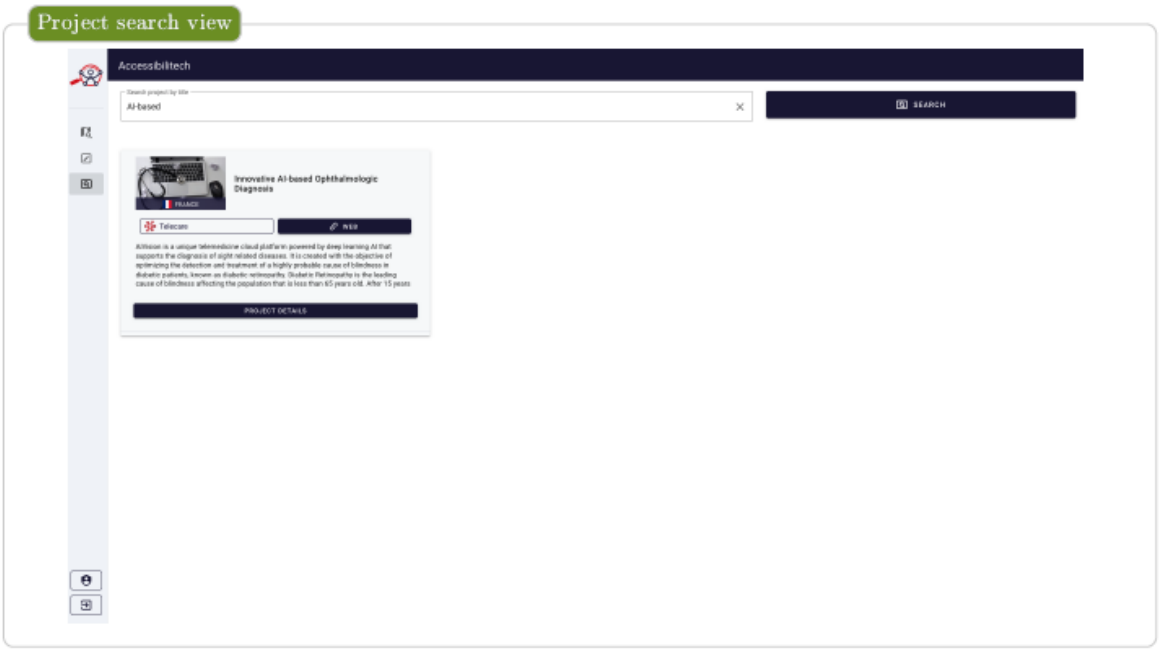
Some information such as project budget or the list of companies behind it is hidden by default. Reviewer will have to click Show More button to see all project details

The public mapping view shows, side-by-side, a list of public projects and a map with the location of each project. To ease map visualization, nearby projects are clustered and shown as a single marker, but that cluster will disappear when the user zooms in the map, and the actual positions of projects will be shown.



As within the intranet, a user can apply some filters to show only a specific subset from the public projects. Project's detail view shows all the project information.

A specific project can by searched by its name with the Search view.



2.4.3. Results

In the end, as a result, a mapping tool was obtained that met all the accessibility levels of the WCAG 2.1 standard up to level AA.

Understanding WCAG 2.1 is an essential guide to understanding and using "Web Content Accessibility Guidelines 2.1" (W3C Introduction to Understanding WCAG 2.1 , s.f.). Although the normative definition and requirements for WCAG 2.1 can all be found in the WCAG 2.1 document itself, the concepts and provisions may be

new to some people. Understanding WCAG 2.1 provides a non-normative extended commentary on each guideline and each Success Criterion to help readers better understand the intent and how the guidelines and Success Criteria work together. It also provides examples of techniques or combinations of techniques that the Working Group has identified as being sufficient to meet each Success Criterion. Links are then provided to write-ups for each of the techniques.

The guidelines and Success Criteria are organized around the following four principles, which lay the foundation necessary for anyone to access and use Web content. Anyone who wants to use the Web/App must have content that is:

1. **Perceivable** - Information and user interface components must be presentable to users in ways they can perceive.
2. **Operable** - User interface components and navigation must be operable.
3. **Understandable** - Information and the operation of user interface must be understandable.
4. **Robust** - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.

WCAG 2.1 has several levels of conformance level A, level AA and level AAA. You can find more information about this standard in the official website.

2.4.4. Learnings

In this case, the ONCE Foundation and Inserta Innovación had to provide in-depth consultancy and advice to the external experts on machine learning contracted to prepare this tool on web accessibility, as there are certain aspects in the development of websites that do not comply with accessibility standards in their entirety:

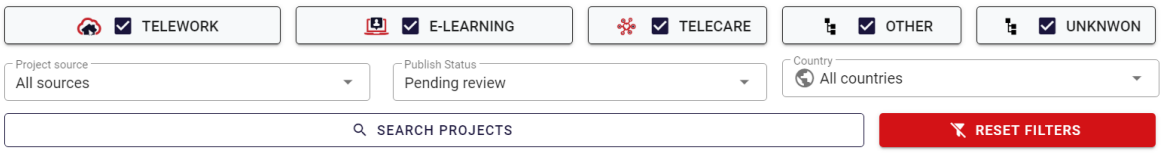
- Create a list as a complement to the map to not depend on an option
- Inclusion of representative icons in all the necessary elements
- Error management in forms facilitating usability when filling them out
- Navigation order control
- Cancel decorative elements
- Facilitate the reading and review of projects through interactive cards
- Measure the contrast between font and background colours
- Include invisible headers to facilitate navigation with a screen reader
- Adjust the combo box and checkbox of the filters to ensure accessibility
- Enter only the necessary information according to the context

This demonstrated within the partners of the project, as on many occasions third sector companies do not have a high level of accessibility when developing products and services for persons with disabilities, in the case of the external

provider, the predisposition of the entire team was fully to make the tool as accessible as possible. Needing training and knowing the legislation to comply with in order to achieve software products with a universal design.

In this case, it was not a requirement when hiring the provider, since the team needed an expert in machine learning, open to learning about accessibility, since this was in the core of the lead team of the Fundación ONCE project and WP2 Inserta Innovación.

Different user tests were carried out since, especially in the map view, it took a greater effort for screen reader users to be able to navigate through this view in a coherent way and with a semantic sense within what the tool wanted to transmit, performing up to 3 different iterations of this screen, in what concerns code and accessibility and not so much aesthetic appearance.



3. Conclusions

The Active listening tool and it´s resulting online-mapping tool has been one of the main products developed within the Accessibilitech project. The general objectives of this package are: To set-up a European technology surveillance team specialized in identifying, analysing, and disseminating accessible technologies, to establish a listening tool combining electronic and human capacities, and design and launch an online mapping tool specialized in three thematic areas.

Throughout this report, different parts of the tool have been developed in depth:

- The algorithm, which has been developed by the company BigML and which has used Machine Learning techniques with the aim of being able to obtain from different project repositories, together with keywords, projects or solutions that had to do with the three thematic areas of this project: eLearning, telework and telecare. Some of the techniques used by the service provider were: Unsupervised machine learning models, like Topic Modeling to find keywords and topics or Clustering to look for similar projects and reduce the number of projects to be reviewed
- The interface of this web tool has also been detailed, explaining the different elements it contains, map, list, manual form and even intranet, within the interface there are several management roles among which are:
    - Administrator
    - Reviewer
    - User

  It has also been discussed how the accessibility standards have been applied, in this case governed by WCAG 2.1, Web Content Accessibility Guidelines.
- The result of obtaining the best solutions for two processes within the project such as the hackathon and beta testing, together with demonstrating the reliability and efficiency of the algorithm and the tool to find projects that improve the quality of life of people with disabilities in the three areas.
    - Identify 100 solutions, with different data related to requirements, countries, types of solutions, etc...
    - Identify 30 finalist solutions detailing what they are, where they come from and a brief description of each. As well as some graphs with conclusions from this analysis.

The Mapping Tol developed in the project now hosts more than 50,000 solutions that have been identified by the Active Listening tool algorithm. These include automatic and manual solutions that have been analysed by the team of accessibility and disability professionals (European Technology Surveillance Team) and categories into those rejected, those pending evaluation and those selected for the public section of the mapping tool having passed the establish criteria. The process of selection and inclusion of manual solutions have aided in

optimising the algorithm for the improvement of its automatic filtering. 810 of the solutions found by the Active Listening Tool were approved and included in the mapping tool, of which 144 came from the manual entries. Regarding the three areas of interest, 354 solutions were approved in telework, 462 in telecare and 348 in eLearning (it is important to note that some of these solutions apply to several themes).

One of the most important issues on which this report has focused has been the issue of results and learning. This project has had an important component of innovation and for this reason it is so important that this type of results and learning can be collected with the aim of making them applicable or other projects that address the issue of disability and can continue to improve from the contributions of this Accessibilitech project and this tool.

ACCESSIBILI TECH

Solutions improving lives

Funded by
the European Union

This project has received funding from the European Union's Rights, Equality and Citizenship Programme (2014-2020).