AI Living Lab Report

November 2022 - GPAI Tokyo Summit

GPAI / THE GLOBAL PARTNERSHIP ON ARTIFICIAL INTELLIGENCE

This report was developed by Experts and Specialists involved in the Global Partnership on Artificial Intelligence's project on the AI Living Laboratory to Experiment Use Cases at the Workplace. The report reflects the personal opinions of the GPAI Experts and Specialists involved and does not necessarily reflect the views of the Experts' organisations, GPAI, or GPAI Members. GPAI is a separate entity from the OECD and accordingly, the opinions expressed and arguments employed therein do not reflect the views of the OECD or its Members.

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Introduction / Objective

The Future of Work (FoW) Working Group (WG) started its work in 2020 with the objective to analyze how AI affects the worker, and how one can improve the AI/human cohabitation in the workplace. In 2021 the FoW WG launched two projects, (i) the AI observation Platform collecting use cases of AI at work, and (ii) AI for Fair Work, a project aiming to propose principles for a fairer AI at work.

With that in mind the AI Living Lab, launched in 2022 and presented below, has found its place in the activities of the WG.

The AI Living Lab would make available to a large public the use cases collected in the AI Observation Platform project. These use cases could then be confronted with the principles of the AI for Fair Work project and thus launch discussions on how to make AI fairer at work.

The goal of this lab is to help interactions between workers, about the impacts of AI at work, but also within companies. The choice was made to create a website, that had to be interactive and went beyond an informative website.

Creating such a platform can ensure collaboration among teams across the globe. Beyond industrial collaboration or tools to connect, this can be a possible meeting place for experts and learners across domains. Respecting users' privacy concerns, this platform is intending to build a safe and secure solution.

Thus, the goal is to foster scientific collaboration and information sharing through metaverse. Few identified objectives for the project are:

- To encourage groups of individuals to interact and have open discussions about common interest areas,
- To bring positive change and have future goals to establish together,
- To foster collaboration and allow the transfer of knowledge in an agile manner which is accessible to everyone,
- To open discussions leading to new doors to the future of AI and fresh perspective on different problems.

Living Lab Presentation

A growing attraction can be seen for new technologies such as AI and even the metaverse. This new dimension will imply the creation of platforms, meeting places, that are enabled to collaborate, to understand, to help the workers, experts and learners to thrive in increasingly complex digital tools and subjects.

The ambition of this project is to create a Living Lab that will be a place for experimentation to address societal challenges around the contribution of AI to the Future of Work. The objective is to propose a virtual Living Lab allowing to experiment, validate, and prototype AI technologies.

The tool has been designed to provide the following functionalities:

- A search functionality to access:
    - Actual case studies (or links to them) of the AI Observation Platform Project,
    - Additional use cases of specific identified areas, e.g., chatbots, library of videos, and learning/skilling resources,
    - National reports/publications/Living Lab initiatives related to Future of Work

from participating GPAI Members.

- A connection to an international community to connect, share, collaborate and get help on AI topics.

Several phases have been defined to build this platform, but also to get the support of the different stakeholders who will make it live in the short, medium and long term.

The currently ongoing Phase 1 consists in the design and development of a **"minimum viable product" (MVP), the Mini Living Lab.** A team of students in India and France was enrolled in the development of this phase.

This platform is built as a website that can be accessed via a mobile device, tablets, laptops and desktops. It will include the following contents together with a search functionality:

1. **Use cases** of specific identified areas such as Health care, Manufacturing and Education,
2. A **chatbot** trained to inform on GPAI and the AI Living Lab. The chatbot can also be used by existing users to interact with other users or in groups,
3. **Video feeds** of Physical Living Labs,
4. **Communities** focused on specific topics related to the Future of Work with AI,
5. National reports, International **reports/publications/Living Lab initiatives** related to the Future of Work with AI.

The STEM (Science, Technology, Engineering and Mathematics) students contributing to the development of Phase 1 are strengthening the larger students' community of the Future of Work Working Group.

The experience of building this MVP will provide the insights and foundation for future phases.

Key Performance Indicators

To measure the success of this project, the following indicators have been identified in the following order of priority:

- Range of tools and solutions available (Augmented Reality and Virtual Reality (AR/VR), learning sessions, interactive use cases review),
- Number of AI Labs that have joined the AI Living Lab, whether in the provision of video feeds, in the number of communities created or their exchange with other site visitors,
- Number of use cases available,
- Number of visitors per day.

User research and system understanding

The development of the AI Living Lab requires much effort and cross domain knowledge. To this end, the background of the entire team identified was a mix of students from Design, AI and Electrical Engineering backgrounds

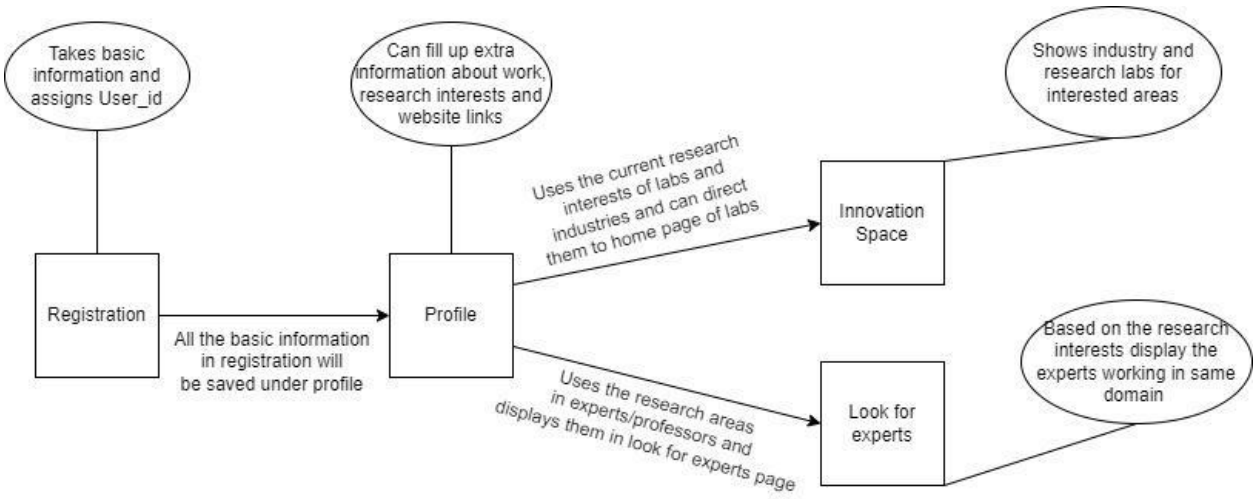
Understanding the requirements and possible means was an important starting point. To this end, several brainstorming sessions were conducted, as well as user profile related case studies and analysis of similar developments.

The current solution provides rich interaction capabilities to users (text, video). Developed

web applications have several components tied together like web, video, chat, etc. MySQL (an open-source database management system) is used for database services as it supports faster development and integration.

Information Architecture

This section discusses the flow of the user data in the website, starting from registration, to all the spaces where the input is taken from the user. This data will be used for storing the registration details of users, and for querying specific topics (for example, Look for Experts and Innovation Space). Below is the architecture of the data that will transit through the site. It is the diagrammatic representation of how the data is managed throughout the whole data life from user inputs to the provision of AI Living Lab resources.



First, the user enters some data in the following steps:

1. Registration of User

   For a user to register to the website, the following information are collected:

   - Name,
   - Location,
   - Company/Institution,
   - Designation,
   - Email,
   - Set Password.

   This data will be stored in the host Database, MySQL through backend.

2. Updating Profile

   Apart from the information given while registering, the following information can be collected in the profile section:

   - Research Interests,
   - Projects,
   - Past publications.

Then these data are used to feed the following sections:

1. Innovation space

   The past projects and publications of top labs/companies who are willing to be public are displayed in the Innovation Space.

2. Look for Experts

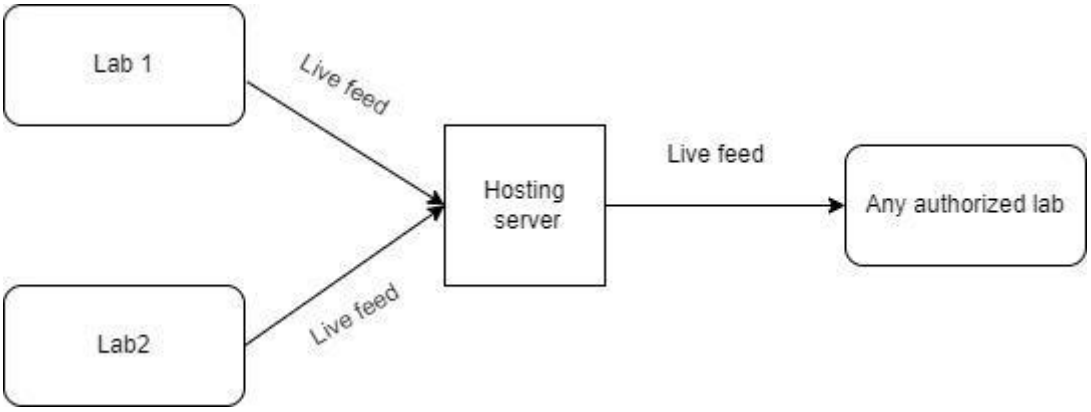
In the Look for Experts section the experts are presented by research interests, using their projects and publications that are on their profile public.

Video feed

Several tools were considered to improve the user experience and immersion in the AI Living Lab. Video feed was chosen as it would allow experts to collaborate in their research and enrich their interactions. One technical solution, with a focus on the community aspect, is the live broadcasting of videos from the physical Living Labs of the project partners and others participants willing to collaborate.

Using an IP based camera (a type of digital video camera that receives control data and sends image data via an IP network), live feeds of various labs are taken and sent to labs that want to access the feed through the host.

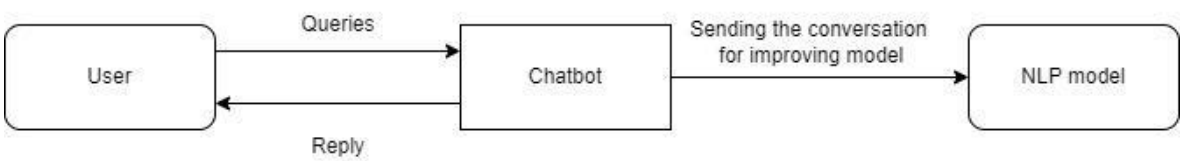
No data or live feed will be saved in this process, parts of the lab or the people of lab can be segmented when the live feed passes through the host for any privacy concerns.



Texting in Chatbot

For the initial phase the chatbot is able to answer a fixed set of common queries related to the Living Lab. A similar question can be asked in multiple ways by different users, so the chatbot will use a Natural Language Processing (NLP) model to understand what the user is asking.

When the user asks any new queries or anything that is new for the model, the model will filter and embed in the chatbot new questions and answers to improve the chatbot.



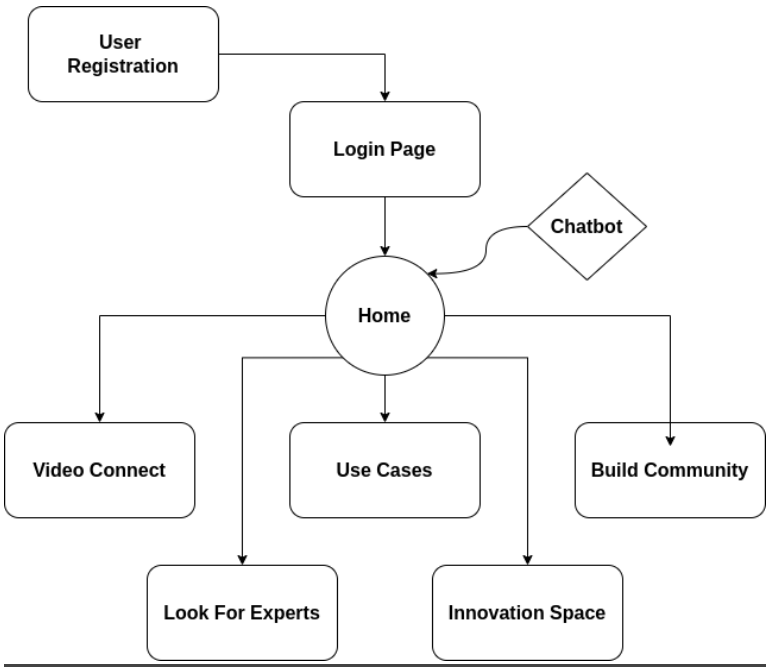
Proposed Solution

To build this web application, node express (a back-end web application framework for building APIs with Node.js) backend servers were used for the skeleton of the platform. Then necessary features were incorporated into the web application, like Video Connect, User Login and Profile pages, Chat Bots and Look for Experts page.

After logging in, the user has access to the main menu and the following resources:

- Video Connect,
- Look for Experts,
- Use Cases,
- Innovation Space,
- Build Community,
- A chatbot that is at the users' disposal throughout their experience with the Living Lab.

The flowchart below shows the possible navigation of the user between different components of the Living Lab.



Design

Design dedicated to the AI Living Lab has been conceived, notably using the GPAI color code. The screenshots below reflect designs created for the main pages of the AI Living Lab, which are, of course, subject to change. The design is created by keeping in mind the usage of community as a factor and ease of use for a user. It will be enhanced over a period of time according to the content.

Back end

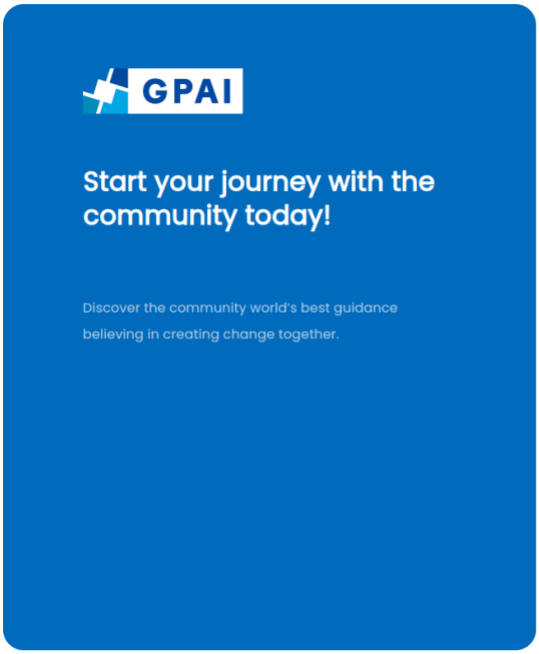
Most of the data return functionalities are completed through a backend Application Programming Interface (API) call (a piece of code that requests data from another software). Express backend service tied to MYSQL database are used for the following tasks:

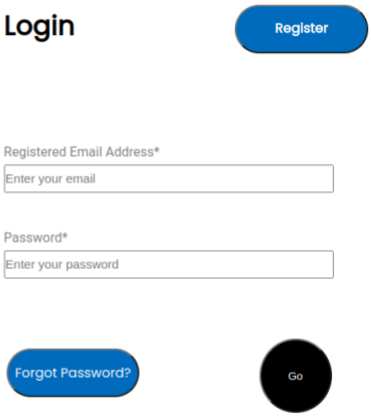
- User Login and Registration: The username and passwords are stored and retrieved to the server via suitable API calls.
- Chatbot: The NLP model is initialized on the backend and the responses are rendered by suitable socket io based API calls. This section is kept separate to reduce the delay in chatbot response.
- Community Building: The options for sharing the website link through different social connect platforms are done with the help of API calls.
- Video Connect: The registry for maintaining a dictionary of labs and their corresponding stream links are hosted on the server backend.
- Innovation Space: The updates of related events and other relevant information procured by web crawlers are stored on the backend and portrayed on the frontend as required.
- Look for Experts: The data for different profiles is saved in the backend server and accessible whenever relevant context is searched for.

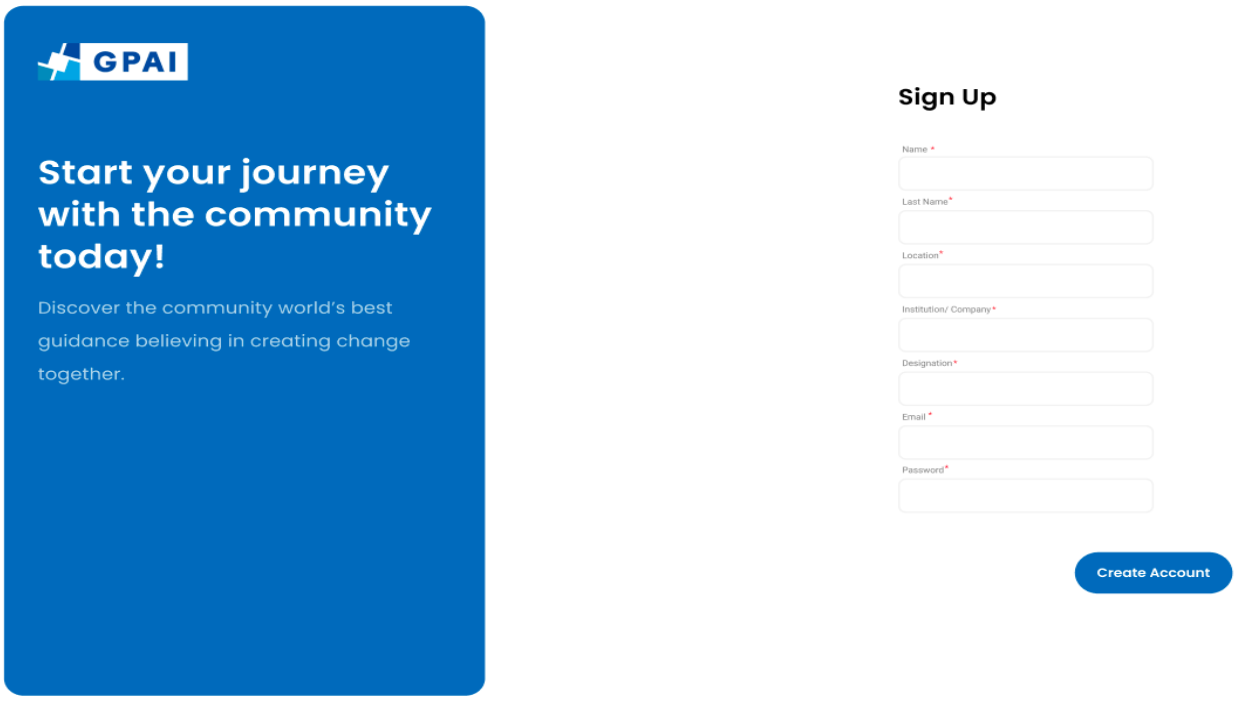
User Interface (UI)

UI pages are built using a well-known JavaScript library called React js, incorporating the designs developed. This communicates with the backend to complete any data retrieval/insertion process.

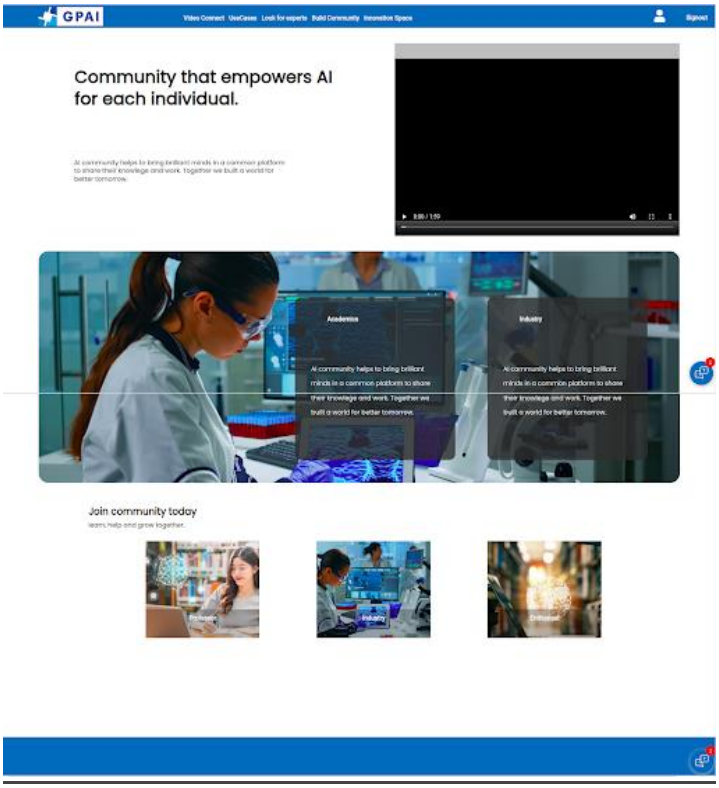
- **Login Page**
  The user can log in and become a living actor of the lab after registration. He clicks on the “Login” button to connect himself.

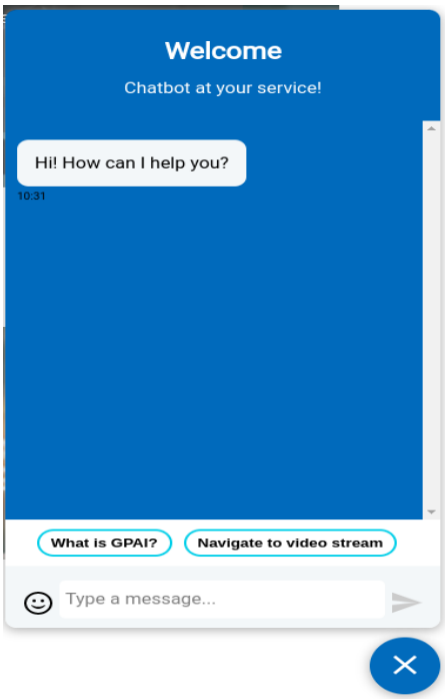






- **Home page and Chat bot pop up window**
  The GPAI logo is displayed to remind everyone that the Living Lab is linked to the Global Partnership on AI.
  In the bottom right of each page, there is a chatbot which can be used by the users if they have a question or if they are looking for something.
  On the top of the home page, tabs are guiding the user in the website. All tabs appear on every page to always guide the user.





- **Video Connect page**
  This page serves as a common platform to share the video feed of one's lab with others to collaborate their research and enrich their interactions. This will help in a collaborative work approach and reaching positive results in a short time.

- **Use Cases page**
  This page will give access to use cases gathered around several sectors:
  - Healthcare,
  - Industry,
  - Education.

  In the future, more domains will be added on the list.

- **Look for Experts page**
  Users can connect to AI specialists using this page to find them by name, institute, or skill. This will assist a user in locating the appropriate person of contact for the pertinent task or use case in which they are interested. Additionally, it will aid professionals in their quest to learn more.

- **Build Community page**
  The main goal of the Living Lab is to have interactions between AI users at work. That is why it was decided to make rooms for discussions. Rooms were created for “Community” based on sector of activity: aeronautical, space, sport, medicine and industry to start. More could be implemented when the website will be running, the objective is to represent all jobs that use AI.

- **Innovation Space page**
  This page lists the most recent developments and advances made worldwide in the field of Artificial Intelligence. Users can keep informed about new developments in the rapidly expanding field of AI. They can also use it to build on previous research or consider future prospects.

Software and Hardware understanding

Software requirements

Software development was done using React js and express node server in the frontend and backend respectively. Packages used were ensured to be open source npm packages. More details can be found in Appendix Table 1.

Hardware requirements

Camera Options to host a lab:

- IP web camera,
- Android mobile phone with IP webcam app server running.

Local Server Hosting:

- Ubuntu-18/Windows OS,
- RAM -4GB (minimum),
- 500GB HDD.

End User / Client:

- Laptop/ Desktop,
- Web camera,
- Microphone.

Online Server Preferences:

- Bluehost,
- Netlify.

Database:

- MYSQL.
  List of API are covered in Appendix Table 2 for reference.

It is important to highlight that Internet connectivity will be crucial as data handled include text, video, etc., which requires high bandwidth.

Limitations and Possibilities

In this implementation of proof of concept for AI Living Lab, a web application has been developed. Through user analysis, it has been identified limitations of the current implementation and possibilities as below:

- Genuine users: How to validate genuine users? At present users will be validated through their institute mail or other genuine and active members of the institute.
- Active Participation: Even though the AI Living Lab is aimed at work collaboration and information sharing, not all end users may provide all the details. Users contributions being awarded by some recognition or badges in the AI Living Lab community might motivate people to be active contributors.
- Building trust: Data privacy is one of the utmost concerns for any users on the web. As this platform supports video feed, people would be worried about personal identifiable data being stored, shared or used by third parties, etc. In the current implementation, the user is not tracked and his data is not shared for any unrelated activities.
- Limitations in tools: As a proof of concept, focus was on creating a web application that can be accessed across the world. with tools like React Native that support iOS and Android apps. The platform can also be accessed on mobile phones, but screen layout may not be the same as with web browsers.
- VR and AR possibilities: AR/VR (Metaverse) capability is now of more interest to users across the globe. It gives a better user experience. Possibility of scaling to VR functionalities requires building applications using tools like React 360/ React VR/ Unity. Methods to link them with normal applications are also limited.
- Language: Currently the webpage is supported in English only.
- Resource Scalability: In its current state, the site can support a limited number of visits. But with a growing number of visitors, resources will have to be increased to ensure a good experience of the site. Video broadcast and connect features would demand more resources. Network load balancing can be ensured by a better hosting platform like Bluehost/ Netlify or through Nginx on a local server.

Summary of Work

The complete development journey of AI Living Lab was a new experience for the team. The overall idea and the features to be included were identified through several rounds of discussions and collaboration. In the current implementation, the features developed are a chatbot, search for experts, video broadcasting, design elements, use cases, etc. as components to help the user.

The key learning was that such a lab must be scalable, secure, safe, easy to navigate and built from open-source components. Collaboration and sharing of information could pave the way to even more powerful solutions to problems that were encountered in the work. This can be foreseen as a solution to connect remotely to a working lab and closely work with them. This could be helpful in periods of pandemic or other calamities. Through Live broadcasts from AI Labs, users could see how labs work, which would especially help students to understand the nature of work and adapt to different work cultures. This helps in bridging the initial dilemma for students joining any research labs for work.

Throughout the development journey, many challenges were faced, especially from identifying what should be incorporated in the AI Living Lab to incorporating the feeds of the camera, getting the chatbot working, etc. The requirement for an end user to access the AI Living Lab, is simply a laptop/desktop or mobile with good internet connectivity.

Extending to AR/VR (metaverse) based functionalities and porting to a mobile based application (using React Native) are few possible extensions of the work.

As the AI Living Lab continues its activities in 2023, the following phases could be undertaken. The following phases has been presented to the Council in the 2023 Work Plan and are subject to its approval during the 2022 Tokyo Summit in November.

Phase 2

Going from Q1 to Q3 2023, phase 2 could consist in the design and development of a demonstration prototype of the interactive platform.

Additionally, to the resources included in the Mini Living Lab of Phase 1, this interactive platform could include **interactive resources**. These could be related to chatbots, AR/VR, skills/learning, and tasks/skills/jobs that have the potential for international impact.

This demonstration prototype would allow the WG to contact potential partners and sponsors and to formulate the strategy to undertake Phase 3.

Phase 3

Going from Q4 2023 to Q1 2024, phase 3 could consist in the design and development of a collaborative platform on top of the demonstration prototype.

This collaborative platform could include:

1. Features that allow for exchange of ideas and/or for communities of interest/practice to form AI communities,
2. Online spaces for collaborations on projects (these projects could possibly be curated before approval),
3. Integrating the above two points with in-person Living Lab initiatives examples, there can be "hybrid" projects where there is seamless collaboration online and in-person across countries.

Phase 4

Phase 4 would consist in creating and developing a network of virtual and physical laboratories of GPAI members and even beyond.

Appendix

Table 1: List of currently used open source packages with license and version.

Name of package	Version	License
@cycjimmy/jsmpeg-player	6.0.3	MIT
@fontsource/poppins	4.5.9	MIT
@fontsource/roboto	4.5.8	MIT
@fortawesome/fontawesome	1.1.8	MIT
@fortawesome/fontawesome-free-solid	5.0.13	CC-BY-4.0 AND MIT
@fortawesome/fontawesome-svg-core	6.1.1	MIT
@fortawesome/react-fontawesome	0.1.18	MIT
@tensorflow/tfjs-converter	3.18.0	Apache-2.0
@tensorflow/tfjs-core	3.18.0	Apache-2.0
@testing-library/jest-dom	5.16.4	MIT
@testing-library/react	13.2.0	MIT
@testing-library/user-event	13.5.0	MIT
axios	0.27.2	MIT
body-parser	1.20.0	MIT
body-pix-react-render	1.0.10	MIT
cors	2.8.5	MIT
csv-parser	3.0.0	MIT
csv-writer	1.6.0	MIT
firebase	9.6.1	Apache-2.0
iotcomms-react-webrtc	1.0.10	MIT
mysql	2.18.1	MIT
node-nlp	4.24.0	MIT
node-rtsp-stream	0.0.9	MIT
nodemailer	6.7.5	MIT

react	18.1.0	MIT
react-chat-widget	3.1.4	MIT
react-chat-window	1.2.1	MIT
react-dom	18.1.0	MIT
react-icons	4.4.0	MIT
react-player	2.10.1	MIT
react-router-dom	6.3.0	MIT
react-scripts	5.0.1	MIT
react-select	5.4.0	MIT
react-share	4.4.0	MIT
react-simple-chatbot	0.6.1	MIT
react-speech-recognition	3.9.1	MIT
rss-parser	3.12.0	MIT
rss-to-json	2.1.0	MIT
rtmp-player	1.0.6	MIT
seedrandom	3.0.5	MIT
socket.io	4.5.1	MIT
socket.io-client	4.5.1	MIT
styled-components	5.3.5	MIT
videostream	3.2.2	MIT
web-vitals	2.1.4	Apache-2.0
webpack	5.74.0	MIT

Table 2: List of currently used and foreseen API.

Service	API	Type	Parameters	Result	Implementation Status	DB access
User validation	/validate_user	POST	Email, password	Success/ Failed	Added	Yes
User registration	/add_user	POST	First Name, Last Name, email, password, designation	Success/ Failed	In progress	Yes
List all use cases	/get_usecases	GET	-	Dict with information about all use cases	TBD	Yes
Build Community	/invite	POST	Name, email, remarks	Sent / Not Sent	Added	No
Registering a lab	/add_lab	POST	Name, institute name, camera web URL, work domain, faculty	Not Added / Added	Added	Yes
Add use case	/add_usecase	POST	Name, picture, short description, zip file with all reports.	Not Added / Added	TBD	Yes
Chat response	new-msg	Socket event	Query text	Response	Added	No
To get camera URL of a lab	/get_url	POST	Lab name	URL / No link found	Added	Yes
List all registered labs	/registered_labs	GET	-	Dict with details of all lab	Added	Yes
List all matching labs	/innovate	POST	Query	Dict of all academic and industrial labs	Added	Yes
Get rss feed	/feed	POST	Rss URL	feeds	In progress	No

Team Description

Team from India (IIT Hyderabad)
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Tadipatri Uday Kiran Reddy	
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Team from France
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