

# Using ICT tools and AI for the social and financial integration of migrants into local societies

CREATIVE TECHNOLOGY, EEMCS  
BAUR ONGARBAYEV

Supervisor: dr. Andreas Kamilaris

Critical Observer: dr. Marcus Gerhold



# ABSTRACT

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In the current state of the world, the circumstances of global migration keep steadily accelerating. This research attempts to address the challenges faced by migrants in their journey towards social and financial integration by harnessing the capabilities of Artificial Intelligence (AI). The main research question addressed in this project is, “How can AI technology and large language models (LLM) help migrants with social and financial integration?”

First, the study examines existing ICT solutions intended for migrants and what can be learned from them for further advancements. Exploring new technologies the project reaches an ultimate decision that LLM can be used for creating an AI-driven chatbot designed to assist migrants. It can help with language, cultural adaptation, and financial literacy, the most prominent hurdles during integration. This chatbot has access to specific types of data related to the problems and will assist in solving them. Through a Human-Centered Design approach, the chatbot was iteratively developed and refined to cater to the diverse needs of the migrant population.

While developing a prototype chatbot various systems were implemented such as text splitting, embedding and vector storing. After designing and building a working prototype, several experiments were conducted to assess the system's usability, employing key performance indicators (KPI), and indicating positive outcomes. Users found the chatbot to be easily comprehensible and navigable, affirming its user-friendly design. However, the research also sheds light on the limitations stemming from the dataset's restricted scope. While the chatbot operates effectively within the provided data, its capacity to offer comprehensive responses can be constrained by the available database content.

Furthermore, the study identifies the need for increased scientific research on financial assistance for migrants. It raises a concern about data privacy and security. Based on the literature research stakeholder involvement is emphasized as crucial, particularly in the context of deploying AI technologies to ensure ethical and responsible practices.

As a call to action, the research suggests future exploration into the implementation of automated chat agents, considering the expanding landscape of Large Language Models (LLMs) and their potential to enhance support systems for migrants. This work contributes to the ongoing discourse on leveraging technology for the benefit of individuals in transition, fostering a more connected and inclusive global community.

# TABLE OF CONTENTS

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Abstract.....	1
List of tables.....	3
1 Introduction.....	4
1.1 Background information.....	5
1.2 Motivation.....	5
1.3 Research Questions.....	6
2 Background research.....	6
2.1 Literature review.....	6
2.2 State of the Art.....	8
3 Method & Techniques.....	12
3.1 Design process.....	13
4 Ideation.....	15
4.1 Generation phase.....	16
4.2 Prototyping.....	17
5 Specification.....	19
5.1 Requirements.....	20
6 Realization.....	22
6.1 Design.....	22
6.2 Implementation.....	25
7 Evaluation.....	28
7.1 Evaluation metrics.....	28
7.2 Experiments.....	28
7.3 Ethical consideration.....	29
7.4 requirements evaluation.....	30
8 Discussion & Future Work.....	31
8.1 Discussion.....	31
8.2 Limitation.....	31
8.3 Future work.....	32
9 Conclusion.....	33
References.....	35
Appendix.....	37
Appendix A.....	37
Appendix B.....	39
Appendix C.....	40
Appendix D.....	46

## TABLE OF FIGURES

---

Figure 1. Mindgrate app .....	5
Figure 2. The phases of HCD.....	13
Figure 3. Project roadmap.....	15
Figure 4. General information.....	16
Figure 5. Job vacancies .....	17
Figure 6. Code for using ChatGPT API key.....	18
Figure 7. Web demo .....	18
Figure 8. Chatbot interface.....	19
Figure 9. MoSCoW prioritization .....	20
Figure 10. System diagram .....	22
Figure 11. Text splitter .....	23
Figure 12. Embedding.....	24
Figure 13. Vector store.....	24
Figure 14. Code of Prototype 1 .....	25
Figure 15. Pinecone vector database.....	26
Figure 16. Upstash Redis database .....	26
Figure 17. Flowise build .....	27
Figure 18. Final chatbot interface.....	27
Figure 19. Chart.....	29
Figure 20. System diagram .....	40

## LIST OF TABLES

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Table 1. Overview of the application .....	11
Table 3. Requirements.....	20
Table 4. Requirements evaluation.....	30
Table 2. ICT solutions .....	40

# 1 INTRODUCTION

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In recent years, there has been a significant growth in migration over the world, driven by factors such as conflict, persecution, economic issues, and environmental changes. According to the International Organization for Migration (IOM) [1], in 2020, there were an estimated 281 million international migrants globally, approximately 128 million more than 30 years ago. These numbers show a steady increase over the years, highlighting the significance of migration on a global scale. This surge in migration has raised the need for effective integration strategies for host societies to grapple with the social, economic, and cultural implications of different migrant populations. Because societies become so increasingly diverse, it is essential to embrace this diversity to foster a better sense of community. Successful migrant integration contributes to the richness of cultural exchange and promotes a more inclusive and tolerant society. Conversely, failure to address integration challenges can lead to social fragmentation and tensions.

Moreover, migrants often play a vital role in the economies of host countries. The Organization for Economic Co-operation and Development (OECD) [2] reported that migrants make up a significant portion of the labour force in many countries, contributing to economic growth. In 2022, the number of permanent immigrants to OECD countries reached a historic high of 6.1 million and in many of those countries, the statistic was higher than in any of the previous 15 years. On average, almost 80% of migrants were economically active [2]. They contribute to labour markets, innovation, and entrepreneurship. However, realizing these economic benefits requires effective integration, including access to education, employment, and financial resources. Neglecting integration can result in untapped economic potential and increased social welfare costs.

It is apparent that the significance of addressing global migration challenges cannot be overstated. Hence, this thesis will delve into the roles that information and communication technology (ICT) tools and artificial intelligence (AI) can play in mitigating those difficult challenges that migrants always face. The goal is to explore the wide array of various ICT tools, including AI technology, that are intended to or have the potential to help migrants with integration into society. It will formulate a unique design that uses AI and devise a plan to implement it.

## 1.1 BACKGROUND INFORMATION

CYENS, the first Research center in Cyprus, runs the Mindgrate project, which is about the development of a mobile application that helps migrants to better integrate into the Cypriot society from a societal and financial perspective. The app is appropriate for legal migrants, refugees, and asylum seekers currently residing in Cyprus. It can be used to examine open positions, create profiles and CVs, apply for those positions, and get useful information about legal rights, news, language courses, how-to procedures, etc. This app addresses problems such as difficulties in reaching the job market, migrants not knowing how to create their CVs, how to apply for vacancies, many vacancies are in Greek, access to information is limited, info is static, and migrants do not know their rights. Moreover, it assists employers who are willing to offer jobs. The Mindgrate mobile app makes a significant advance by verifying users' legal status so that companies feel more secure about receiving job applications through this app.



Figure 1. Mindgrate app

One of the objectives of this project is to find a solutions that are expected to encourage and train both migrants and potential employers to use the app, either as users (migrants) or as job providers (employers), as many migrants and potential employers are still either sceptic about or unable to use the Mindgrate mobile app.

## 1.2 MOTIVATION

For the past few years, AI technology's significance and advancement have grown rapidly. For example, artificial intelligence has learned to analyse vast amounts of data and identify patterns. It makes it a lot easier to come up with more innovative solutions for really complex problems. You can use it to set the automation of repetitive tasks, enhancing efficiency and freeing up human resources for more strategic and creative endeavours. One of the more prominent features is the use of natural language processing (NLP) technologies, which is responsible for better human-machine communication and language understanding. However, for this project, the focus will be on implementing the large language model (LLM). It is a deep-learning algorithm that can perform a variety of NLP tasks, such as comprehending and generating human language text, the most common example of which are the chatbots. Building an AI chatbot for migrants using Large Language Models like GPT-3<sup>1</sup> can offer several advantages, providing a powerful and versatile tool to assist migrants in their integration journey. The chatbot can provide language assistance, translation services, and help migrants communicate effectively in their new environment. LLMs can be trained on different cultural contexts and provide real-time guidance on local customs and norms. The chatbot is also available 24/7, providing instant assistance to migrants regardless of time zones or working hours. These and many other useful features of AI can implemented into the Mindgrate application for migrants.

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<sup>1</sup> Generative Pre-trained Transformer 3 (GPT-3) is a large language model — also known as an AI foundation model — developed by OpenAI.

## 1.3 RESEARCH QUESTIONS

**RQ:** How can AI technology and large language models (LLM) help migrants with social and financial integration?

- Which features of existing ICT tools are considered useful by migrants?

## 2 BACKGROUND RESEARCH

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### 2.1 LITERATURE REVIEW

#### 2.1.1 Introduction

The integration of migrants into local societies is a very complex and multifaceted process that has gained significant importance in recent years. It includes the social, economic, cultural, and political aspects of foreigners' adaptation to their host countries. Information and communication technology (ICT) and artificial intelligence (AI) have emerged as quite powerful tools to support and enhance migrant integration efforts. Therefore, this literature review aims to explore and synthesize the existing research on the role of these technologies in enabling migrant integration.

This review consists of two parts, the first part will focus on how innovative ICT-based solutions can impact migrant adaptation. The second part will specifically examine the implementation of AI in the current technology. Lastly, conclusions will be drawn on how can ICT tools help migrants with social and financial integration into a new society.

#### 2.1.2 The impact of ICT tools

Speaking a foreign language and being able to understand local communities is one of the first problems that arise for people that just migrated. Studies indicate that while digital language learning instruments are progressively incorporated into training programs for migrants, they are not consistently tailored to their specific needs [3]. These tools often do not include information about local cultural norms, rules, and regulations, leading migrants to perceive them as overly complex and not helpful for effective integration [4].

Migrants' meaningful engagement in the host society goes beyond just language proficiency. It also includes cultural proficiency, which can affect employability and open access to educational opportunities, as highlighted by Lindström [5]. Proficiency in both language and culture plays a pivotal role in enhancing social integration, as described by Ager and Strang in 2008 [6]. They defined social integration as the extent and nature of social connections and interactions between migrants and the local population. Lindström [5] states that the achievement of employment, specifically the recognition of your professional skills and the means to sustain oneself, stands as a pivotal motivating factor and has a high priority. Lindström found a clear demand for specialized assistance in language and cultural education and fostering social connections for recently arrived migrants. This support is intended to enhance their professional capabilities and facilitate the acquisition of contacts that can ultimately lead to employment opportunities. The report [5] concluded that there is a requirement for ICT solutions that facilitate collaborative efforts among professionals from various fields, including medicine, language, and intercultural communication. The

assessment made by Passani [7] supports these findings by discussing how implementing ICT tools would simplify and encourage integration into society, especially in the early stage. It underlines the need for ICT-based solutions to facilitate a more sustainable integration by providing not only language assistance but also guaranteeing access to essential information regarding key services (such as training, employment, health, welfare, etc.) offered by local public administrations and relevant organizations [7]. Even though, multiple sources agree on the importance of language learning and acquiring relevant knowledge for faster integration, Leligou [8] states that the currently available platforms for providing information are not sufficient.

While there are ICT tools that can offer migrants an opportunity to learn a language or find out more about the culture many of them were not targeted towards them. Both Karimi [9] and Concilio [10] underscore the importance of connecting stakeholders in the collaborative design of services and enhancing the development of technology applications through user-centric approaches. In the creation of applications and technological advancements, it is essential to engage primary beneficiaries, namely migrant workers, during the design and development phase to guarantee sustainability and that their views are considered [11, 13]. Additionally, Karimi [9] proposes that service design and strategies should not aim for a universal solution due to the varied needs, challenges, and circumstances of individuals.

When designing a digital solution for migrants, smartphones are the most common instrument to reach and help people. Lindström [9] discusses that participants in their research who possess smartphones generally use them to maintain connections with their home countries. However, it was also discovered that participants do not view mobile technology as particularly useful for integration, especially in terms of job searching, which is a critical aspect of the integration process. This suggests that migrants might not perceive mobile technology as a supportive tool for employment but rather as a means of enjoyment and entertainment. However, after conducting a survey Leligou [8] concluded that migrant people are welcome and ready to use ICT tools to find an appropriate job. Furthermore, Lindström's [16] research also suggests that migrants express apprehension about potential surveillance risks, particularly when utilizing social media accounts for authentication in mobile applications. Concerns include the lack of anonymity for both the user and their social connections when using a social media identity. This approach may enable third parties to access private data from social platforms, posing a risk of unintended disclosure of user credentials. Zomignani Barboza [13] arrived at a similar conclusion and advised for inclusion of migrants into the development process to correctly identify the social concerns related to them and address them.

### **2.1.3 AI implementation**

AI technology is gaining popularity in the realm of migrant integration. In the context of entering the migrant labour market, key factors include job supply, demand, and matching. An emerging application area involves connecting the professional skills of migrants to locations that exhibit similar markets, aiming to identify the most promising opportunities for securing employment [4]. In learning a foreign language, AI components are progressively employed to offer personalized language courses. This involves providing learners with instantaneous and non-judgmental feedback and aiding teachers by handling certain time-consuming tasks. However, being a very powerful tool AI implementation for migrant employment is still underdeveloped, according to Lindström [4]. They state that establishing access to opportunities for employment serves as the base for disputing stereotypes surrounding immigrants, countering the perception of them as unskilled, passive individuals reliant on state assistance and charity. Additionally, it helps decrease instances of workplace intimidation.



Various ICT and AI technologies are currently being developed and used across different realms of migrant integration. Although there is limited empirical research regarding migrant workplace integration and AI [4], and technologies using artificial intelligence to assist migrants are not actively developed, they have a large potential in the future. One of the prominent examples is the digital companion agents. The conversational approach, specifically using a Chatbot, is a recognized and highly regarded method as it provides the opportunity for interactive surveying services. Simultaneously, the effectiveness, longevity, engagement, and efficiency of a conversation are enhanced when facilitated by an “agent” with a thoughtfully crafted companion identity [14]. That means integration of large language model (LLM) or simply chatbot assistants into the current system would be very promising direction for this project. However, while chatbots offer advantages such as objectivity and time efficiency, Schildknecht et al. [15] note that challenges arise due to their wide use of language variations and the current technology's limited capacity to comprehend contexts and complex relationships. These issues often result in communication breakdowns when interacting with job seekers.

#### **2.1.4 Conclusion**

The goal of this literature review was to provide a comprehensive exploration of the role of Information and Communication Technology in the social and financial integration of migrants into new societies. This paper focused on different aspects of migrant integration that can be assisted with modern technology. Additionally, there was concluded a research on the AI as currently one of the biggest and fastest-developing ICT tools. The state of global migration necessitates innovative solutions, and the findings presented herein underscore the strong potential of ICT and AI in addressing the challenges faced by migrants.

This research highlighted the role of language learning applications as a key factor in linguistic integration and the cultivation of social connections among migrants and locals. Additionally, community engagement platforms, such as social media networks and online forums, were identified as powerful instruments for building community ties and facilitating cultural exchange. These platforms not only connect migrants with their local communities but also serve as virtual spaces for sharing experiences, seeking advice, and enabling a sense of belonging. Furthermore, digital assistant programs or LLMs were acknowledged for their potential to enhance social integration by providing migrants with guidance on cultural adaptation and professional development. These programs leverage AI technologies to establish a connection between migrants and the technology, creating valuable support systems.

From the research, it is found that there are plenty of ways the technology can help people integrate socially. However, the amount of scientific research on financial assistance for migrants was limited. There is an aspect of data privacy and security that needs to be addressed. That means, especially when using AI, the involvement of stakeholders is of the utmost importance. Ultimately, there are countless possibilities for using technology to help migrants. This paper suggests that future research considers the implementation of automated chat agents as the realm of LLMs is constantly expanding and has great potential.

## **2.2 STATE OF THE ART**

For immigrants, figuring out how to navigate a new country and access social systems and public welfare can be incredibly challenging. Recent advancements in information and

communication technology (ICT) and services digitization provide an opportunity for immigrants to better understand the complexity of their new environment and improve their situation. There are several ways in which ICT tools and AI technologies can be applied to address the challenges of migrant integration:

### 1. Financial integration

ICT tools, including mobile banking apps and digital financial platforms, can increase financial inclusion among migrants. AI can be used to assess creditworthiness and provide access to financial services. In 2020, 63% of financial service providers were using AI for personalized customer services.

- **PickRemit** (Launched 2015)  
Developed and overseen by the World Bank Group, PickRemit is an application designed to assist migrants in selecting optimal services for sending money to their families. It accomplishes this by comparing various providers. PickRemit offers comprehensive details on key data points, including exchange rates, service fees, transfer speed, type of service provider, payment methods for transactions, and the disbursement process for funds.
- Chat bot from [QuData](#) for refugees  
Chatbot that operates 24/7 across popular communication channels like Telegram, Viber, Facebook Messenger, and the web. The result is a flexible and efficient chatbot that significantly reduces response time and supports the needs of refugees seeking information and assistance.  
Main goal is to help Ukrainian refugees. Chatbot used several modules and an additional NLU processing module.

### 2. Language learning

ICT tools and AI-driven language learning apps can provide personalized language learning experiences for migrants. These apps can adapt to individual learning styles, track progress, and offer real-time feedback, helping migrants improve their language skills [4].

- Duolingo, Babbel, Rosetta Stone and Google Translate

### 3. Job finding

- **AgHelp** (United States, launched 2019)  
AgHelp aims to mitigate agricultural labour shortages by facilitating directly connecting employers, migrant farmworkers, and worker support agencies. It also enables workers to access supportive services like migrant education programs, migrant head start programs, immigration services, legal assistance, and job training programs.
- **Pink Collar** (Malaysia, launched 2019)  
Pink-collar is a recruitment agency that specializes in connecting migrant domestic workers with prospective employers through a digital web and mobile platform. The platform allows women from sending countries to seek domestic work opportunities and connects them with employers from

destination countries. Pink-collar provides profiles for both employers and domestic workers, facilitating a transparent matching process.

- **SWADES** (India, launched 2020)  
The Indian government has recently introduced the Skilled Workers Arrival Database for Employment Support (SWADES) to leverage the expertise of Indian migrant workers returning home due to COVID-19. This initiative involves skill mapping and the establishment of a database containing information on workers, facilitating their referral for potential employment opportunities.

#### 4. Social integration and Community engagement

Social media and community engagement platforms can facilitate connections between migrants and local communities. These platforms can promote cultural exchange, organize community events, and foster relationships, improving sense of community.

- **Welcome!** (Sweden, launched 2015)  
Launched in Sweden, this mobile resource offers assistance to migrants in connecting with locals by asking specific questions, thereby encouraging genuine language and cross-cultural education.

#### 5. Navigation and Travel

- **MigApp** (Launched 2017)  
MigApp, the downloadable application by IOM, functions as a comprehensive resource for migrants, offering up-to-date, trustworthy, and practical information at every stage of their migration journey. Serving as a hub specific to each country, MigApp guarantees that migrants can readily access local information and services.
- [TARS Immigration Services ChatBot](#)  
Experienced Visa providing company. Explains the rules and regulations in details to the applicants who are new in this sort of process.
- Google Maps or Waze can help migrants navigate their new city and use public transportation

The economic consequences of migrant integration are significant. Successful integration can contribute to economic growth by filling labour market gaps. Hence, ICT technologies that help migrants and refugees with employment process are in demand.

Migrant workers may rely on disparate sources of information to seek out jobs such as word of mouth, interpersonal network referrals, or social media postings. There are a number of well-developed platforms specializing in job matching and recruitment, such as LinkedIn; however, these sites are generally targeted towards highly skilled professionals, rather than low-paid migrant labourers [11].

Table 1. Overview of the application

	Description	Notable features
<b>MigApp</b>	<ul style="list-style-type: none"> <li>• Useful information for a safe migration: MigApp compiles the requirements of entry and stay in other countries, explains how to manage work permits</li> <li>• Migrants can compare the prices of different remittance platforms to choose the one that is least expensive</li> <li>• Access to information on basic telephones and/or without Internet</li> <li>• If a migrant voluntarily decides to return to his/her country, IOM facilitates a safe return</li> </ul>	<ul style="list-style-type: none"> <li>- Designed to work on any OS</li> <li>- 9 languages</li> <li>- Can save and copy documents and access without the internet</li> <li>- Allows sharing location</li> <li>- Acts as a currency converter</li> </ul>
<b>miHUB</b>	<p>Designed for:</p> <ul style="list-style-type: none"> <li>• Asylum Seekers</li> <li>• Refugees</li> <li>• International Protection Beneficiaries</li> <li>• Third Country Nationals               <ul style="list-style-type: none"> <li>○ <i>Domestic Workers</i></li> <li>- <i>Students</i></li> </ul> </li> <li>• Resettled Refugees</li> </ul>	<ul style="list-style-type: none"> <li>- Simple interface</li> <li>- Predominantly consists of useful information and guides</li> <li>- Dedicated news page</li> </ul>
<b>Homeis</b>	<ul style="list-style-type: none"> <li>• Developed by an Israeli immigrant, offers itself as a social media application for the new migrant. It aims to consolidate features seen on other social networking sites, such as groups and pages, into a single location geared toward foreign-born residents.</li> <li>• Homeis seeks to provide all the conveniences of social media, such as events, recipes, and human connections, with a greater emphasis on cultural inclusivity.</li> </ul>	<p>Pros:</p> <ul style="list-style-type: none"> <li>- Homeis established by immigrants who understand the challenge of balancing two homes originates.</li> <li>- It has expanded its reach to Canada. The platform now links South Asians in both the United States and Canada.</li> </ul> <p>Cons:</p> <ul style="list-style-type: none"> <li>- The app's negative reviews are mainly due to content silos and design filters. For instance, the job section includes content from both job seekers and employers, but there is no way to organize it.</li> <li>- At the moment, the app only offers content in English, French, and Spanish.</li> </ul>
<b>Settle In</b>	<p>Despite its focus on refugees, Settle In provides important tools for anybody seeking to establish a residence in the United States from another nation. The application includes information on <b>housing options, job hunting, and language study</b>. The information is given</p>	<p>Pros:</p> <ul style="list-style-type: none"> <li>- Easy-to-use interface.</li> <li>- Up to six people can have accounts on the same app.</li> </ul>

	in a variety of formats, including quizzes and games.	<ul style="list-style-type: none"> <li>- Currently available in English, Arabic, Kinyarwanda, Swahili, and Dari.</li> </ul> <p>Cons:</p> <ul style="list-style-type: none"> <li>- This content is primarily intended for refugees, so it may not always apply to other kinds of migrants.</li> </ul>
<b>Welcome! Sweden</b>	It's primary purpose was to create a digital meeting place for contacts between locals and migrants for learning about Sweden and the Swedish language.	<ul style="list-style-type: none"> <li>- Available in English, Swedish, Norwegian, Arabic, and Farsi</li> <li>- Cross-platform app and free of charge</li> </ul>

In the tables from Appendix C are listed more examples of innovative ICT solutions that provide information for migrant workers [11].

### 3 METHOD & TECHNIQUES

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In this chapter, the general method design used for this project will be explained. Since the goal is to create a solution for a specific target group, migrants, the design method was chosen by focusing on the individuals.

Human-centered design (HCD) [17] is a cyclical method of problem-solving that centres the development process around actual people, allowing you to develop services and products that speak to and are customised for the needs of your target market. When using HCD method as a specific design approach for creating an AI chatbot for the social and financial integration, it places the needs and experiences of the migrants at the core of the design process.

# Design Thinking Stages

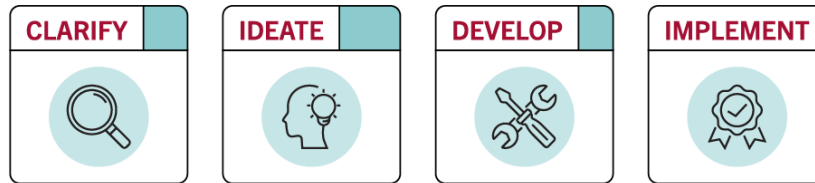


Figure 2. The phases of HCD

## 3.1 DESIGN PROCESS

The process is split up into four stages (Fig.2). In order to identify the issue and potential solutions, the initial stage of the process is spent gathering information and watching your target group. To find out what potential users want, you do user research and evaluate consumer needs rather than creating a product based on assumptions. The next step is to synthesize the data gathered during the first phase and make sense of it. Common techniques are to facilitate brainstorm sessions, create a user journey map and making a lo-fi prototypes to gather feedback from potential users. During the third phase, to generate a variety of potential solutions, you integrate and evaluate the ideas that have been generated throughout the previous step. It is done to better satisfy user demands and decide which ideas to go into prototype to cut costs, save time, and improve the quality of the finished product by merging and assessing ideas. The final stage of HCD design process is implementation of all the findings into a complete design.

### Clarify

For this stage it important to conduct an in-depth research on needs and experiences of migrants. The literature review yielded a considerable amount of information regarding the use of ICT tools and AI technologies intended to help migrants in a various ways.

Based on the survey responses from migrant workers [12], an effective digital product would have to include a number of attributes:

- Works on a mobile phone
  - Migrant workers predominantly use mobile phones as their primary devices.
- Can be accessed even where connectivity is poor and/or intermittent
  - The product must function, for instance, in rural villages.
- Features information from a trusted source
  - In terms of concerns related to digital technology usage, migrant workers identified misinformation as the top-ranking issue. They express greater trust in friends, family, and recruitment agencies compared to online sources.
- Features the right information for the right audience

- The presented information can be customized based on factors such as migration stage, specific migration corridors, languages spoken by migrant workers, and other relevant considerations.
- Regularly updated and well maintained
  - This appears obvious, yet several of the products identified by the research were out of date and/or malfunctioning
- It is strongly promoted to the target audience
  - Migrant workers should be informed about the availability and means of accessing the product. To establish trust, the promotional efforts should incorporate details about the developer and the source(s) of the featured content. Traditional offline awareness-raising methods, such as radio broadcasts and posters, should be retained for individuals with limited access to digital information and communication technology (ICT).
- Knows about migrants' heavy use of social media
  - A significant number of migrants primarily utilize their devices to stay connected with friends and family, with Facebook emerging as the most widely used app among the migrants examined in the study. Consequently, social media networks should be systematically integrated into digital outreach efforts.
- Include digital literacy skills training
  - Numerous migrants possess limited digital literacy, leading to a lack of awareness about the diverse array of services accessible online. Integrating digital literacy and safety skills training into pre-departure orientation and training programs could address this gap.
- Finally, the project involves migrants in product design and development

### **Ideate**

The ideation phase is conducted by brainstorming a better design for an AI chatbot. During the session, several interface ideas were brought up and the best one turned out to be the most simplistic. It was decided to have an ordinary chat system embedded into a website so it could be possible to share between participants.

During this stage, the roadmap to deploying the prototype was developed. It was divided into three phases. Preparation, the time to collect all the necessary data and study the needs and characteristics of the target group. Second is the prototype design, during which the first prototype is developed. Finally, last phase user testing with the target group and evaluation of the system.

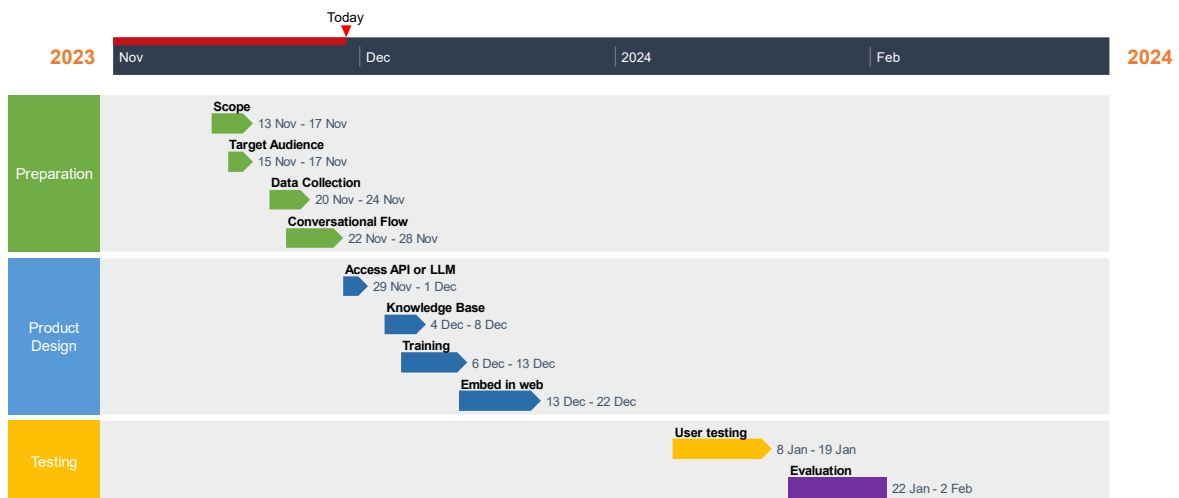


Figure 3. Project roadmap

## Develop

One of the parts of this phase is to ensure the AI chatbot is accessible to users with diverse needs, including those with limited literacy and different language proficiency levels. Integrate into the chat necessary AI capabilities, such as natural language processing and understanding, to enhance the chatbot's ability to provide relevant and concise information.

In this stage the right choice would be to adopt an iterative design process. It ensures that the real users constantly validate design decisions because they provide continuous feedback from testing. Moreover, during the experiments the effectiveness and user-friendliness of chatbot can be assessed.

## Implement

The goal is to launch and monitor the AI chatbot in real-time settings. First, conduct several tests with the participants, monitor interactions and gather feedback. Scale the deployment of the chatbot making sure that the system can handle an increased user engagement. Finally, evaluate the impact of the AI chatbot on migrant integration.

# 4 IDEATION

The stakeholders of the projects are migrants in Cyprus and employers ready to provide a job. Moreover, host countries and various NGOs are also invested in enhancing the process of integration, since it carries a positive economic and cultural impact. By conducting the research it is possible to identify the main challenges and requirements of migrants, such as language barriers, cultural integration, legal and administrative processes, finding jobs, and housing.



## 4.1 GENERATION PHASE

The goal of the generation phase would be to create an AI assistant chatbot using OpenAI and ChatGPT. Then train this AI chatbot with custom knowledge and deploy it into an autonomous system. This phase could be divided into different steps:

### 1. Purpose and scope

The main goal is to create a functioning chatbot using GPT or any other available LLM. This chatbot will have its own knowledge base with useful and relevant information regarding language learning, job searching, cultural adaptation, or accessing local services. The AI will be able to answer user questions based on the data it was provided.

### 2. Target audience

In this case, the target audience is migrants. Therefore, the system design needs to consider language proficiency, cultural background, and technological literacy to tailor the chatbot's interactions accordingly.

### 3. Data collection

A considerable amount of data was collected from sources like [Cyprus-Caritas](#), [miHUB](#) and others. Moreover, the Ministry of Labour provided a large list of available job vacancies with descriptions, requirements and many other necessary information. This data had to be cleaned and pre-processed to remove duplicates, irrelevant information or any noise that might affect the training. After compiling and structuring all the data two main documents will go into the system. One containing all the general information such as employment process, medical care and language learning. Second is the wide sheet of vacancies.



Figure 4. General information

Working Days								
A	B	C	D	E	F	G	H	I
Address Line 1	Email	Telephone Number	Contact Person	Contract Typ	Economic Activity	Employment D.	Job Title	Vacancy Job Requirement Description
1	Address Line 1							
2	DISTOMOY 15A	info@asismsociety.org.cy			SOCIAL WELFARE		MORE THAN 6 NURSE	WORK LICENSE IN AT THE RELATED FIELD. CLEAN CRIMINAL RECORD, HEALTH
3	KARAS VILLAGE TAVERN	a_mikaras@hotmail.com	23741690, 99415101	CHRISTOS KARAS + KOSTAS KARAS	FULLTIME RESTAURANT		UP TO 6 MONTHS	KITCHEN ASSISTANT
4	STROVIOYLOU AVENUE 114	anniosh@cytanet.com.cy	22314314	MR CHADJIGEORGIOU ANNINOS	FULLTIME WHOLESALE TRADE		MORE THAN 6 SECRETARY	KNOWLEDGE OF COMPUTERS AND ENGLISH, E-SOFT PROGRAM, OFFICE OR
5	SALINS 3A	aaconnomidi@cytanet.com.cy			FULLTIME BUSINESS CONSULTANTS		MORE THAN 6 SENIOR AUDITOR	BASIC COOKING SKILLS FRIDAY 1639-2300 WEEKEND 1009-2200
6	TAKI SOFOCLEOUS 5	info@santa-marina.com.cy			FULLTIME NURSING		UP TO 6 MONTHS	RECEPTIONIST, ENGLISH, GREEK RUSSIAN LANGUAGE
7	SPIROU KIPRANIOU 63	innizintli@gmail.com	99637859	SOTIRIS ZINTILI	FULLTIME PASSENGER TRANSPORTATIONS		MORE THAN 6 SAILOR	SAILOR
8	PSARON 16	constantinazanti72@gmail.com	99642401	CONSTANTINA ZANTI	PARTTIME AMUSEMENT		MORE THAN 6 WAITERS	WAITERS ONLY FOR WEEKENDS
9	BITHLIDEM 50	reception@thebestmcc.com	99641264	THEODORA SABBA	FULLTIME CLEANING		MORE THAN 6 CLEANER	GREEK AND ENGLISH LANGUAGE, CLEAN CRIMINAL RECORD, RESPONSIBLE
10	PSAROV 16	constantinazanti72@gmail.com	99642401	CONSTANTINA ZANTI	FULLTIME AMUSEMENT		MORE THAN 6 COOK	BASIC COOKING SKILLS FRIDAY 1639-2300 WEEKEND 1009-2200
11	TAKIS SOFOCLEOUS 5	info@santa-marina.com.cy	35723811999	DR DROSOS MICHAELIDIS	FULLTIME NURSING		MORE THAN 6 RADIOGRAPH	ENGLISH LANGUAGE
12	SPIROY KIPRANIOU 15A	alexandroultd@gmail.com	99745815	CHRISOBALANTOS ALEKSANDROU	FULLTIME CONSTRUCTIONS		MORE THAN 6 CAR MECHAN	GOOD PHYSICAL CONDITION - KNOWLEDGE OF GREEK
13	KARAS VILLAGE TAVERN	a_mikaras@hotmail.com	23741690	CHRISTO KARA OR ANTONI KARA	FULLTIME RESTAURANT		MORE THAN 6 RESTAURANT	HIGH SCHOOL GRADUATE OR TOURIST SCHOOL, EXCELLENT KNOWLEDGE OF
14	MARONI	99859266	DIAMANTIS ELEFTHERIOU		FULLTIME AGRICULTURE		MORE THAN 6 AGRICULTURE	LABORER
15	TSEROU AVENUE 212	anti-cy@cytanet.com.cy			FULLTIME NURSING		MORE THAN 6 HEALTHAIDE	CLEAN CRIMINAL RECORD
16	ANTHROPION DIKAIOMATON 7	info@tsouliftas.net	25665421	ANDREAS TSOULOFTAS	FULLTIME WASTE MANAGEMENT		MORE THAN 6 ROAD CLEAN	GOOD PHYSICAL CONDITION - KNOWLEDGE OF GREEK
17	KARAS VILLAGE TAVERN	a_mikaras@hotmail.com	23741690, 99641264	CHRISTOS KARAS	FULLTIME RESTAURANT		UP TO 6 MONTHS	BARISTA
18	KAPPARIS 55 KARA ANTONI	a_mikaras@hotmail.com	99641264	CHRISTOS KARAS	FULLTIME HOTELS		UP TO 6 MONTHS	CLEANER
19	TSEROU AVENUE 212	anti-cy@cytanet.com.cy		ANDREAS KONSTANTINIDI	FULLTIME NURSING		MORE THAN 6 NURSE	NURSERY DIPLOMA, CLEAN CRIMINAL RECORD, PASSION FOR WORK
20	ANTHROPION DIKAIOMATON 7	info@tsouliftas.net	25665421	ANDREAS TSOULOFTAS	FULLTIME WASTE MANAGEMENT		MORE THAN 6 SUPERVISOR	GOOD PHYSICAL CONDITION - ORGANIZE SKILLS
21	IBIKOU 36	shikisvasiliskolaf@gmail.com	24533244	NIKOLAS SHIKOS 99530118, CHARIKLIA	FULLTIME CAR REPAIRS		MORE THAN 6 CAR ELECTRIC	GRADUATE OF TECHNICAL SCHOOL, HIGH SCHOOL LICENSING OR RELATED DI
22	KARAVOSTASIOY 22-28	jobs@saewero.com.cy		ELENI PARASKEVA	FULLTIME WHOLESALE TRADE		MORE THAN 6 FRESHSELLER	HIGH SCHOOL GRADUATE, ENGLISH AND GREEK LANGUAGE
23	LORDOU BIRGHOS 33	info@tichetel.com.cy	24209300	LOUKIA ACHILLEOS	FULLTIME HOTELS		MORE THAN 6 COOK	EXPERIENCE IN A SIMILAR POSITION IN A LA CARTE KITCHEN AT LEAST 3 YEAR
24	LARIACIA DEKELEIA ROAD	louisinstallations@gmail.com	24663341, 59996311	LEFTERIS LOUBIAS	FULLTIME ELECTRICIANS		MORE THAN 6 ELECTRICIAN	TECHNICAL SCHOOL, EXPERIENCE IN A SIMILAR POSITION IS CONSIDERED AS
25	LARIACIA DEKELEIA ROAD	louisinstallations@gmail.com	24663341, 59996311	LEFTERIS LOUBIAS	FULLTIME TRANSLATIONS		MORE THAN 6 ELECTRICAL	UNIVERSITY OR COLLEGE GRADUATE, GOOD GREEK LANGUAGE, EXPERIENCE
26	D. MITROPOULOU 7-9	admin@oxfordray.com	25353210		FULLTIME REAL ESTATES		MORE THAN 6 KITCHEN ASSI	GREEK-ENGLISH
27		99809666			FULLTIME RETAIL TRADE		MORE THAN 6 TIRES REPAIR	EXPERIENCE AT TIER REPAIRING IS AN ADVANTAGE
28	CHALKOKONDILI 23	KTRANSL@GMAIL.RY	95503419	MRS KATERINA	PARTTIME TRANSLATIONS		MORE THAN 6 TRANSLATOR	ENGLISH, RUSSIAN, BULGARIAN AND GREEK LANGUAGE
29	SPIROU KIPRANIOU 63	innizintli@gmail.com	99637859	SOTIRIS ZINTILIS	FULLTIME PASSENGER TRANSPORTATIONS		MORE THAN 6 CAPTAIN	SKIPPER, VERY GOOD ENGLISH, A/D BENEFITS, 13TH SALARY, BONUS, ACCO
30	ATHINON AVENUE 40	charathermo@hotmail.com	22825153, 9942244	CHRISTOS CHRISTOU	FULLTIME PLUMBERS		MORE THAN 6 PLUMBER	KNOWLEDGE AND EXPERIENCE AT SIMILAR POSITION
31	ATHINON AVENUE 41	charathermo@hotmail.com	22825153, 9942244	CHRISTOS CHRISTOU	FULLTIME PLUMBERS		MORE THAN 6 ARCHONITON	KNOWLEDGE AND EXPERIENCE IN THE FIELD, COOPERATION AND RESPONSE
32	ARCH MAKARIOY C AVENUE 8	info@engtree.eu	22460900	DIMITRIS MELIOS	FULLTIME ELECTRICIANS		MORE THAN 6 STOREKEEPER	DRIVING LICENSE, GREEK LANGUAGE
33	LEFKOTHEOU 20 AVENUE	hr@apollonion.com.cy			FULLTIME MEDICINE		MORE THAN 6 SECRETARY	EXCELLENT KNOWLEDGE OF GREEK LANGUAGE, VERY GOOD KNOWLEDGE (
34	ARACHOBIAS 10, 3RD INDUSTRIAL	rovanas@cytanet.com.cy	25338121	KIRIAKOS ROBANIAS	FULLTIME WHOLESALE TRADE		MORE THAN 6 COURIER	
35	P. C. 33168	info@tekmotshotel.com		DIMITRI TSISSIO	FULLTIME HOTELS		UP TO 6 MONTHS	CHAMBERMAID
36	ANTONI ELLINA 7	stelios@talavades.com	25586486	STELIOS KALABAZIDIS	FULLTIME WHOLESALE TRADE		MORE THAN 6 LABORER	FACTORY
37	TROODOUS AVENUE 11D	markoulachryso@gmail.com		GIORGOS MARKOYLIA	FULLTIME RETAIL TRADE		MORE THAN 6 CASHIER	
38	POSEDOONIS 17		96322240	CHRISO NIKOLAOU	FULLTIME RESTAURANT		UP TO 6 MONTHS	COOK ASSISTANT
39	TROODOUS AVENUE 11D	markoulachryso@gmail.com	22822635	CHRYSO MARKOULLIA	PARTTIME RETAIL TRADE		MORE THAN 6 ACCOUNTANT	ASSISTANT
40	GRISA DIGENI 81-83	stanou@togo.com.cy		PANAYIOTIS VASILIOU	FULLTIME RESTAURANT		MORE THAN 6 CLEANER	RELIABLE, TEAM SPIRIT
41	GRISA DIGENI 81-84	stanou@togo.com.cy		PANAYIOTIS VASILIOU	FULLTIME RESTAURANT		MORE THAN 6 COOK	COOK B, ASIAN CUISINE
42	ALEKSANDREIAS 2	athena@oaoconstruction.com	95202946	ATHINA ANASTASIOY	FULLTIME CONSTRUCTIONS		MORE THAN 6 CONSTRUCTIC	PREVIOUS RELATED EXPERIENCE

Figure 5. Job vacancies

#### 4. Prepare the LLM Model for the chatbot

- Access GPT-3 API

First, step is to set up API calls to interact with the GPT-3 model. Using the OpenAI Python library or an API wrapper to send requests and receive responses.

- Handle multiturn conversations

This chatbot most likely will involve multiturn conversations. Therefore, it needs to maintain context between interactions by saving and appending conversation history to each API call.

- Integrate external services

To get more elaborated user feedback this chatbot can be connected to an external database like Upstash Redis and save the conversation history from all the users.

- Preparing a knowledge base
- Training the chatbot

Train the chatbot using the prepared data and the chosen framework.

5. Embed the chatbot into a website
6. Test and iterate

Iterate on chatbot based on the user feedback and evolving needs. Possibly scaling its capabilities by adding more features or integrating with additional services.

## 4.2 PROTOTYPING

The course from [DeepLearning.AI](#) was used as a source for the purpose of understanding the use of LLM.

The main topics this course covered consist of details of how an LLM works, including subtleties like the tokenizer. Methods for evaluating user inputs to ensure the

quality and safety of the system, processing inputs using both chain of thought reasoning and splitting tasks into subtasks with chain prompts, and checking outputs before showing them to users. It also took a look at methods for evaluating the system over time so as to monitor and improve its performance. Throughout the course, there was discussed the importance of building responsibly with these tools, ensuring that the model is safe and provides appropriate responses that are accurate, relevant and in the tone you want. Conclusively, practice is key to mastering these concepts.

The first step is to build a simple AI chatbot using the ChatGPT API. With the implementation of a Gradio interface to easily demo the AI model in the web browser. This chatbot can be attuned to be a digital assistant for migrants by specifying a system role in the source code. Similarly, it can acquire specific knowledge related to the project. However, with a large amount of information it would be ineffective and most likely require purchasing extra tokens to compute everything.

```

1  import openai
2  import gradio as gr
3
4  messages = [
5      {"role": "system", "content": "You are a helpful and kind AI Assistant. You
6      help migrants with social and financial integration into society"},
7  ]
8
9  def chatbot(input):
10     if input:
11         messages.append({"role": "user", "content": input})
12         chat = openai.ChatCompletion.create(model="gpt-3.5-turbo",
13         messages=messages)
14         reply = chat.choices[0].message.content
15         messages.append({"role": "assistant", "content": reply})
16         return reply
17
18 inputs = gr.inputs.Textbox(lines=7, label="Chat with AI")
19 outputs = gr.outputs.Textbox(label="Reply")
20
21 gr.Interface(
22     fn=chatbot,
23     inputs=inputs,
24     outputs=outputs,
25     title="AI Chatbot",
26     description="Ask anything you want",
27     theme="compact",
28 ).launch(share=True)
29
30

```

Figure 6. Code for using ChatGPT API key

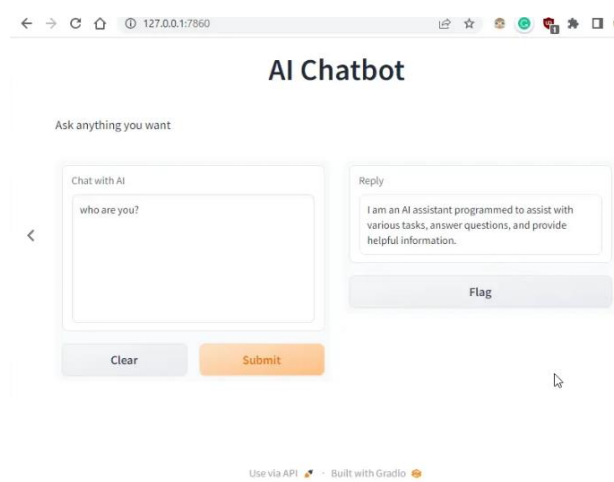


Figure 7. Web demo

With this simple approach it is possible to experiment with interface designs and AI capabilities. Gradio allows to easily customize your interface and demo it on a website. After

several iterations to get the system to look like a part of Mindgrate application, the chatbot reached its almost final look.

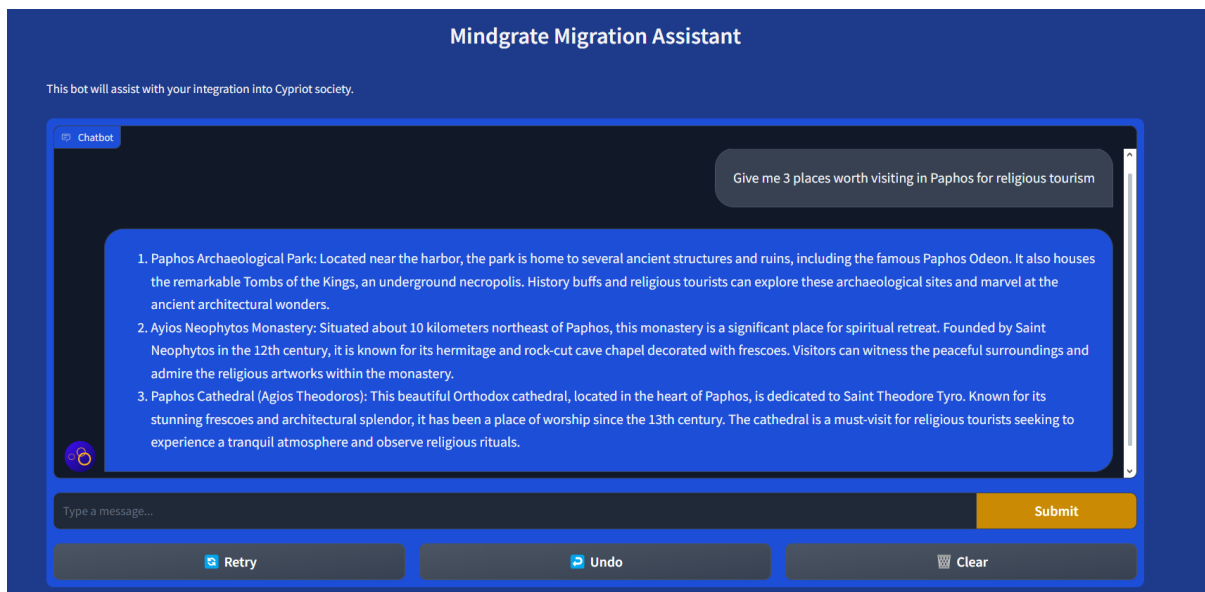


Figure 8. Chatbot interface

## 5 SPECIFICATION

The goal of this project is to employ AI, specifically the capabilities of the GPT-3 language model with embedding, to make it easier for migrants to integrate socially and financially. This specification chapter outlines the main features, requirements, and technical information details for the effective development and implementation of the chatbot.

The primary objectives of the AI chatbot project are:

- Social integration
- Financial integration
- User-centric experience

One of the outcomes of using an AI chatbot is to break down a language barrier. It makes sure that migrants can express themselves and understand the conversations that are going on around them by providing language help features. Fortunately, the LLM from OpenAI supports more than 50 languages. The chatbot serves as an educational resource, offering information on financial concepts, and providing guides and tips.

## 5.1 REQUIREMENTS

During the specification phase, the preliminary requirements from previous chapters are reexamined and revised into the real requirements for the prototype. The MoSCoW (Fig. 8) method is a prioritization technique used to categorize requirements into Must-haves, Should-haves, Could-haves, and Won't-haves. Several business disciplines apply the MoSCoW [17] approach. It makes it possible for all involved in the project to understand what tasks need to be finished first and how they will contribute to a project's goals. In the case of the AI chatbot, this method gives a clear picture of the amount of effort and resources each component would need. This information raises the possibility that the project will be finished by the deadline, optimizes time management, and makes it more manageable.



Figure 9. MoSCoW prioritization

To distinguish those requirements, it needs to be considered if they are critical for achieving the project's primary objectives. Must-haves are the core and non-negotiable requirements that are critical for the success of the system. They address the project's main goals, are typically include fundamental functionalities that meet the basic user needs. Should-have requirements enhance the project but are not strictly necessary for the initial release. They usually provide additional value and contribute to the overall project's success. Non-compliance with them may lead to a less optimal but still functional solution. If there is enough time and resources, could-have requirements can be implemented into the design process to further improve the final product.

Table 2. Requirements

Requirements	MSCW
--------------	------

Implement GPT-3 for robust natural language understanding	Must have
Provide real-time translation and language support for migrants	Must have
Answer questions using information in the provided documents	Must have
Can prioritize responses based on content explicitly provided in the documents	Must have
Clear and intuitive UI for easy navigation	Must have
Response time within 2 seconds for user queries	Must have
Allow users to customize their profiles for a more personalized experience	Should have
Enhance responses by considering the context of previous interactions	Should have
Explore the possibility of integrating voice-based interactions for enhanced accessibility	Should have
User feedback channels for continuous improvement	Should have
Save chat history	Could have

## 6 REALIZATION

The final prototype requires compiling together all the collected data, the main interface design (Fig. 7) and external services into one connected system. For that purpose will be used LangChain, an open-source framework for building applications based on large language models. It allows creation of an interconnected chatbot that can retrieve information from the provided documents, compare it to the user queries and respond in a human language.

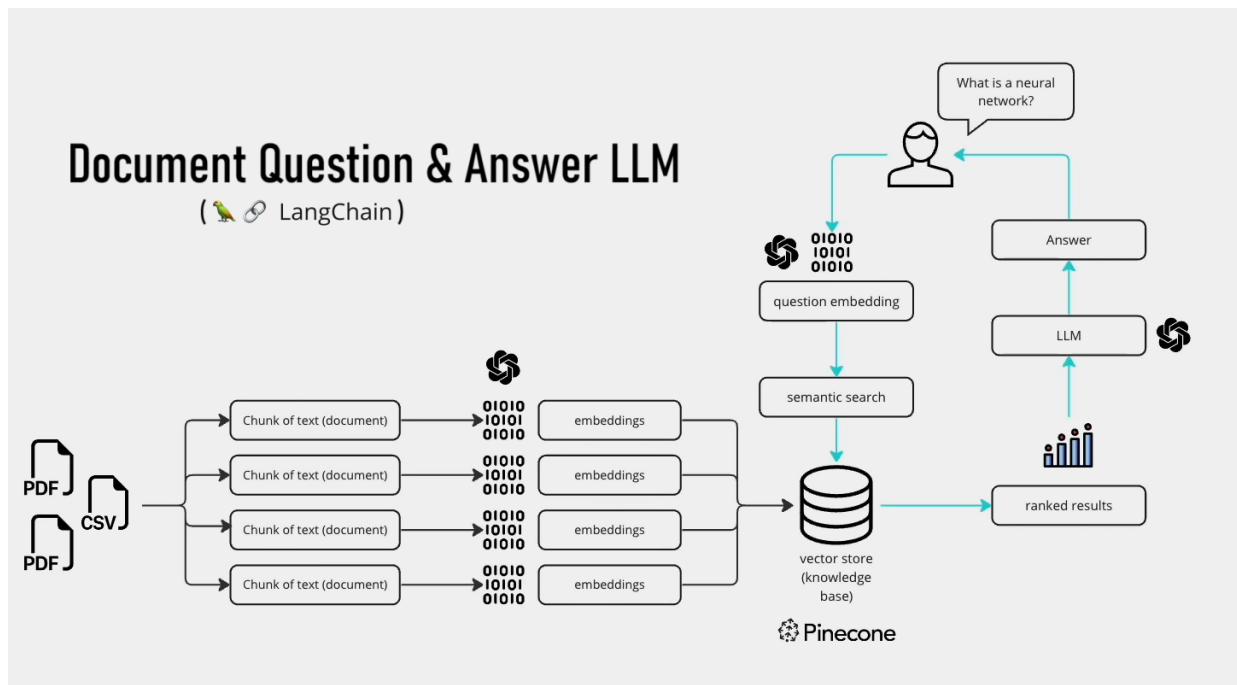


Figure 10. System diagram

### 6.1 DESIGN

The whole system can be depicted in one diagram (Fig.9). The main feature of this diagram is the GPT embedding [19]. In the context of natural language processing and machine learning, embedding refers to the representation of words or phrases in a continuous vector space. For ChatGPT models, which are based on the GPT (Generative Pre-trained Transformer) architecture, embeddings play a crucial role in understanding and generating human-like text. Text embedding is closely related to text encoding, which converts plain text into tokens. As an example, when using word embeddings, each word in the vocabulary is associated with a unique vector. The same principle is applied in this prototype.

Embedding plays an important role in realizing the functions of this chatbot. It helps the AI to parse through the knowledge base and find relevant information. It is especially needed in this project because without it AI not only would not be able to access useful

information from the documents it also would not be able to find any relevant data on the internet. Because OpenAI's database cuts off by the year 2021 all the data is outdated.

### 6.1.1 Vector Embeddings

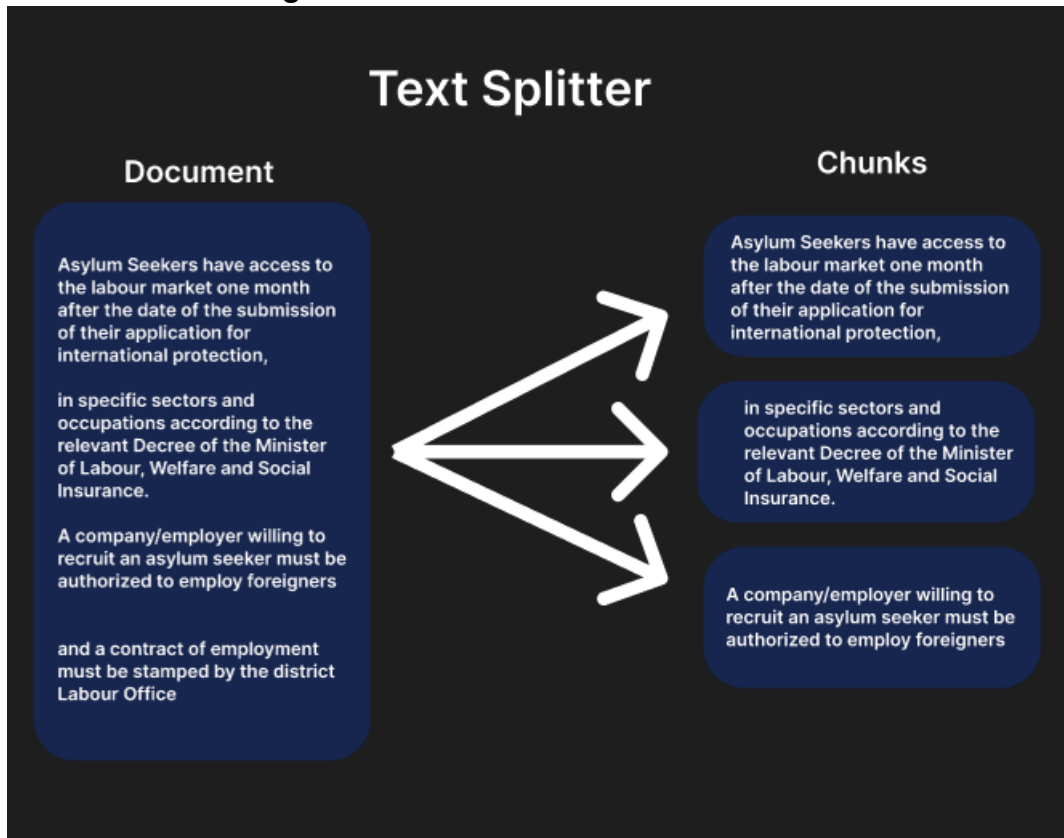


Figure 11. Text splitter

When working with large amounts of text or other data, in this project it is text and spreadsheets, it is important to split the data into smaller chunks. Otherwise, the LLM will have to go through a vast amount of information each time there is a query, which is far from optimal. A text splitter allows us to break the document into smaller pieces. Each of those smaller chunks is then converted into LangChain documents, which also contain METADATA. Now, all of that information needs to be stored in one place. However, these bits of data first have to be transformed into vector arrays, which in other words is called embedding (Fig. 11). These arrays are then stored as records in a special vector store, which later will be used to answer user's questions (Fig. 12). For that purpose the vector database from Pinecone was used in this project.



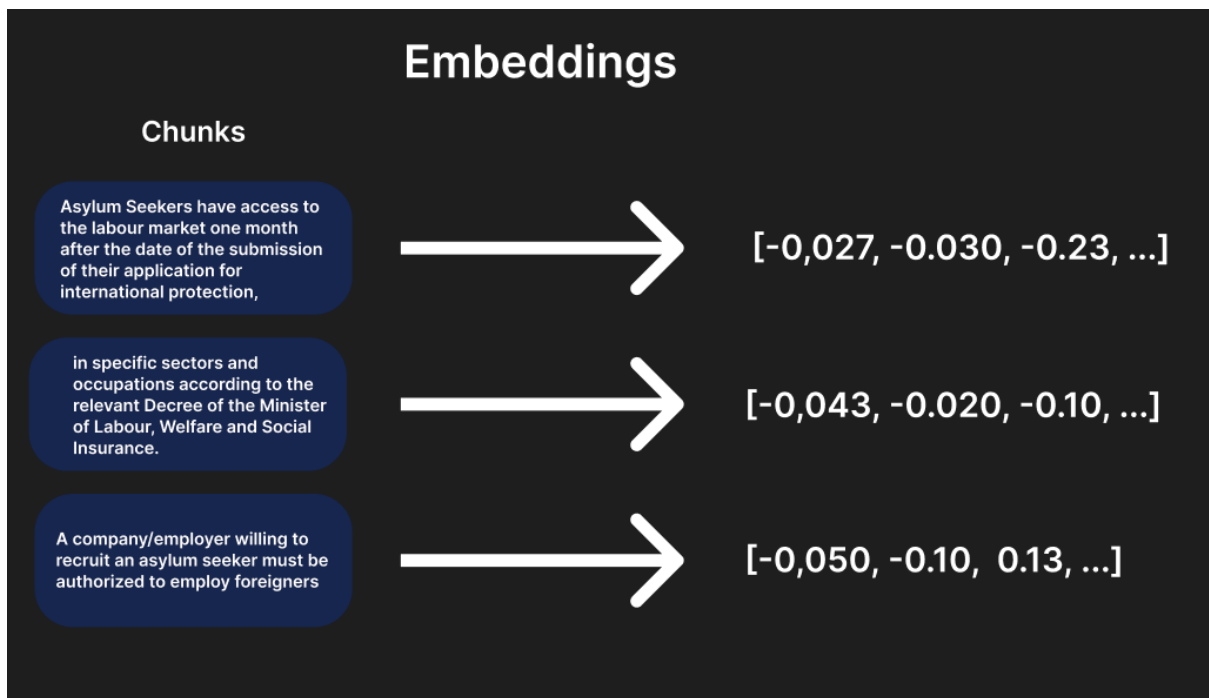


Figure 12. Embedding

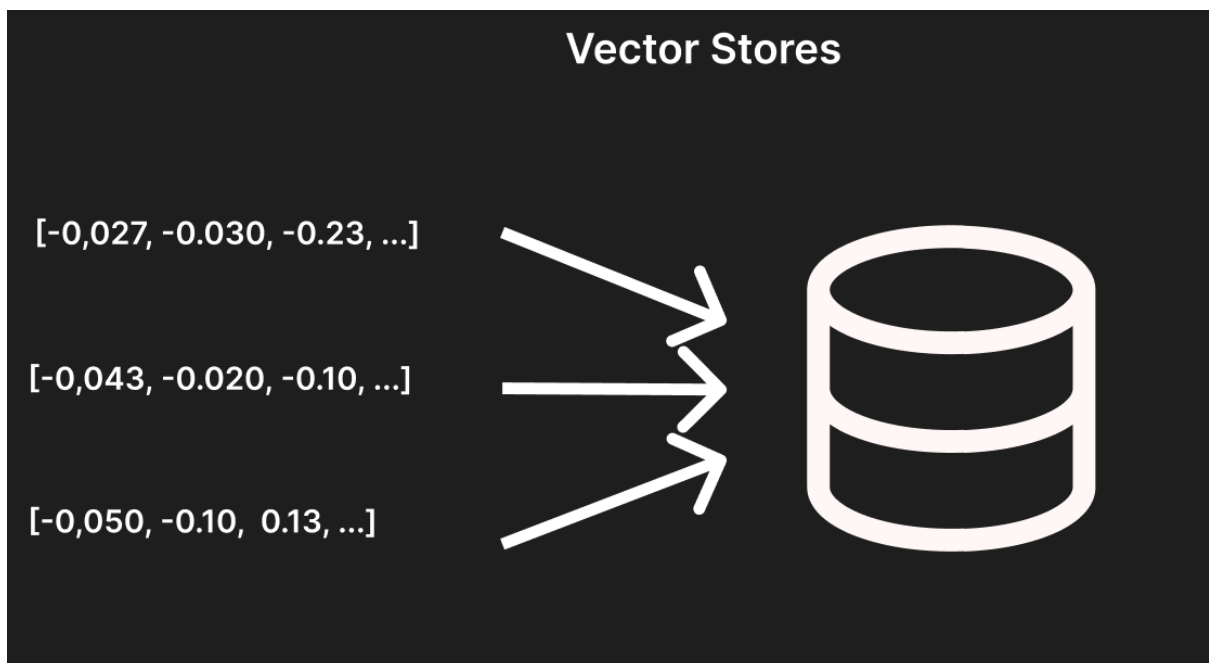


Figure 13. Vector store

The arrays of vectors, which contained “coordinates” to text parts, are now stored in the external database. When the user asks AI a question, this question gets embedded and the LLM performs a similarity search between the user’s message and the array in the vector store. After similar embeddings are matched the LLM take those pieces of text and generates a cohesive human-like sentence.



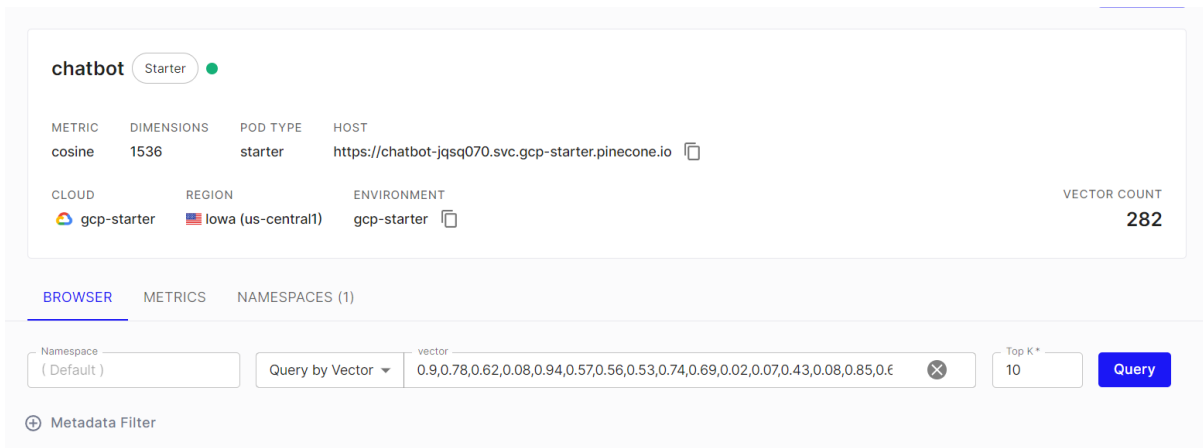


Figure 15. Pinecone vector database

In addition, a serverless database for storing chat histories provided by Upstash Redis is implemented into chatbot system. With additional database it is possible to review and examine all the conversations between the human and AI.

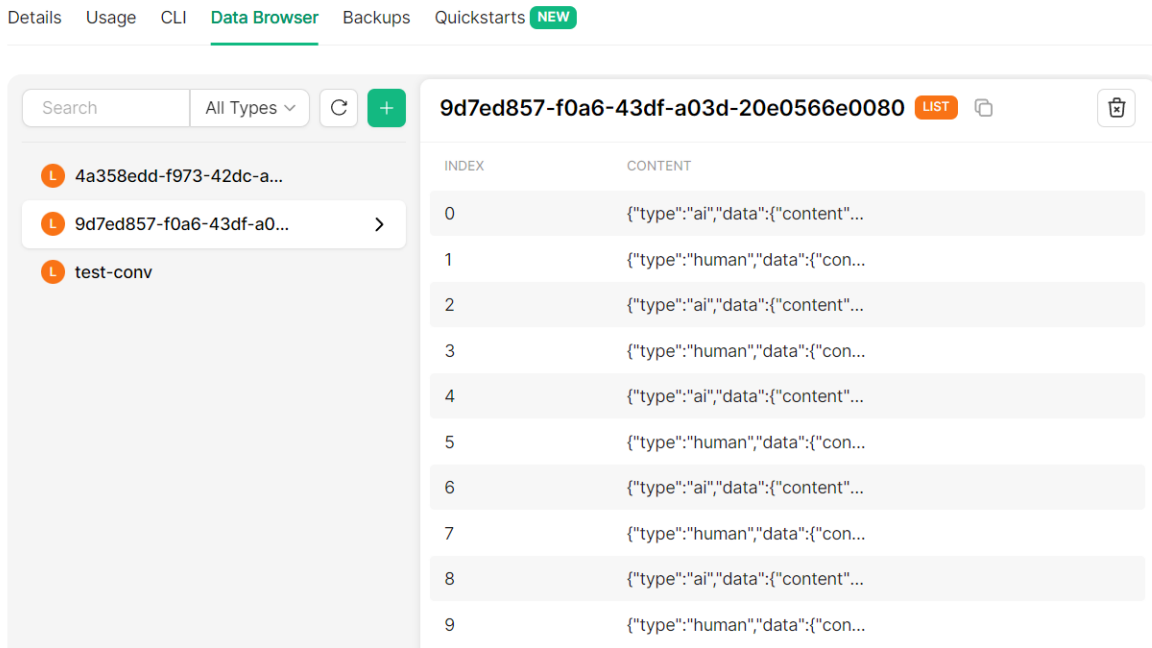


Figure 16. Upstash Redis database

The final chatbot system was created in Flowise using components from OpenAI, Pinecone and Upstash. It works fully autonomous and can save all conversation histories. The link to the prototype: <https://chatbot-assistant.onrender.com/chatbot/95f176b8-ca9c-491e-8415-25855b090b9c>

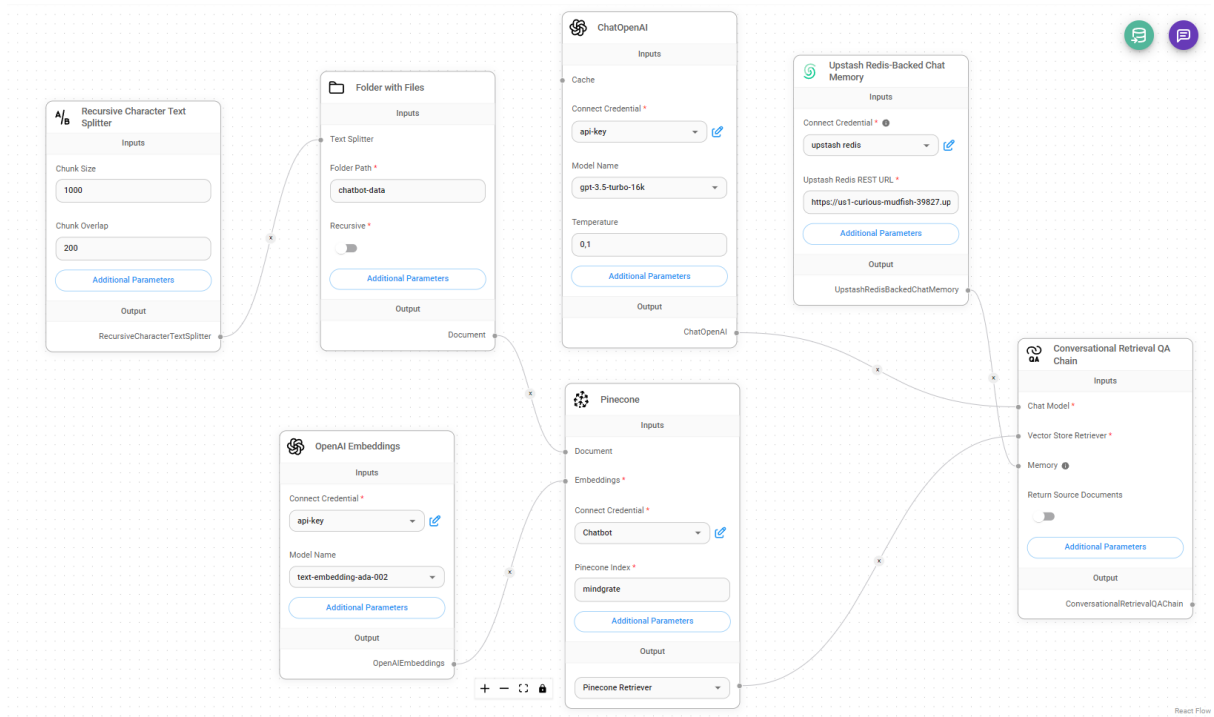


Figure 17. Flowise build

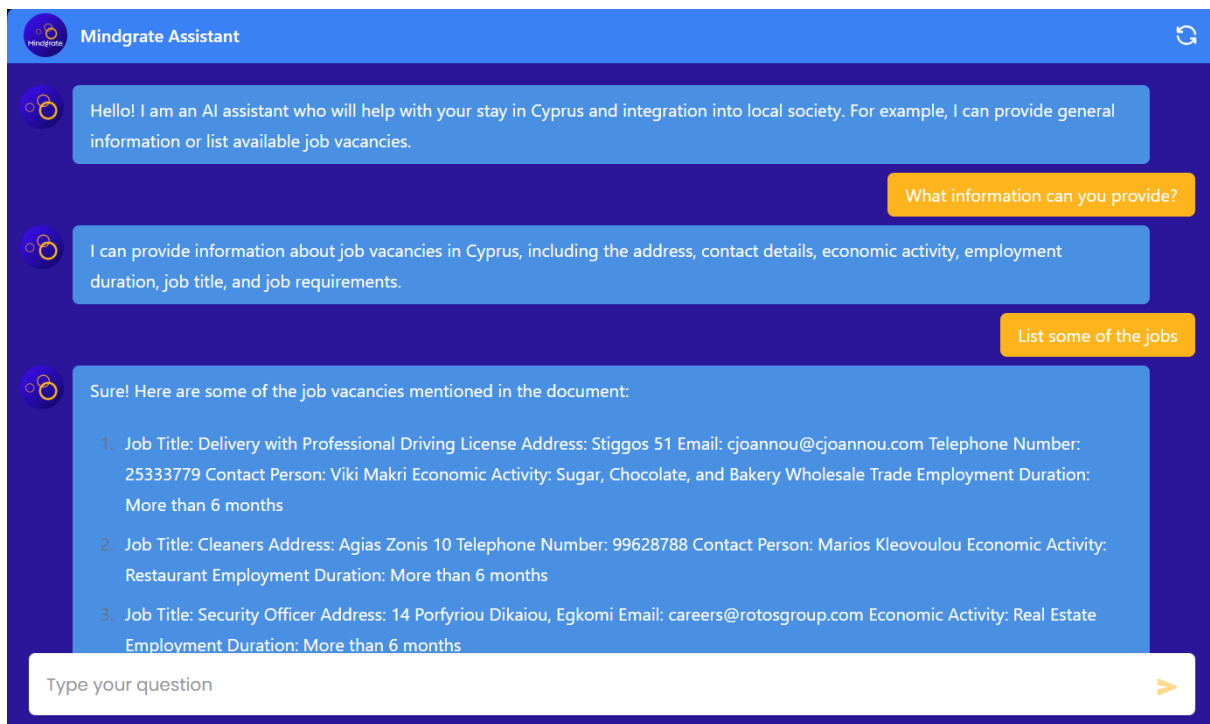


Figure 18. Final chatbot interface

## 7 EVALUATION

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Based on assessment of the prototypes created in the preceding chapter, it is possible to reliably decide whether the proposed system satisfies the research questions and goals. A user testing experiments are used to carry out this assessment. At first, the idea was to employ Prototype 1 in an experiment with migrants in Cyprus. However, because of technical and computing limitations that prevented the chatbot from being used during the experiment, a different experiment was carried out in its place. This chapter will include the participant input as well as the researcher's observations made throughout the experiment. The chapter will also evaluate the prototypes' capabilities by contrasting them with the specifications established during the specification stage.

### 7.1 EVALUATION METRICS

After the chatbot is live, it's critical to put strong analytics and monitoring in place to analyze its success and pinpoint areas for development. Several key performance indicators (KPI) were developed:

1. Task completion rate - (percentage of completed tasks)

Measures the effectiveness of the chatbot in assisting users with their intended tasks, such as finding information or getting guidance.

Based on specific tasks.

2. Fallback rate – (percentage of fallbacks to human assistance)

Identifies scenarios where the chatbot is unable to address user queries, leading to a transfer to human support. A lower fallback rate indicates better chatbot performance.

3. Clarity – (Coherence and readability of the answers)

4. User satisfaction – (on a scale of 1 to 5)

Gathers feedback on user experience and satisfaction through surveys or forms. At the end of work.

### 7.2 EXPERIMENTS

The experiments with participants were conducted in two different ways. First method included user tests with an older iteration of the AI chatbot, which means it required active participation from the researcher. The system was not autonomous enough to be tested by users alone. Therefore, the approach for those experiments was slightly different. It was possible to observe the participants in real-time and ask more questions. The list of questions can be viewed in Appendix A.

The latter method involved a more advanced chatbot that did not require any participation from the researcher and could be presented in the form of a survey. So it was sent to different groups of people like migrants in Europe as well as just locals. The form can be viewed in Appendix B. The main goal was to have a participant complete four representative tasks and get their feedback.

**Task 1.** Find out what kind of information this assistant can provide.

**Task 2.** Chatbot has a large database of available job vacancies and relevant information. Try to find a job that interests you based on the activity, title or any other characteristics.

**Task 3.** Find out what are the job requirements or if there any.

**Task 4.** Pretend as if you are an asylum seeker or a refugee. Ask any questions regarding language learning, or medical care, or employment.

These four tasks are practically the most representative questions that the user would ask. They cover most of the bot's capabilities since these questions are quite basic and aimed at most of the topics in the document. After collecting the responses to the tasks it is possible to assess the prototype based on formulated KPIs.

- Both offline and online methods have almost perfect completion rates. The smallest minority of people either did not complete all the tasks or completed but incorrectly.
- The fallback rate is also surprisingly minimal. In the online form, no one needed help at all, opposite to an offline experiment. Perhaps, the tasks were too easy, although they represent what the chatbot can do.

Did you feel the need to seek human help to answer your question?

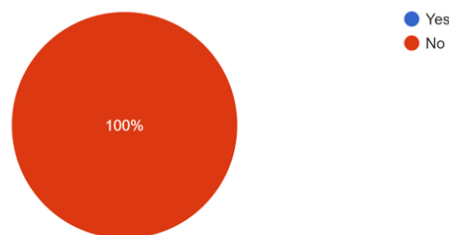


Figure 19. Chart

- The clarity of the answers was graded as maximum in all of the tests. This was expected, since this AI chatbot uses the latest GPT-3.5 language model and the temperature of the model was set to 0,1. The higher the temperature the more creative, unexpected and less focused the answers are.
- Scaling both types of experiments to a 1 to 5 range. The overall satisfaction could be rounded to 4 out of 5. This is quite an optimistic result, considering some of the limitations during the design process.

### 7.3 ETHICAL CONSIDERATION

There were a number of ethical issues to take into account. To make sure that the research was carried out with appropriate attention to ethical rules and principles, ethical approval was sought for the experiment. Since this project involves AI it raises various concerns, such as bias and validity of the information. The participants will be informed beforehand on how this system works, and what kind of topics this chatbot can talk about. The information in the documents is referenced to their sources, e.g. job information (address, contact, description, requirements etc.) is provided by Ministry of Labour, useful resources are from different NGO pages. The AI does not make any complex decisions here just searches through the documents and forms sentences, so the problem of validity is not concerning, and AI's decisions are pretty explainable. The users especially migrants, should be informed about

how their data will be used and must provide informed consent. Therefore, the purpose of data collection, usage, and storage are clearly communicated to them. The information letter and informed consent are in Appendix D.

## 7.4 REQUIREMENTS EVALUATION

It is critical to use the list of requirements while assessing chatbot's results. Each requirement is shown in the tables below, along with a description of how it has been addressed.

*Table 3. Requirements evaluation*

Requirements	MSCW	Met Req.	Description
Implement GPT-3 for robust natural language understanding	Must have	Yes	The chatbot uses full capacity of the GPT-3
Provide real-time translation and language support for migrants	Must have	Yes	It can translate the languages supported in OpenAI
Answer questions using information in the provided documents	Must have	Yes	Takes information from the documents
Can prioritize responses based on content explicitly provided in the documents	Must have	Partially	It will give a response based on the documents if the question is stated clearly. If it vaguely mentions the data, the bot will try to answer it itself
Clear and intuitive UI for easy navigation	Must have	Yes	Simplistic design
Response time within 2 seconds for user queries	Must have	Yes	Responses are very quick
Allow users to customize their profiles for a more personalized experience	Should have	No	There is no option to do that
Enhance responses by considering the context of previous interactions	Should have	Partially	Chatbot keeps the history of the conversations. However, if not refreshed the history of last session will transfer

			to the next session with a different user
Explore the possibility of integrating voice-based interactions for enhanced accessibility	Should have	No	Not able to do that
User feedback channels for continuous improvement	Should have	No	Not able to do that
Save chat history	Could have	Yes	Save chat history of each conversation in the database

## 8 DISCUSSION & FUTURE WORK

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This chapter covers the design process, prospects for further research and development, and an evaluation of the final prototype and its limitations.

### 8.1 DISCUSSION

Initially, the project started with a task to explore various ways in which ICT tools can be used to help migrants. The assignment was to discover a suitable solution that could be implemented into the Mindgrate application. Early on in the project's roadmap, it was decided to move the research closer to AI to investigate the potential for combining migrant support tools with LLMs. During the planning phase, the idea to use deep learning techniques and create an AI chatbot for migrants has emerged.

The plan was to build a working prototype embedded in a website and conduct experiments with actual migrants from Cyprus. However, since the previous iteration of the system, created with free libraries, did not function as expected, another approach was taken. The new iteration was designed with online services, capable of storing data records in the vector database, and capable of running on the server permanently. The functionality proved the new version to be much easier to test.

The experiments focused on testing the usability of the system based on specific key performance indicators. The tests revealed that users found it quite easy to comprehend and navigate through. The recent burst in AI development and the high popularity of ChatGPT definitely helped with understanding the system. The chatbot can effectively receive your message find similar matches in its knowledge base and formulate an answer based on given information. Participants noted as well that the time to send a message and get a reply from the AI is remarkably fast.

### 8.2 LIMITATION

One of the main two difficulties during the project's process was coding a system that would correctly retrieve information from the documents and continuously work on a hosted webpage. These parts would function separately but not at the same time. However, with an improved version of the chatbot, it was possible to conduct the experiments and expose



other innate constraints. While the chatbot operates effectively within the parameters of the provided data, the limitations in the dataset's breadth and depth are evident. The scope of the available documents limits the extent to which the AI can provide comprehensive and useful responses. However, this problem is solvable by doing more research and adding more different data to the documents besides. Right now it is only limited to some general knowledge collected from the NGOs and official Cyprus resources and the storage capacity in the vector database is capable of storing a thousand times of the current usage. This also leads to another problem. The small dataset might affect the user experience since consumers might run across situations where the chatbot is unable to answer their questions satisfactorily because the papers don't include pertinent information.

### **8.3 FUTURE WORK**

Talking about future work involving AI technology will lead to numerous potential solutions. The AI boom that just happened in the past few years continues to evolve and advance technology. However, in the context of this project, it does not seem to be necessary to update the current LLM for a higher more advanced version. As a language model, it plays its role splendidly already. Still, in light of the identified limitations and the success of the current prototype, there are several avenues for future work to enhance the chatbot's capabilities.

- First of all, provide a way for users to give feedback on the chatbot's operation. Examining user input can help identify areas for development and direct future versions.
- One of the distinctive features of more complex, usually paid, language models is multimodal capabilities. Explore how multimodal features like image and video processing can be integrated to help the chatbot extract information from more sorts of content, hence broadening its knowledge base.
- Conduct a more comprehensive ethical assessment of the chatbot's interactions. Due to constrained time limits, it was difficult to examine ethical issues such as bias and explainability. A good way would be to add functions to mitigate possible prejudices and preserve transparency in the chatbot's decision-making processes.

Lastly, to address those aspects there could be created a structure or framework for continuous assessment and observation of the chatbot's functionality. Frequent evaluations and modifications will boost the enhancement of the system and make sure that other features are not failing.

## 9 CONCLUSION

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This research examined the question of how AI technology and large language models can aid migrants in their journey towards social and financial integration. Specifically, the implementation of the LLM into a Mindgrate project was the main goal. With the patterns and knowledge it has learned throughout the training process, the model can comprehend and produce text that resembles that of a person. Utilizing this feature and building an AI chatbot for migrants can have a number of benefits, including offering a strong and adaptable tool to help migrants on their integration journey.

The research findings reveal numerous ways in which technology can assist individuals in their social integration. However, the available scientific research on financial assistance for migrants is relatively scarce. Addressing data privacy and security is an imperative aspect, especially in the context of utilizing AI. This underscores the significance of involving stakeholders, i.e. migrants, in the deployment of such technologies. Ultimately, the realm of technology presents myriad possibilities for aiding migrants. The literature study proposes that future research explores the implementation of automated chat agents, considering the ever-expanding landscape of LLMs and their immense potential.

This project navigated through the stages of problem clarification, ideation, development, and implementation, guided by Human-Centered Design principles. During the stages, there were conducted user testings and developed a comprehensive roadmap for the project. The development of the AI chatbot becomes a collaborative and user-driven process because the design process embraces the principles of HCD throughout these stages. This guarantees that the final solution effectively addresses the challenges faced by migrants.

After assembling a plan and gathering data it was time to build a working prototype. The first iteration was not fully functional so a new system structure was chosen. The chatbot now worked cleanly by splitting the documents into chunks of text and converting them into vectors. When the embeddings are stored in the database, whenever the user asks the question the LLM performs a similarity search, which means it will extract all documents that are related or similar to the question and retrieve the needed information. With this simplified method the chatbot is able to find information regarding job vacancies, medical care and others.

With a fully working prototype started the stage of evaluation. The experiments focused on assessing the system's usability using predefined KPIs. Results from the tests indicated that users perceived the system as easily understandable and fast. Although the chatbot demonstrates effectiveness within the constraints of the available data, the dataset's limitations in its amount become apparent. The scope of the provided documents constrains the AI's ability to deliver comprehensive and valuable responses. Nevertheless, that is one quite solvable issue but overall experience and effectiveness of the system are pretty evident.

This project is important because it may empower migrants, refugees and asylum seekers by giving them the resources they need to overcome obstacles and facilitate their financial and social integration. By utilising LLM and AI, people not only solve current issues but also build a larger story about the positive societal impact of technology. The development of solutions like AI chatbot is evidence of the revolutionary effects that creativity, driven by purpose and empathy, can have on people going through a difficult time.

In conclusion, the true impact is found in the application and deployment of these solutions, not in the theoretical frameworks. By incorporating these ideas into the larger discourse of migrant support, we provide the groundwork for a more connected, understanding, and economically empowered global community.

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# APPENDIX

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Search terms: “migrants” AND “integration” AND “technology” OR “ICT tools” OR “AI”, “migrant integration”

## APPENDIX A

### General user experience:

1. How would you rate your overall experience with the chatbot on a scale of 1 to 10?
2. Did you find the chatbot easy to use and navigate?
3. Were you able to accomplish your goal or find the information you were looking for?

### Effectiveness in providing Information:

4. Did the chatbot provide accurate and relevant information?
5. Were the responses from the chatbot helpful in addressing your queries or concerns?
6. Did you encounter any instances where the chatbot misunderstood your input?

### User engagement and efficiency:

7. How would you describe the tone and language used by the chatbot? Was it friendly and approachable?
8. Did you feel engaged during the conversation with the chatbot, or did it feel robotic?
9. Were there any points during the interaction where you felt frustrated or confused?
12. How quickly did the chatbot respond to your queries?
13. Did you feel that the chatbot efficiently guided you through the conversation?
14. Were there delays or lags in the chatbot's responses?

### Awareness of limitations:

15. Were you aware of the chatbot's limitations in certain areas or scenarios?
16. Did the chatbot effectively guide you to seek human assistance for more complex issues?
17. Were there instances where you expected the chatbot to perform a task but it couldn't?

### Accessibility:

18. Did you find the chatbot accessible in terms of language and readability?
19. Were there any challenges in using the chatbot on different devices or platforms?

### Suggestions for improvement:

22. What additional features or functionalities would you like to see in the chatbot?
23. Are there specific areas where the chatbot could improve in terms of user experience or information delivery?

**Future Use:**

- 24. Would you use the chatbot again in the future?
- 25. How likely are you to recommend the chatbot to others?

**Additional Feedback:**

- 26. Do you have any additional comments or suggestions regarding your experience with the chatbot?

# APPENDIX B

19/02/2024, 08:25

Research on the use of AI for migrant integration

## Research on the use of AI for migrant integration

**Purpose of the Research:** The primary goal of this research is to examine how AI chat assistant can help migrants with financial and social integration. We aim to find in what aspects is chatbot effective for assisting with intended tasks, such as finding information or getting guidance. We will gather feedback on user experience and satisfaction.

**What Will Happen:** During the research session, you will be using chatbot to complete certain tasks and to ask your questions. The session is expected to last approximately 5-7 minutes.

**Risks of Participating:** This research project has been reviewed and approved by the Computer & Information Sciences (CIS) ethical committee.

**Withdrawal from the Study:** Your participation is entirely voluntary, and you may choose to withdraw from the study at any point without providing a reason. Your decision to withdraw will not have any impact on your relationship with or any associated entities.

If you have any questions or concerns, please feel free to contact us at [b.onqar@yzyv@student.uhwerite.nl](mailto:b.onqar@yzyv@student.uhwerite.nl).

Thank you for considering participation in our study.

\* Indicates required question.

1. What is your age group?

Mark only one oval.

- 18 - 24  
 25 - 35  
 35 - 45  
 46 - 65  
 65 or more

<https://docs.google.com/forms/d/1-GjVlguXjy9wM9vSGDcJRBuX7pGyGPqafV7yokid/>

15

19/02/2024, 08:25

Research on the use of AI for migrant integration

2. Do you have an experience with moving and integrating into another country? \*

Mark only one oval.

- Yes  
 No

3. Do you live in Cyprus? \*

Mark only one oval.

- Yes  
 No

### Test the system

You will be given access to a chatbot assistant that we designed as part of the project that helps migrants in Cyprus with their financial and social integration. This AI assistant has various knowledge regarding employment, education, health support etc. from official sources. We want you to try to complete a few tasks and explore its capabilities yourself.

Follow the link: <https://chatbot-assistant.onrender.com/chatbot/95f176b8ca9c491e841525855b090b9c>

### Task 1

Find out what kind of information this assistant can provide.

### Task 2

Chatbot has a large database of available job vacancies and relevant information. Try to find a job that interests you based on the activity, title or any other characteristics.

### Task 3

Find out what are the job requirements or if there any.

### Task 4

Pretend as if you are an asylum seeker or a refugee. Ask any questions regarding language learning, or medical care, or employment.

19/02/2024, 08:25

Research on the use of AI for migrant integration

### Questions

4. Could you complete all the tasks? \*

Mark only one oval.

- Yes  
 No

5. If not, what tasks did you complete?

Check all that apply:

- Task 1  
 Task 2  
 Task 3  
 Task 4

6. Were the answers understandable? \*

Mark only one oval.

- Yes  
 No

7. Did you feel the need to seek human help to answer your question? \*

Mark only one oval.

- Yes  
 No

19/02/2024, 08:25

Research on the use of AI for migrant integration

8. How long does it take to answer your questions? \*

Mark only one oval.

- 1 2 3 4 5  
Very      Very Fast

9. What is your overall satisfaction with the chatbot? \*

Mark only one oval.

- 1 2 3 4 5  
Poor     Great

10. What other features or changes would you add to improve this AI assistant?

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Google Forms



## APPENDIX C

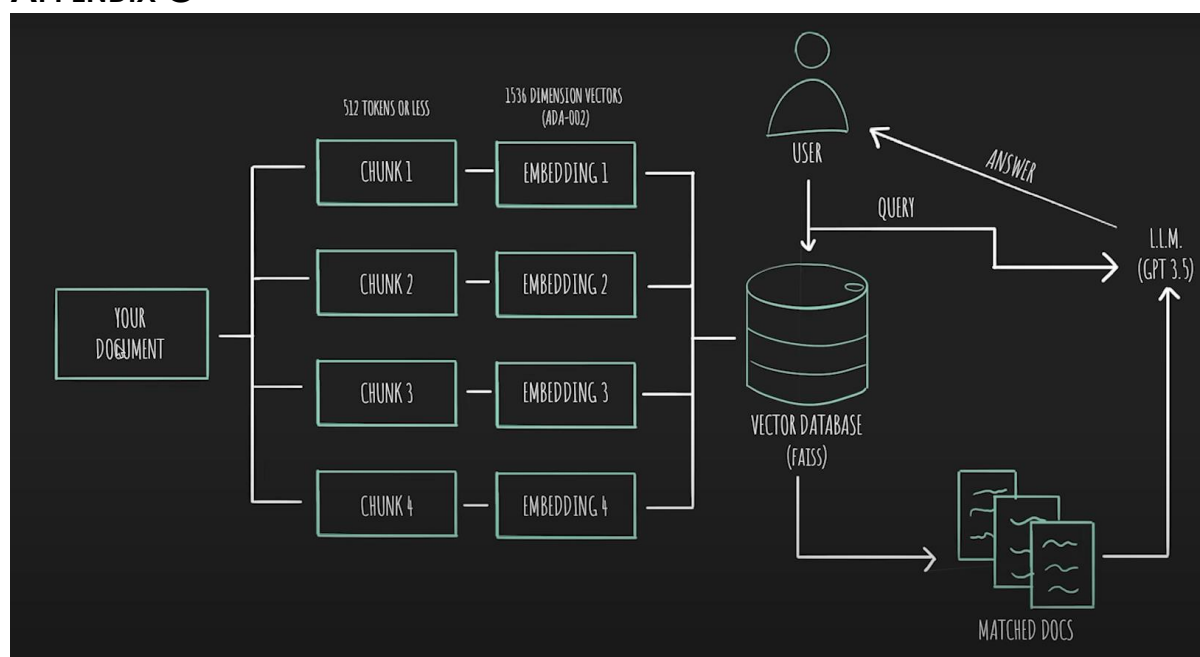


Figure 20. System diagram

Table 4. ICT solutions

Global ICT solutions providing information for migrant workers	
<b>MigApp</b> Launched 2017	MigApp is a mobile phone app that offers reliable and practical information to help migrants make well-informed decisions pre-departure, during transit and upon arrival. It provides information and tools related to money transfer services, visa regulations, health care options, rights in specific countries, and voluntary return options.
<b>Migrants as Messengers</b> West Africa Launched 2017	Migrants as Messengers is a peer-to-peer awareness-raising campaign that empowers young people in West Africa to make informed decisions about migration by leveraging digital communications technologies. Implemented across three countries in Senegal, Guinea, and Nigeria between 2017 and 2019.
Asia-based ICT solutions providing information for migrant workers	
<b>BdeshJaatra</b> Bangladesh Launched 2020	BdeshJaatra is a mobile phone application and information platform that was developed by IOM in collaboration with BDjobs, Bangladesh's largest jobs site, to deliver migrant-friendly information services. The app contains information that is relevant to prospective migrants, migrants currently overseas, and returnee migrants such as remittance management, medical services and legal services.
<b>Miss Migration</b> Myanmar Launched 2018	Miss Migration (Mel Shwet Pyaung) is a Facebook chatbot that was developed and is managed by IOM X with support from USAID as part of a regional anti-trafficking campaign. The chatbot processes information queries and directs users to official migration information on government websites to help them make informed migration decisions. Miss Migration is regularly updated by IOM to answer questions related to procedures for regular migration, security during migration, and rules and regulations in destination countries.

<b>Corridor-specific ICT solutions providing information for migrant workers</b>	
<b>Shuvayatra</b> Nepal Launched 2016	The Asia Foundation, the Non-Resident Nepali Association (NRNA) and Young Innovations created and manage “Shuvayatra” (Safe Journey), a mobile application that provides Nepali migrant workers with the tools that they need to plan a safer period of travel and work abroad. The mobile app connects the user to multimedia content supplied by a consortium of experts, advocates and peers. Migrants can access quick capsules of relevant information on a range of topics such as practical financial information, changes in government rules and procedures regarding migration, services offered by Nepali Embassies abroad, contact information for migration-related organizations, and read stories and advice written by other Nepali migrants currently living abroad.
<b>FDH Portal</b> Hong Kong SAR Launched 2016	The Foreign Domestic Helper (FDH) Portal of the Hong Kong SAR Labour Department is a one-stop online platform that helps FDHs to understand their rights and benefits before coming to work in Hong Kong SAR. The website is available in English, Chinese, and the top ten most spoken native languages by FDHs. In addition to extensive housing information, there is an integrated form for FDHs and employers to make enquiries and complaints. There is also a dedicated 24-hour hotline to provide support for FDHs seeking advice on their employment rights and obligations.

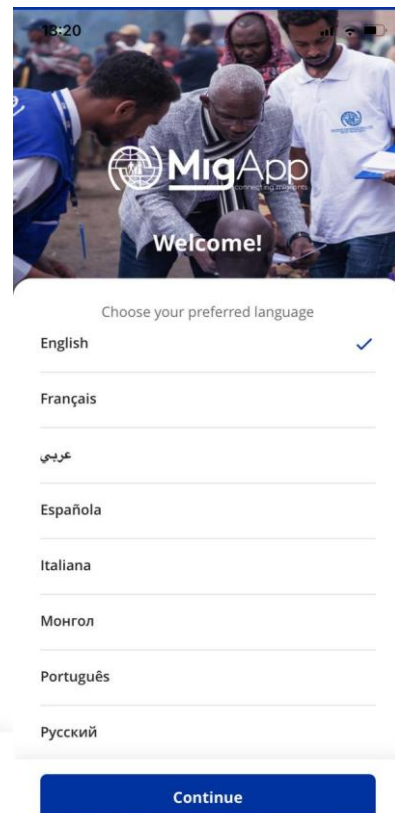
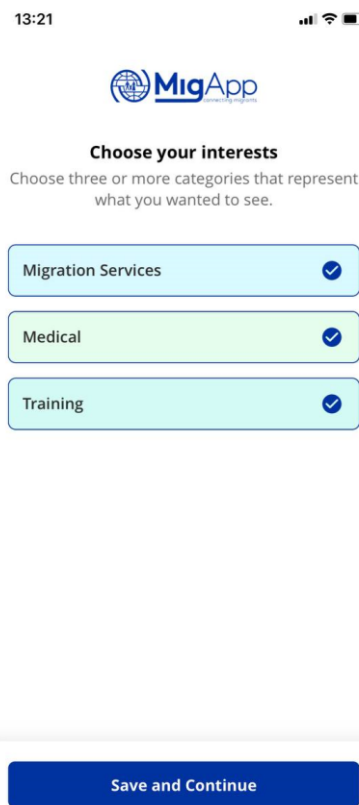
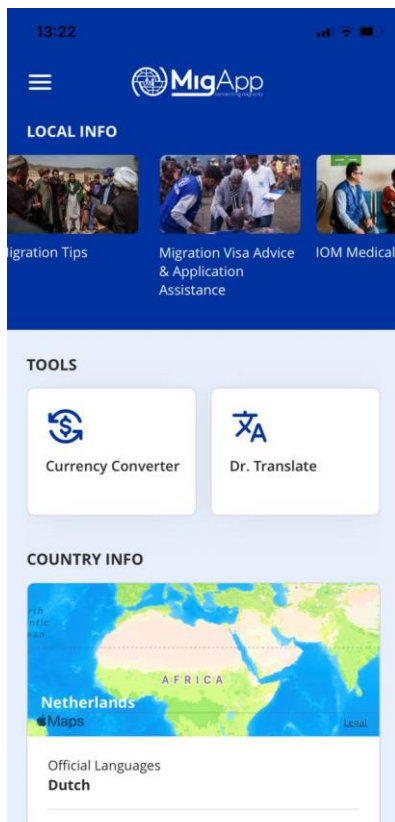
## Existing Applications

1. <https://oecd-development-matters.org/2022/02/07/how-migrants-can-best-benefit-from-the-use-of-digital-tech/>

The **InfoAid app**, for example, launched by **Migration Aid** in Hungary amid considerable publicity in 2015 to make life easier for migrants travelling to Europe.

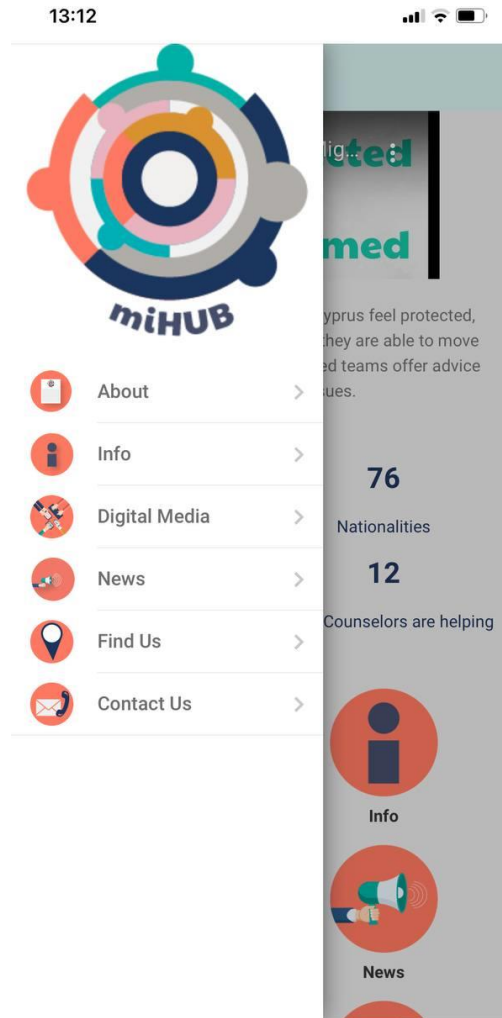
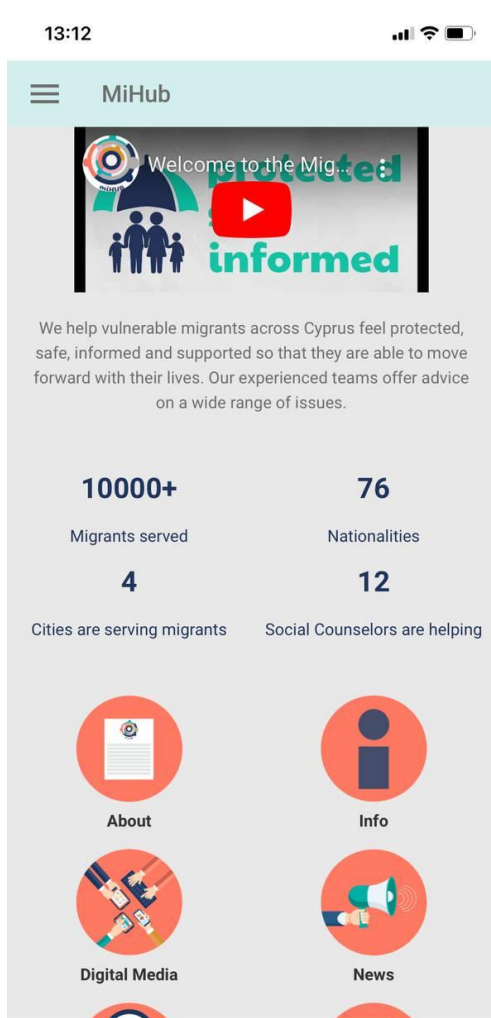
2. <https://rosanjose.iom.int/en/blogs/how-does-technology-help-migrants-central-america>

The International Organization for Migration (IOM), developed the MigApp application (formerly under the name MigrantApp) to answer the most frequent questions and needs of migrants, before, during and after their journey. It is a tool that focuses on relevant information and excludes "boisterous" content.



3. <https://mihub.eu/en/>

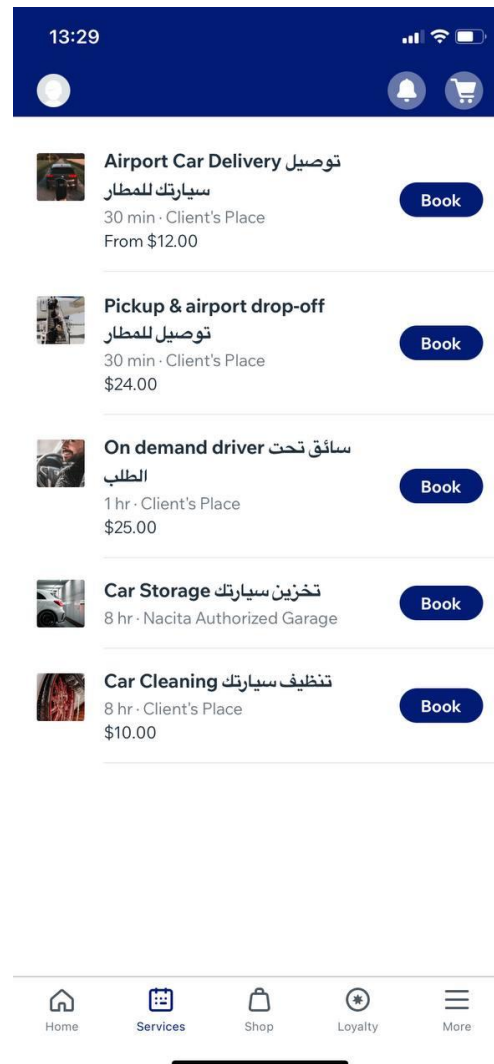
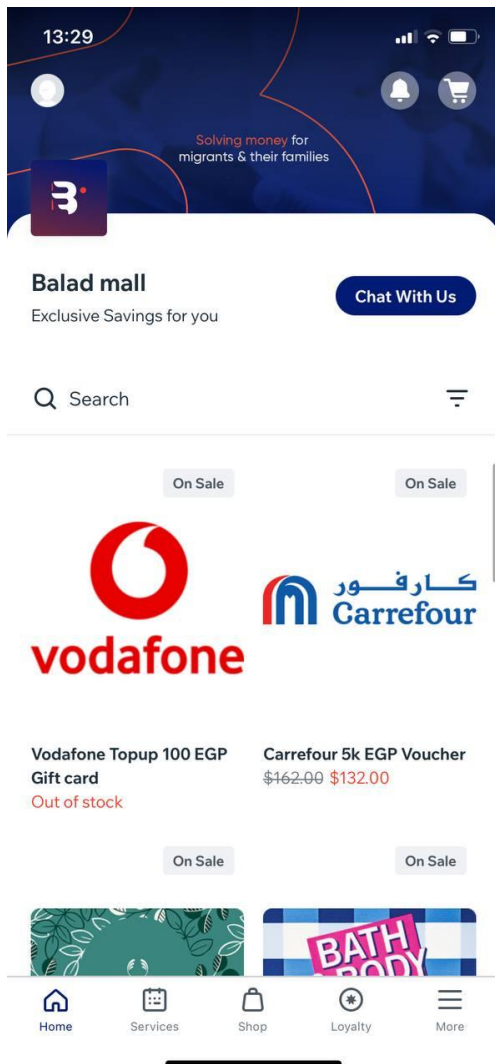
The [University of Nicosia](#) in collaboration with the research organisation [CARDET](#) and the [Cyprus University of Technology](#) implements the Action entitled: **Migrant Info-Centre CY/2020/AMIF/SO2.NO2.1.3/ 4**



#### 4. Ballad mall - Egyptian Migrants Marketplace

*Are you an Egyptian living far from home, working hard to support your loved ones back in Egypt? Balad understands the challenges you face, and we're here to make your life easier. Welcome to Balad, your ultimate savings and discount destination designed exclusively for Egyptians living abroad.*

Balad is more than a marketplace; we're your financial partner in your journey abroad. Our mission is to make your life easier and ensure that you can provide for your family and loved ones in Egypt without hassle.



## AI implementation

### 1. TARS Immigration Services ChatBot

<https://hellotars.com/chatbot-templates/travel/H1mUrB/immigration-services-chatbot>

People these days are migrating themselves in search of jobs and a better lifestyle. But to get settled in a different country requires expertise and adequate knowledge about the immigration process, eligibility, and the right type of visa. With this Immigration services chatbot, you can solve all the queries of your customers and also capture leads even after business hours.

Template can be used for integration into a messenger.

### 2. AI-driven chatbot for refugees helplines

<https://qudata.com/en/ai-ml-case-studies/an-ai-driven-chatbot-for-refugees-helplines/>

Intending to provide quick and quality assistance to refugees, we developed a chatbot that operates 24/7 across popular communication channels like Telegram, Viber, Facebook Messenger, and the web. The result is a flexible and efficient chatbot that significantly reduces response time and supports the needs of refugees seeking information and assistance.

Main goal is to help Ukrainian refugees. Chatbot used several modules and an additional NLU processing module.

### 3. The All-In-One Relocation Platform Built For Immigrants

<https://immibot.ai>

A revolutionizing way to navigate complex immigration procedures & requirements.

### 4. MyWelcome agent

[https://link.springer.com/chapter/10.1007/978-3-030-85739-4\\_26](https://link.springer.com/chapter/10.1007/978-3-030-85739-4_26)

The first assessment of the functionality of the prototype by TCNs, NGOs and governmental institutions indicates that the information provided by the MyWelcome agent is useful, supports the TCNs in their concerns and alleviates the workload of NGO workers and officers.

## APPENDIX D

Information Letter for Research Participation

**Purpose of the Research:** The primary goal of this research is to examine how AI chat assistant can help migrants with financial and social integration. We aim to find in what aspects is chatbot effective for assisting with intended tasks, such as finding information or getting guidance. We will gather feedback on user experience and satisfaction.

**What Will Happen During the Session:** During the research session, you will be using chatbot to complete certain tasks and to ask your questions. The session is expected to last approximately 10 -15 minutes.

**Benefits and Risks of Participating:** This research project has been reviewed and approved by the Computer & Information Sciences (CIS) ethical committee.

**Withdrawal from the Study:** Your participation is entirely voluntary, and you may choose to withdraw from the study at any point without providing a reason. Your decision to withdraw will not have any impact on your relationship with or any associated entities.

**Personal Information and Data Privacy:** During the research session, we may collect certain personal information, such as age and profession. This information will be handled with the utmost confidentiality and used only for the purposes of this research. You have the right to request access to, rectification, or erasure of your personal data by contacting [b.ongarbayev@student.utwente.nl](mailto:b.ongarbayev@student.utwente.nl).

**Usage of Data During Research and Safeguarding Personal Information:** The data collected will be used exclusively for research purposes and will be anonymized to protect your privacy. Confidentiality will be maintained, and your personal information will be securely stored on the researcher's personal drive until the results are published. No personally identifiable information will be disclosed in any publications or presentations resulting from this research.

If you have any questions or concerns, please feel free to contact Baur Ongarbay at [b.ongarbayev@student.utwente.nl](mailto:b.ongarbayev@student.utwente.nl).

Thank you for considering participation in our study.

### Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science: [ethicscommittee-CIS@utwente.nl](mailto:ethicscommittee-CIS@utwente.nl)

# Consent Form for research on the use of ICT tools for migrant integration

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

*Please tick the appropriate boxes*

## Taking part in the study

- I have read and understood the study information dated \_\_/\_\_/\_\_\_\_, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.
- I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.
- I understand that taking part in the study involves interacting with the system online and answering the survey.

## Use of the information in the study

- I understand that information I provide will be used for future publications and reports. Outcomes will be used for improvement of the system.
- I understand that personal information collected about me that can identify me, such as age and occupation, will not be shared beyond the study team.
- I agree that my information can be quoted in research outputs

## Future use and reuse of the information by others

- I give permission for the conversation and the answers that I provide to be archived on local drive.
- I agree that my information may be shared with other researchers for future research studies that are similar to this study. The information shared with other researchers will not include any information that can directly identify me. Researchers will not contact me for additional permission to use this information.
- I give the researchers permission to keep my contact information and to contact me for future research projects.

**Yes No**

**I agree with everything above**

## Signatures

\_\_\_\_\_  
Name of participant [printed]

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

## Study contact details for further information:

Baur Ongarbay, [b.ongarbayev@student.utwente.nl](mailto:b.ongarbayev@student.utwente.nl)