

Design of helpdesk service for migrants

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ABSTRACT

This paper presents a research study that employed User-Centered Design (UCD) and participatory design (PD) principles to explore the frequently asked questions and prevalent needs of new migrants. The objective was to develop a prototype of an information system that effectively addressed and fulfilled these identified needs. The research process involved conducting workshops and engaging with new migrant participants to gather their insights and perspectives. By incorporating their input, a comprehensive understanding of the migrants' concerns and requirements was obtained. Using this knowledge, a prototype of an informational system in the form of a Telegram Bot was designed and implemented to provide accessible and relevant information to new migrants, facilitating their integration into Swedish society. The prototype underwent user evaluation, and although some suggested improvements were identified, the overall response was positive. This study highlights the value of UCD and PD in creating user-centric solutions that meet the specific needs of new migrants, enabling them to access essential information and support during their integration process.

CCS CONCEPTS

- Software and its engineering~Software creation and management~Designing software~Software design engineering
- Human-centered computing~Interaction design~Interaction design process and methods~Participatory design
- Human-centered computing~Human computer interaction (HCI)~HCI design and evaluation methods~Usability testing

KEYWORDS

UCD, participatory design, chatbot, design workshop, migrants

1. INTRODUCTION

In 2022 as a result of the Russian invasion of Ukraine Europe accepted millions of refugees [1,2]. Which became a huge challenge for the infrastructure of the host countries [3,4]. However, this wave of forced migration was not the first one in modern history. The previous migration surge in 2015 was a result of a complex combination of conflicts, including the Libyan civil war, the Syrian civil war, and the 2014-2017 War in Iraq. Prior to this, the highest volume of applications received by Europe was in response to the Yugoslav Wars in 1992. These waves of migration

caused a number of challenges for local authorities and society as a whole [5, 6]. It has been proven that successfully integrating migrants into a new environment is crucial not only for newcomers' well-being [19, 20, 31] but also for the safety and prosperity of host countries [21, 22].

Even though hundreds of papers related to HCI application to the migration processes were published in the recent decade [18], there is still plenty of work to do to improve the experience of both migrants and host countries' citizens [18].

2. RELATED WORKS

Initially, Participatory Design (PD) aimed to promote workplace democracy [7, 8, 9]. However, it has also been recognized as a remarkably adaptable method, capable of being customized to various contexts, population groups, and circumstances. Consequently, it has been extensively employed as an approach with numerous vulnerable populations, including the elderly [10, 11, 12], children [13, 14], and forced migrants [15, 16, 17]

Participatory Design is an approach that seeks to design systems by establishing a connection and fostering collaborative work between the targeted user group and the developers. In the past, these groups were often isolated from each other during the design process, primarily due to their divergent levels of experience [7, 8]. To tackle this challenge, Participatory Design facilitates the establishment of a novel collaborative space known as "the third space". This space encourages a collaborative process that integrates the experiences of both groups through innovative forms of communication [9]

A great example of the benefits provided by "the third space" has been shown by Jensen et al [30]. Digitalization is perceived by the younger generation as an absolute blessing. However, it has been discovered that not only do refugees face trouble with a new language, they additionally face trouble with using computers and smartphones. Elderly people, people who arrived from the poorer regions, experience a lot of stress when they are pushed to use online forms and digital materials instead of communicating with real people.

Approaching PD Poyer et al. [31] found that teachers prefer not to be labeled as "refugee teachers" to avoid feelings of exclusion and discrimination. Avoidance of labeling enabled an opportunity to build a more trustful, respectful, and equal atmosphere among researchers and respondents. Creating a "safe space" for workshops and

other PD activities is crucial for reaching the highest possible level of engagement and productivity of participants [15].

3. RESEARCH AIMS AND HYPOTHESES

The primary research problem is centered around facilitating access to and comprehension of vital information for the successful integration of migrants into a new society. The proposed design hypotheses suggest the ability to create a comprehensive list of topics and questions covering basic new migrants' needs, and delivering answers to these questions through a chatbot. The research includes conducting an investigation of new migrants' needs and problems. The artifacts of this work include a list of identified migrants' needs and the development of an information system prototype in the form of a Telegram bot as a practical solution.

4. WORKSHOP

4.1 Motivation and goals

By following the principles of UCD and PD, potential users are empowered to have a say in shaping the system they will be using. The usage of the collaborative approach will likely result in a more user-friendly and effective system which is a win-win situation for both researchers and users [34].

Therefore we conducted a workshop to gather real emigrant opinions on the most significant problems in the existing information systems and public services, particularly regarding information that is difficult to find or comprehend. It is a proactive step towards understanding real migrants' needs and incorporating their perspectives into the design process.

4.2 Recruitment of participants

To attract participants, the idea of the workshop was presented at the local IT conference. As a result, a total of eight individuals signed up. Among them, four males and four females, five are married, and four have children. They come from various countries, namely Iran, Iraq, Albania, India, and Afghanistan. The participants' ages range from 25 to 42 years old. These individuals have immigrated to Sweden relatively recently, with their arrival ranging from four to twenty months ago. Although none of the participants are native English speakers, they all rate their English skills as advanced. So the English language was used during the workshop.

4.3 Workshop activities



Figure.1 The voting process

The workshop was conducted offline. Its program consisted of several steps designed to facilitate productive discussions and engagement among the participants:

Step 0: Ice breaker game

Ice breaker activities are often used at the beginning of design workshops to establish a positive and collaborative atmosphere among participants. The Game called 'Hat' was chosen as an icebreaker activity. It is a game in which participants take turns pulling out papers with words or phrases related to emigration from a hat and try to demonstrate them using gestures, movements, and facial expressions. Other participants attempt to guess. The goal of the Hat Game is to stimulate creative thinking, associative abilities, and the generation of new ideas.

Step 1: Individual experience

During this step, the participants were asked to briefly describe on stickers the most important problems and questions that were relevant to them in the first week, first month, first six months, and first year of their emigration. So that each participant had the opportunity to share their individual experiences.

Step 2: Key problem identification

The whole group worked together to find similar stickers and left unique ones on the board. Afterward, participants were given 5 small stickers each for a voting process to determine the most important topics or issues that the group wanted to focus on. It was possible to put more than one vote on a topic (see Figure 1). When everyone had voted, only the stickers with 3 or more votes were left on the board.

Step 3: Card sorting

In this step, the participants engaged in an open card sorting activity. The task was to group stickers on the board

based on their topic and provide meaningful names for the final groups.

Step 4: Discussion

During this step, the participants proposed and discussed potential solutions or approaches to address the problems identified in the previous step. The group engaged in constructive discussions, sharing their ideas, insights, and perspectives. This collaborative process allowed for the exploration of different viewpoints.

Step 5: Reflection

The final step of the workshop program involved reflection. Participants had the opportunity to reflect on the workshop's activities, discussions, and outcomes. This reflection phase enabled individuals to consolidate their learnings, identify key takeaways, and consider how the insights gained during the workshop could be applied to their respective contexts. One of the participants said: "I have never been asked about the emigration challenges, even by myself. I never felt like it was appropriate to complain."

4.4 Outcome of the workshop

The outcome of the workshop led to the selection of five key topics that were identified by participants as the most important. These topics will be addressed by the prototype. For ease of presentation, short aliases have been assigned to each topic. There are getting a social security number (pn), opening a bank account (bank), renting an apartment (apartment), learning the local language (swedish), and going through cultural differences (culture).

Additionally, one of the subjects that emerged was the emigrants' perplexity regarding free language courses. Not everyone was aware of free language courses' existence. But even those who knew of them and expressed a willingness to participate highlighted a lack of clarity regarding the necessary steps to initiate the course. That is why providing clear instructions about joining language courses was chosen as one of the main features of the prototype.

5. PROTOTYPE

5.1 Prototype Design

5.1.1 Architecture

The interactive prototype of the information system, that can help migrants find answers to their questions, was decided to create in the form of a Telegram chatbot. Chatbot prototype has received positive feedback from migrants who participated in previous research, indicating that dialogue-based interfaces are perceived as supportive and user-friendly [23]. Another reason to choose this form for the prototype was cost efficiency. There is no need to develop a graphical user interface or to think about the

delivery of service to the users' devices. It is also easy to collect users' feedback and save other statistics.

Instruments of Amazon Web Services were chosen for the implementation and hosting of the prototype. AWS provides a rich set of developer tools, SDKs, and APIs that simplify the development, deployment, and management of your chatbot. Additionally, AWS has a large community of developers and resources available, including documentation, forums, and support so it was a reasonable choice.

For the first step of prototype design we used C4 diagram [24]. C4 diagrams provide a clear and concise way to represent the architecture of a system at different levels of abstraction. They allow system designers to focus on key elements and their relationships. Each level of the diagram provides increasing levels of detail and granularity, allowing designers to navigate from high-level system context to specific components.

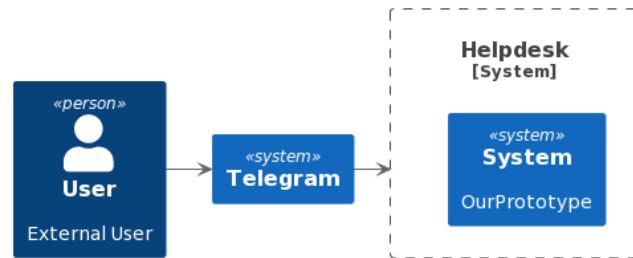


Figure 2. C4 Level 1: System Context Diagram

The first level of C4 is the system's context diagram. It illustrates the system's external dependencies and interactions with other systems or actors. It helps in identifying the boundaries and interfaces of the system and its interactions with external entities.

Here is a description of the components and their relationships in the diagram (see Figure 2). The user sends requests or messages to our system via Telegram. Helpdesk boundaries represent our system's boundaries. It receives messages from the user through Telegram and processes them accordingly.

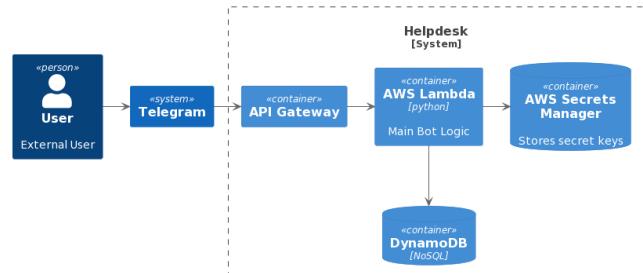


Figure 3. C4 Level 2: Container diagram

The second level of the C4 diagram (see Figure 3) introduces the concept of Containers, which represent the major technology platforms or subsystems within the system. This decomposition aids in understanding system modularity and facilitating scalability and maintainability.

Despite the User and Telegram bot blocks that were presented in the first level second level contains more blocks:

- API Gateway: This component is part of the AWS infrastructure and serves as a gateway to our system. It handles incoming requests from Telegram and forwards them to the lambda function.
- AWS Lambda: This component represents the serverless computing service provided by AWS. It contains the main logic of our bot, processing incoming requests and generating responses. AWS Lambda functions are triggered by API Gateway upon receiving requests from Telegram.
- DynamoDB: This component represents the NoSQL database service provided by AWS. It is used to store and manage data related to our bot, such as session state and users' feedback. The NoSQL database was chosen because AWS provides generous free usage of DynamoDB. Also, NoSQL databases offer a flexible data model that can adapt to evolving requirements which is perfect for early prototypes.
- AWS Secrets Manager: This component is another service provided by AWS. It is responsible for securely storing and managing secret keys or sensitive information used by our system, such as API keys or access tokens.

In the third level of the C4 diagram (see Figure 4), we delve deeper into the internal components of our system, providing more detail about the functionalities and relationships. Here's a description of the components and their relationships:

- Bot Message Handler: This component is responsible for receiving incoming messages from API Gateway and managing the flow of conversation with the user. It handles message parsing, routing, and generating appropriate responses.

- Bot State Manager: This component tracks and manages the state of the conversation with the user. It keeps track of the current context, user preferences, and any relevant session information.
- Feedback Manager: This component handles the collection and processing of user feedback. It captures and saves user feedback regarding their experience with the chatbot or the system.
- Sklearn Model: This component represents a machine learning model, specifically a topic recognition model built using the Scikit-learn library. It is responsible for analyzing and categorizing user messages into specific topics.

5.1.2 Topic Recognition

Based on the workshop results, a set of five topics was chosen to be covered by the bot prototype. There are 'culture', 'swedish', 'apartment', 'bank', and 'pn'. The goal was to recognize the topic of users' free input.

The set of 933 questions from the real users of the Reddit community r/TillSverige was collected using Reddit's API. Questions were manually labeled with one of 5 of our topics. The set was used to train different versions of Kmeans models [28] from sklearn package [29].

To evaluate the models' quality and choose the best one the following metrics from the sklearn.metrics package were used:

- Homogeneity, which measures the extent to which each cluster contains only samples from a single class. Higher homogeneity scores indicate better clustering results [27].
- Completeness, which measures the extent to which all samples from the same class are assigned to the same cluster. The model with the highest completeness score indicates better clustering performance in terms of

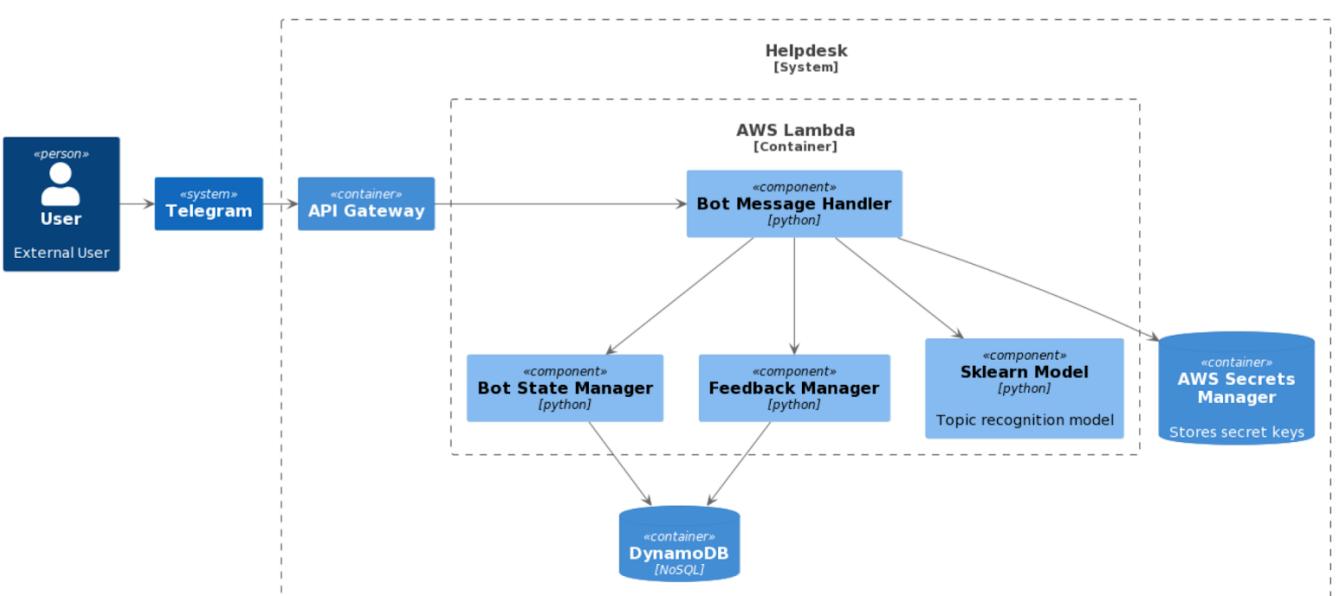


Figure 4. C4 Level 3: Component diagram

- correctly grouping samples from the same class into the same cluster [27].
- V-measure, which combines both homogeneity and completeness into a single metric. The model with the highest V-measure score indicates better clustering performance [27].
- Adjusted Rand Index (ARI), which measures the similarity between the clustering results and ground truth labels. The higher the ARI value, the better the clustering performance in terms of similarity to the ground truth labels [26].

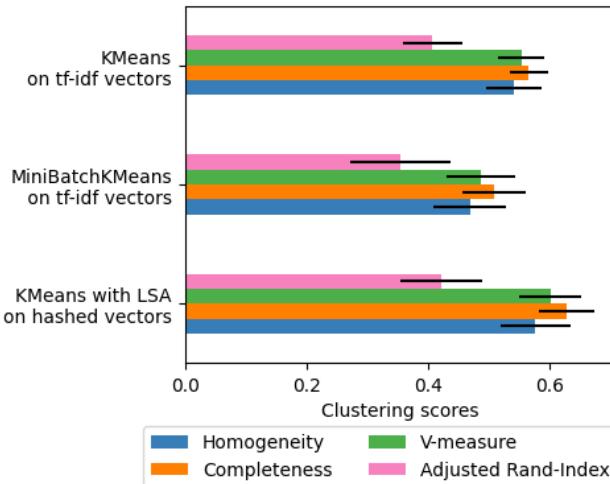


Figure 5. Quality metrics for different versions of Kmeans model

The best results had shown Kmeans with LSA on hashed vectors model (see Figure 5). That is why it was chosen for the topic recognition in the bot.

5.1.3 Main features

One of the topics that were raised during the workshop was the confusion of emigrants about free language courses.

Almost everyone had heard about them, and the majority were willing to join them. However, nobody had a clear understanding of what needed to be done to start the course. So the following User Story was formulated:

*"As a new immigrant in Sweden,
I want to know how to apply for the free language courses
so that I can join them as soon as possible."*

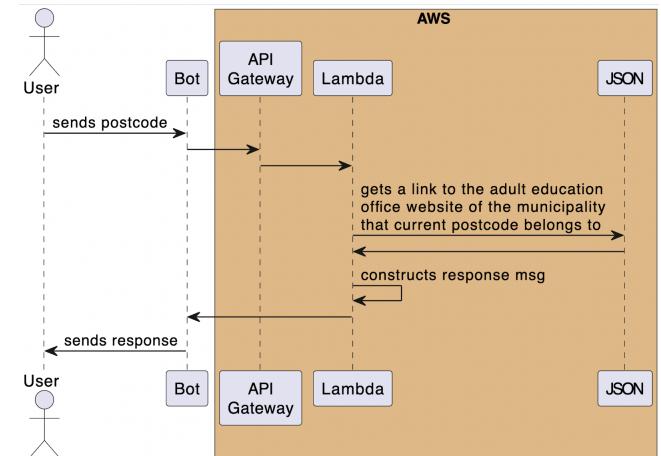


Figure 6. Sequence diagram: getting a link to the needed website to apply for free language courses

The main obstacle for migrants to start the application process was not knowing where to apply. Adult education is handled by municipalities. This is not obvious for migrants. Additionally, it is hard for migrants to find out which municipality they belong to. So the feature aimed to solve this problem was proposed: users can get the link to the particular municipality's adult education website base by entering their postcode (see Figure 6). Since all public APIs had very strict call limits all the data needed for the current feature was prefetched and stored in a JSON file.

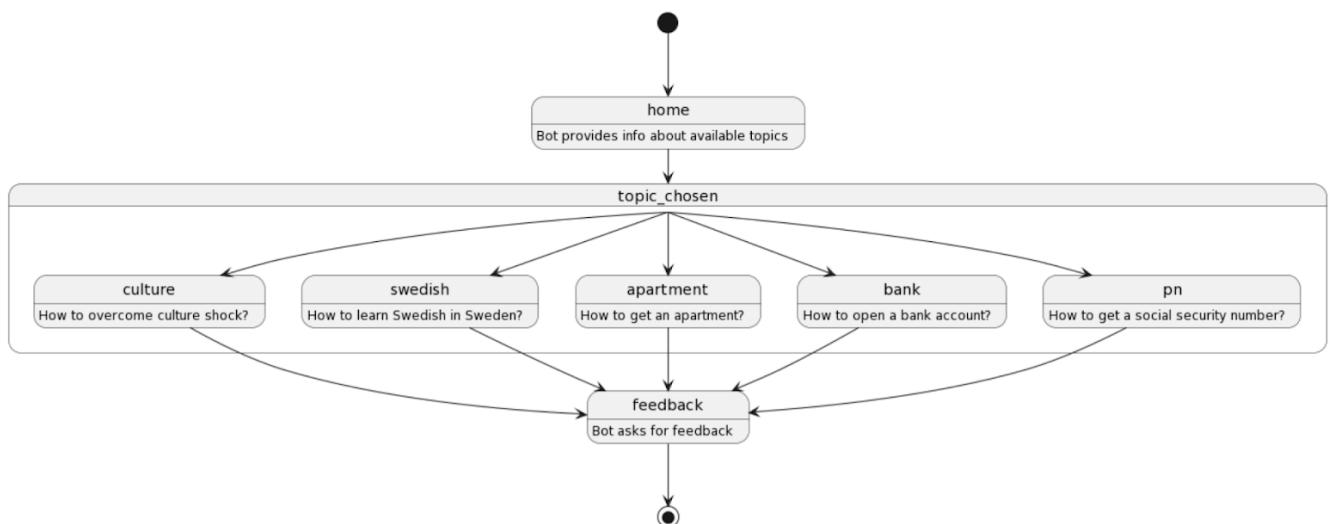


Figure 7. State Diagram

5.1.4 Scenarios of Usage

For the next step of the prototype design we used a state diagram (see Figure 7). State diagrams are valuable for modeling and describing the dynamic behavior of a system. It provides a visual representation of the processes in the system and helps designers and stakeholders understand and communicate the system's behavior.

The bot starts in the 'home' state, where it welcomes the user and provides initial instructions. From the 'home' state, the user can transition to the 'topic_chosen' state by selecting a specific topic that the bot can provide information or assistance about. Once users get all the information about the topic they can transition to the 'feedback' state. In the 'feedback' state, the user is presented with three options to evaluate their experience (negative, neutral, or positive).

The next step of the design process was to describe scenarios of the bot's usage in detail using activity diagrams. Activity diagrams help in modeling and visualizing the flow of activities or processes within a system. They provide a clear representation of the steps, actions, and decisions involved in carrying out a specific task or process. Based on the information collected from the official websites

of governmental and commercial public services scenarios for all 5 topics were written.

5.2 Prototype Implementation

To make the process of scenario implementation and updating easy even for people without strong software development experience it was decided to enable the opportunity to describe scenarios declaratively in YAML files (see an example on Figure 8).

YAML is a human-readable data serialization format that is often used for configuration files, data exchange between languages, and storing structured data. The converter from YAML files to Python entities has been created using PyYAML package.

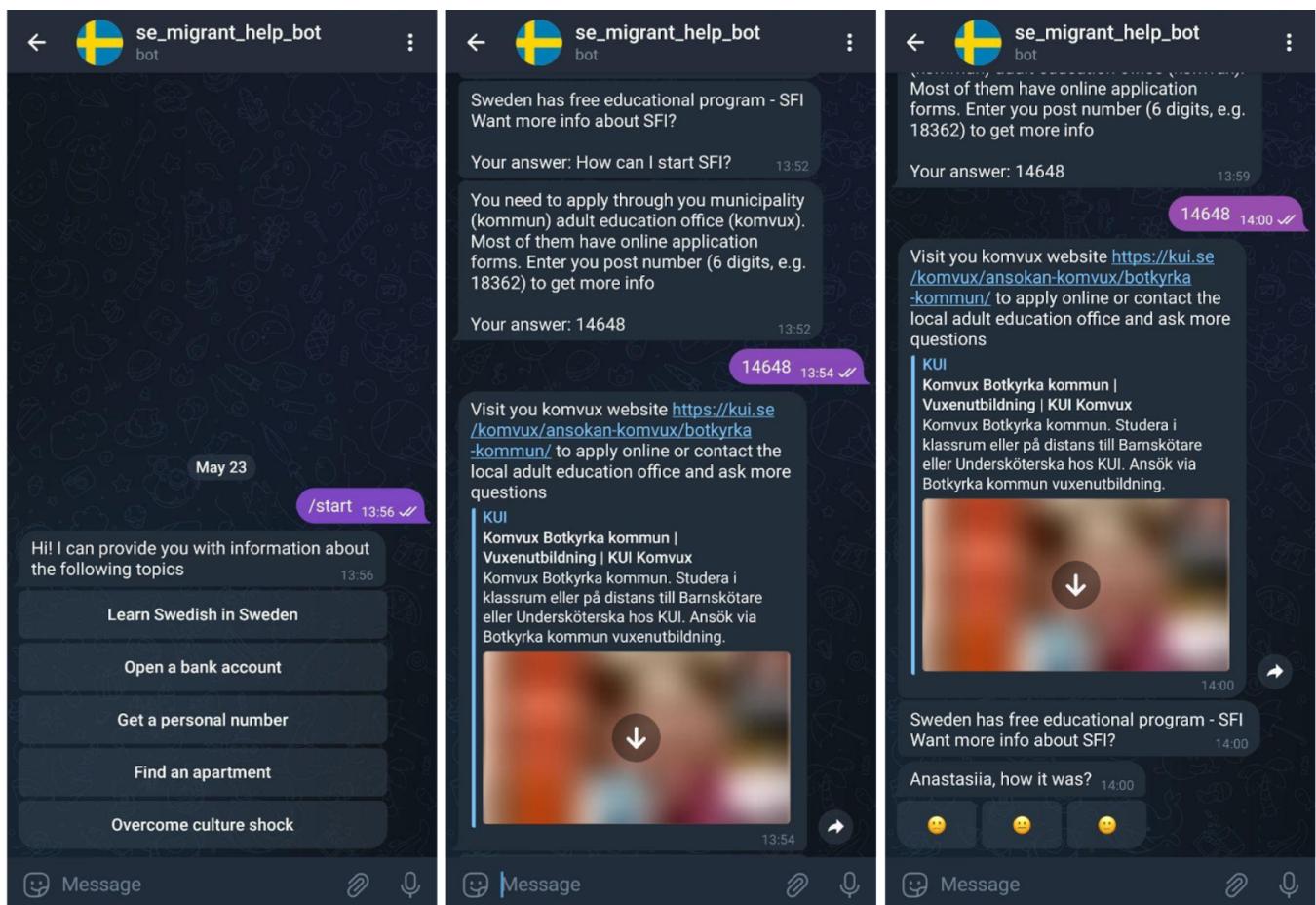


Figure 9. Bot usage screenshots: "swedish" scenario

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bank_citizenship:
  node_type: "SimpleOptionNode"
  content: "What citizenship do you have?"
  exit_node_content: "End session"
  exit_node_id: "feedback"
  options:
    - - content: "EU or EEA country"
      next_node_id: "bank_eu_docs"
    - - content: "Ukraine"
      next_node_id: "bank_ukraine_docs"
    - - content: "Other non-EU/non-EEA or stateless"
      next_node_id: "bank_other_land_docs"

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Figure 8. Example of bot's response description in YAML format

To interact with various AWS resources and services programmatically, e.g. create, invoke, and manage Lambda functions, Boto3 Software Development Kit was used.

Another Python library that was used for the bot implementation is pickle. Pickling a model refers to the process of serializing (converting) an object into a byte stream. By pickling, the model can be transferred to another environment where it can be loaded and utilized. This is particularly useful when you need to deploy the trained sklearn model to the cloud as it was done in the current case.

5.3 Prototype Evaluation

To evaluate the prototype we used the think-aloud method [24]. It is a usability testing technique where users are asked to verbalize their thoughts, actions, and decision-making processes as they interact with a prototype.

Users often encounter usability issues that they may not report unless prompted. By thinking aloud, users are more likely to express their difficulties, confusion, or areas of frustration during the interaction. This method helps uncover usability problems that may not be apparent through traditional observation techniques [24].

Five think-aloud sessions with different users (see Table 1) were conducted online using Zoom. Respondents used desktop or web Telegram applications.

Respondent ID	Age	Gender	Months in Sweden
R1	38	M	10
R2	26	F	20
R3	30	M	10
R4	25	F	10
R5	30	F	5

Table 1. Think-aloud sessions respondents

Participant R1 noted a lack of context that the user is provided with by the bot. He noted that all the dialogs need to be started with a more detailed introduction to the topic. This comment was taken into account and corrected in the final version of the prototype. Participants R4 and R5 noted that there is no option to go back to a previous step in the dialogue and modify their responses. They both noticed that it can be very useful as it is very easy to accidentally press something unintended. Four of five participants shared their willingness to see links to the emigrants' online communities in the 'culture' block. R5 said that there could be free language club links. R5 also shared a desire to have a way to save useful links to revisit them later.

The unexpected observation that was made during the session is that it is hard for users to switch from choosing an option to free input mode. Only 2 of 5 participants understood that they were allowed to do free text input. So four of the participants skipped the feature that was assumed as the main one in section 5.1.3.

Overall the participants think that the format of the bot is a good choice for that task and the answers of the bot are useful.

6. LIMITATIONS OF THE STUDY

The research participants lacked diversity in terms of their backgrounds. While efforts were made to ensure gender balance and representation from different countries, the sample predominantly consisted of individuals with higher education and office jobs. This exclusion of stay-at-home parents, students, and other social strata limits the generalizability of the findings. Additionally, the study did not include representation from refugees or undocumented migrants, resulting in a narrow focus on the specific group of economic and political migrants.

Telegram was chosen as the bot platform for the prototype due to its popularity among citizens from post-Soviet and Middle Eastern countries [32]. Its developer-friendly interfaces and documentation facilitated the initial development process at a low cost. However, the limited number of Telegram users in Sweden [33] poses a constraint to the future development of the helpdesk. Considering alternative platforms may be necessary to reach a wider user base.

The topic recognition model was trained using a limited set of questions from the subreddit, which may not be representative of all user inquiries. The nature of questions on Reddit differs from those typically asked in search engines or chatbots. As a result, the model's performance may have been suboptimal. Using a more diverse and representative learning sample would yield better results for the model.

These limitations should be taken into account when interpreting the findings and considering the broader applicability of the result research artifacts.

7. CONCLUSION

The research aimed to identify the commonly asked questions and prevalent needs among new migrants in Sweden. Based on this understanding, the goal was to develop a prototype of an information system that effectively addresses and fulfills these identified needs. By creating such a prototype, the research aimed to provide new migrants with a comprehensive and accessible resource to obtain the necessary information and support, thus facilitating their integration process into Swedish society.

The prototype of the information system for migrants was designed, implemented, and evaluated by adhering to the principles of UCD and PD. The workshop provided valuable insights and allowed for the inclusion of the migrants' perspectives in the design. The creation of the chatbot prototype enabled a tangible representation of the system, which was subsequently assessed by the users in think-aloud sessions. While users suggested some improvements, the overall response was positive. All in all, this iterative and user-centric approach ensured that the information system effectively addressed the needs and preferences of the migrant community.

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