Semantic Information Search Service by Person's Face Photo

Artur Harkovchuk, Dmitry Korzun
Petrozavodsk State University (PetrSU)
Petrozavodsk, Russia
{harkovch, dkorzun}@cs.karelia.ru

***Abstract*—The problem of information search by person's face photo has many promising applications. Search procedure is performed in the global Internet content. The primarily open data source for searching is social networks, where large amount of semantically-related information fragments about a particular person can be found. In this demo, we show our implementation of the search information service. The service is semantic—several iterations are performed, and each subsequent iteration uses a semantic relation of the found information fragments to the new information sources. For instance, some basic information (such as name or nickname) can be found by the photo on the first iteration. Then this information (e.g. in the form of keywords) allows searching the related web pages (e.g., found web pages have many keyword occurrences). Development of the demonstrated service focuses on the use existing data mining techniques such as face and gender recognition, knowledge reasoning and semantics retrieval, information ranking and information selection problem.**

I. Introduction

People daily activity frequently meets with the problem of knowing information about persons that appear in our life. Examples include new neighbors, a company in train cabin, applying for a position in the company. On the one hand, we can easily observe such persons of our interest and make their photos. Thanks to the progress in information technology, which leads to more and more means of image recording (e.g., outdoor video surveillance cameras, smartphones with integrated cameras). On the other hand, a lot of information about such persons are available in various open Internet sources (e.g., in social networks). In this demo, we study the problem of matching person's face photo with related information about the person in the Internet. We describe our implementation of the search information service.

There are many methods of searching for information about a person in the global Internet. They all fall into two categories: manual and automatic search. In various cases, applying different methods from these categories helps to achieve optimal results. According to report [1] (dated 06/30/2018), the number of Internet users in the world is 4.2 billion. The largest social network by the number of users has 2.32 billion users [2]. With so many users and data, manual search becomes not valid, and the problem arises of searching, processing information in terms of its variability and time constraints. To solve this problem, apply a mixed search. This is a search method in which each stage of the automatic search is consistent with the person, which gives the user the opportunity to influence the search process. This search has several advantages, such as reasonable search speed and user involvement into the process to make better decisions.

The rest of this short paper is organized as follows. Section II defines the studied search problem. Section III describes our demo to experiment with solutions to the search problem. Section IV summarizes the key results.

II. Problem Statement

Before start searching for data about a person, the expected search result is specified [3]. The model is shown in Fig. 1. The search can be divided into two main tasks: identification and search for side information. Identification we will call the found data set, by which we can distinguish one person from another, for example, such as name, gender, date of birth, city of residence. Under the search there is a type of finding pages recognizable in social networks, mention in various news resources, as well as additional personal information, marital status, place of work, etc.

Table I presents an overview of similar existing solutions for the specified task of finding information on a face photo. The existing solutions have such a disadvantage as the lack of information retrieval in the global Internet. In operation, they use databases with information on a limited list of people (must be loaded in advance). For other people, only face recognition in the image is supported.

Our developed demo application makes search and analyzes the information on recognized people from a variety of sources located on the Internet. This way potentially supports the user with large amount of information about a particular target person. The search services can interact with the user. The proposed interaction model is shown in Fig. 2.

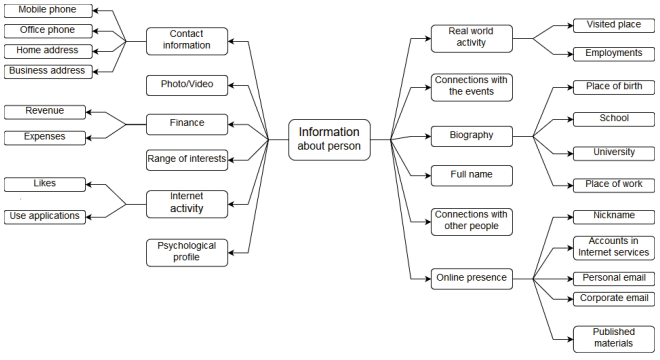

Fig. 1. Data schema for information search

TABLE I. DISADVANTAGES OF ANALOGUES

Application	URL	Description
Blippar	blippar.com	It recognizes person's face and performs a search on a limited circle of people (70 thousand) with the definition of such information as first name, last name, middle name, date of birth, what is famous for, what hobbies, etc.
FindFace	findface.pro	Recognizes the person's face and searches the previously loaded database. The search function in open Internet sources is not available.
Pictriev	pictriev.com	It recognizes person's face, determines the approximate age and estimates the probability of belonging to the floor. Also looking for similarities with celebrities (limited circle of people).

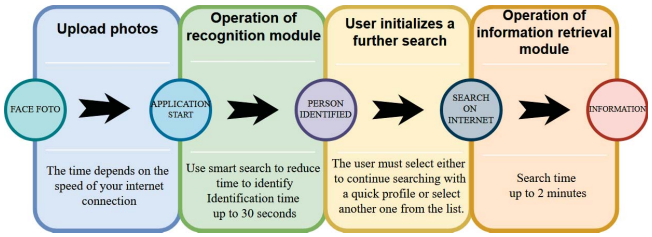

Fig. 2. System operation model

To interact with the system, the user access the web page hosted on the Internet, desktop, or mobile application. To get started, the user must upload a photo of a person, which clearly shows her/his face. Then the service starts the search operation for the target person. With a favorable result, the user receives the initial results that include: name, surname, year of birth, gender. Since the initial search is conducted on photos posted on a social network, the user also shows links to the profile.

When several results are found, the user is shown everything, but the most probable is marked, which will be used for further search. The user has the right to change the probable profile depending on personal reasons. Further full search occurs within a few minutes. The user receives a list of Internet links where a person is mentioned about the person being sought, and also he can already get specific data (for example, place of work or some personal achievements)

III. PILOT APPLICATION

The technology means are presented in Table II. They were selected for demo implementation. Each of the selected solutions is one of the best in its segment, and has all the qualities to solve such problems as better speed of operation, accuracy of the data provided, and failure tolerance. The system structure model is shown in Fig. 3.

The entire system is divided into four levels. 1) The custom level is for the photo to be loaded and the result to be displayed. 2) The interface level is the logic is implemented on how the system interacts with internal modules and with users. 3) The computation level is to locate all computational modules of the system. 4) The data storage level is for recording auxiliary data for information retrieval.

The level of computation can be divided into modules for face recognition and information retrieval. Face recognition modules are used in Face recognition library. It performs several functions: it recognizes the face in a photograph and

TABLE II. ENABLER SOLUTIONS

Solution	URL	Description
Face recognition	github.com/ageitgey/face_recognition	Built using dlib's state-of-the-art face recognition built with deep learning. The model has an accuracy of 99.38% on the Labeled Faces in the Wild benchmark.
Age and Gender Estimation	github.com/yu4u/age-gender-estimation	This is a Keras implementation of a CNN for estimating age and gender from a face image.
PostgreSQL	postgresql.org	PostgreSQL comes with many features aimed to help developers build fault-tolerant environments, and help you manage your data no matter how big or small the dataset.
OSRFramework	github.com/i3visio/osrframework	OSRFramework is a GNU AGPLv3+ set of libraries developed by i3visio to perform Open Source Intelligence tasks. They include references to a bunch of different applications related to username checking, deep web search, regular expressions extraction and many others.
Knime	knime.com	The KNIME Textprocessing feature enables to read, process, mine and visualize textual data in a convenient way. It provides functionality from: natural language processing (NLP), text mining, information retrieval.

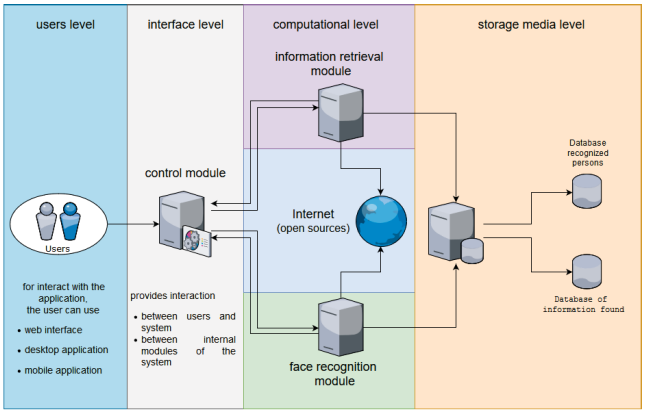

Fig. 3. Application structure model

calculates an individual facial characteristic expressed by a 128-digit vector.

The identification phase model is shown in Fig. 4. The process is implemented as follows. The distance between two vectors is found and if it is less than a certain number, then the persons are considered to be the same. To reduce the time to search for matches, we use a database of users already converted into a vector taken from avatars of users in a social network and links to their profiles [4].

As a database management system, we use the PostgreSQL tool, since it fully satisfies our needs in terms of functionality, read and write speeds. To compile a database, we use the social network Vkontakte and in particular its API. The database is dynamic, constantly checking for new profiles, adding, updating and deleting old profiles. At the moment 533 million people are registered in VKontakte. Therefore, there is the problem of implementing a quick search on big data. To solve this problem, you can use a search that takes into account gender. According to statistics this will help to reduce the search time in half. We define gender using the Age and

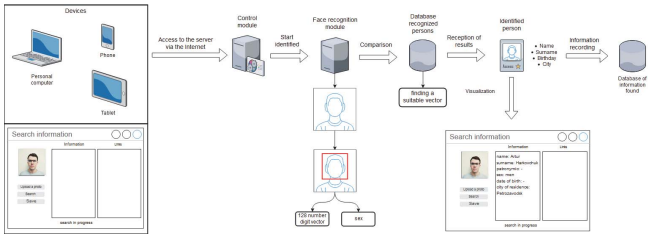

Fig. 4. Identification phase

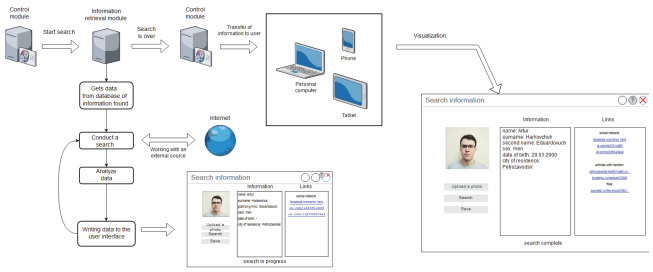

Fig. 5. Search phase

Gender Estimation tool.

There is also a problem if the person does not use her/his face as an avatar on the personal page. Since identification is done precisely by it, this makes a person invisible to our system. To solve this problem in the absence of a person on the avatar, you can scan all the photos in albums and identify the most frequently encountered and take it as the owner of the page.

Information about the probable profile obtained in the initial search for the probable profile is stored in the repository for subsequent use by the information search module. The search phase model is shown in Fig. 5.

For the information retrieval module, tools such as OSRFramework and Knime are used. Using the utilities included in the OSRFramework library for initial data, a search is conducted in open sources, where the results of this search are links to web resources where some information about the person sought has been posted. Using OSRFramework with different initial data, we get several lists of pages. The information obtained has a large amount, therefore, prior to its processing, there is a problem of ranking. There are various methods for ranking information [5]. For different conditions, different solutions can be applied to obtain the most reliable information [6].

The found information can be further analyzed to identify semantic links [7]. The identification of communication means the identification of a person's participation in an event. For example, person's participation in an information security conference in Moscow. For the analysis can be used Knime platform. After processing, the information found is transmitted to the user in a convenient graphical form, and is also stored in a database to prevent "repetition of similar actions".

IV. Conclusion

This short paper described the presented demo application. The demonstrated service is associated with the semantic search for information on a photograph about a person. The application is designed with a focus on the use of automatic tools and search methods. The problem of identification of the person is solved by the multiple finding of indirect information in order to reduce the group of similar personalities and to find one specific one. A two-level structure of semantic search is proposed for precise definition and retrieval of information.

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