Can I Eat That - Cloud Assistant for People with Special Diets

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***Abstract*—For people with food allergies and food intolerances eating out could be a challenge. There is a need for solution that would allow to simplify the process of checking food safety. The app is a Cloud app and allows to instantly check if some food is suitable for a certain diet. The app uses responsive design approach to cover both desktop and mobile versions in one go.**

I. Introduction

For someone who has special food requirements eating out is almost always a challenge. Trying to find out if some meal is suitable for a certain diet is not easy. Some restaurants explicitly specify in the menu that their meals contain or do not contain certain allergens, but most often this is not the case.

It's hard to tell just from looking at the menu if the meal is safe even if there is a list of ingredients: some of the ingredients can in turn consists of other ingredients that will not be listed. For example, croutons made of white bread may contain lactose (because almost all types of white bread contain milk), but it will not be necessarily listed. Wasabi sauce often contains milk which also will not be listed – it can be just wasabi sauce in the list. People often know about many of these hidden sources, but it's impossible to know them all.

Some restaurants and eating places are required by the law to specify potential allergens in the menu. For example, if we look at the menu of U.S. McDonald's, the allergy information is explicitly specified for each meal [1]. In UK, for example, there are 14 standard allergens that manufacturers must specify. Some restaurants do that to: a good example is the menu of UK's chain restaurant Wetherspoon [2] where each item has a section called 'Dietary information' that contains allergy advice. A counterexample is UK's chain restaurant Harvester. The only allergy information that all their food could have been in contact with allergens [3].

However, even when the allergens are specified this doesn't guarantee that this food was clean. Again: some restaurants notify the clients about the potential traces of traces of allergens and some - not. People with food intolerances and allergies often use online communities to check if meal is safe for them. For example, there is a special section with sub-sections on celiac.com forum where people discuss foods and restaurants in terms of their safety [4].

There are a lot of solutions on the market that help people to eat healthy and safely. One of the examples is Healthy Restaurant [11] app that allows users to rate meals in restaurants. Another example is Controlling Calories [10] app that automates daily calories consumption.

Thus, there is a need for solution that would allow to simplify the process of checking food safety for people with special needs. These solutions can potentially include special analysers, smart plates or sensors which are all potential features for future development of smart services for restaurants. Unfortunately, as of now, the restaurants rarely provide enough information to implement these solutions.

If we narrow our search down to just the apps for allergy sufferers, there are also several good solutions. The best representatives that are closest to the suggested solution are AllergyEats[13], iEatOut Gluten Free & Allergy Free [14] and Fast Food Allergies [15]. The first app is based purely on user ratings for the US restaurants and does not consider individual meals. The second one provides general information on what meals can contain certain allergens. The last one covers 17 fast food restaurants in the US and has great implementation, however, the app only exploits the information from the menu which is often insufficient because there could be hidden sources of allergen.

This solution could be implemented as a Cloud app made in accordance with the IT paradigm [8] where all IT actors operate within a common network environment sharing the same content and the same semantics. This app will need to handle large amounts of date, and thus it should be a cloud app in first place. The proposed solution implies using PaaS. Different PaaS providers were considered: Microsoft Azure, IBM Bluemix and Amazon AWS. IBM Bluemix was chosen as the most convenient option.

II. Main part

The suggested solution is a cloud app that will allow the user to quickly check if a certain meal was safe for her. The app is designed to help the user to evaluate the meal before making the order. We could have made the app that would notify the user what meals are potentially dangerous for him the moment he enters the restaurant. But obviously that would be obviously too many notifications: for example, for someone allergic to gluten it's quite typical that 290 out of 300 titles are not safe. It’s more convenient to check specific meal that we suspect can be suitable for us (no one will check coffee with milk being allergic to milk). In the end the best solution is simply to show the user just the meals he can eat. However, this step is impossible if we don’t have enough data in the database or if we don’t partner with restaurants so that they can provide information in a certain format.

Existing apps typically just show the user an answer: ‘yes’ or ‘no’ and these answers are often unreliable. The reason is that it’s often more complex that just ‘yes’ or ‘no’. That’s why our app gives an explanation on why this answer was given. There are several criteria that define meal safety: 1) Official information. What does the menu say? Sometimes restaurants specifically state that a meal contains certain allergens. 2) Societies information. Information retrieved from forums and web pages of relevant societies or information added directly by the society. 3) Users reports. Number of app users’ reports – i.e. number of cases when the meal turned out to be unsafe.

It’s impossible to imagine an app like that without serious amounts of data, and this is what makes it a challenge. There are three models for getting data:

1)Direct: restaurants. Restaurants can provide data in exchange for promotion.

2) Indirect: restaurants web-sites. Web-scraping can be used to extract necessary information if it’s present on the web-site. This can include using computer vision tools if the menu is represented as an image.

3) Indirect: users. Information can be added by allergy society’s enthusiasts.

We need to store several types of information:

- Eating place location (including latitude-longitude to enable automatic detection).
- Eating place rating (in terms of food safety).
- Menu items with allergens information.

To make the representation as compact as possible, we suggest the following format to store the information about the allergens. For each menu item, we keep 6 strings where each position in the string represents the status of the allergen. The length of the string depends on the number of allergens tracked by the system. In our case, we use 14 allergens: gluten, crustaceans, eggs, fish, peanuts, soy, lactose, celery, mustard, sesame, sulphites, nuts, lupine, molluscs. And the 5 strings that describe the meal are as follows:

1) Listed as ingredient: 1/0 string, where 1 indicates that the allergen is explicitly listed as one of the ingredients.

2) Listed by restaurant: 1/0 string, where 1 indicates that information about the allergen in this position is explicitly specified by the restaurant (i.e. “Contains peanuts”), 0 otherwise. Example: 00100000000000. This means that the restaurant has information about eggs presence in that particular meal.

3) Restaurant information. 0/1/2 string, where 0 indicates that the allergen is present in the meal, 1 – the allergen is not present in the meal, 0 – may contain traces. Example: first string is te same, and the second string is - 002000000010. It means that there can be traces of eggs. It also contains 1 for lupine, but we don’t use that information because the first string indicates there is none (it could have been 1 in the past, but currently it shows that restaurant doesn’t tell us anything about lupine presence.

4) Added by society: 1/0 string, where 1 indicates that information about the allergen in this position was added or reviewed by the relevant society, 0 otherwise.

5) Societies information. Same structure as in 2).

6) Users information. 1/0 string, where 1 indicates that more than 3 users reported the meal was unsafe.

The prototype for the app uses simple relational database which is enough for demo purposes. It already implements the suggested compact data representation. This solution however can be non-optimal in production, so for production we offer a little bit different architecture (see Section IV).

Another challenge was to make search as easy as possible. If user allows geo-location, then the app tries to define the place automatically (if it’s present in the database).

The prototype is built with Django and Python. A lot of work has been done to make the interface intuitive and easy to understand. The user starts with choosing county (if it’s not detected automatically), then the request is sent to the server to get the list of all the cities present in the database (city is added to the list if there is at least one restaurant in this city with at least one meal in the database). However, the city is optional: if this is a chain restaurant (e.g. Sushia in Ukraine or Harvester in UK), then there could be information about the chain that still might be useful. After choosing the restaurant all the available menu items are loaded and available for search as shown on Fig. 1.

The app now considers 14 allergens that must be labelled according to UK Food Standards Agency (since we plan to make the app available in Ukraine and UK in first place).

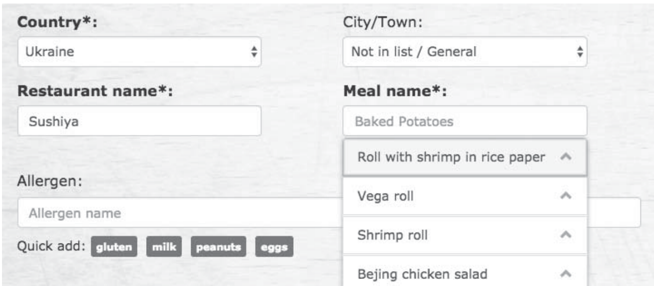

Fig. 1. Choosing a meal name

We used responsive design approach to cover both desktop and mobile versions in one go that are shown on Fig. 2 and Fig. 3.

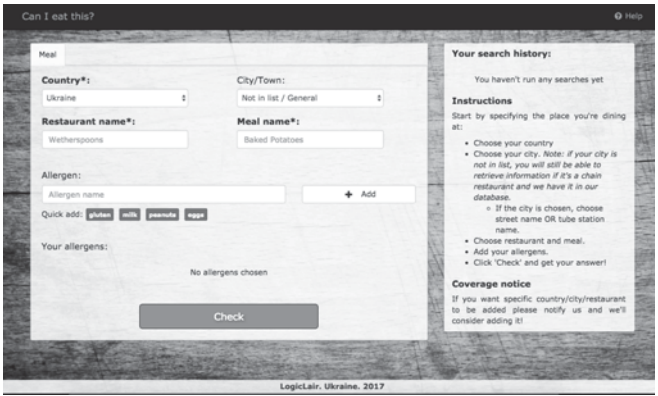

Fig. 2. Demo App Main Page on Desktop

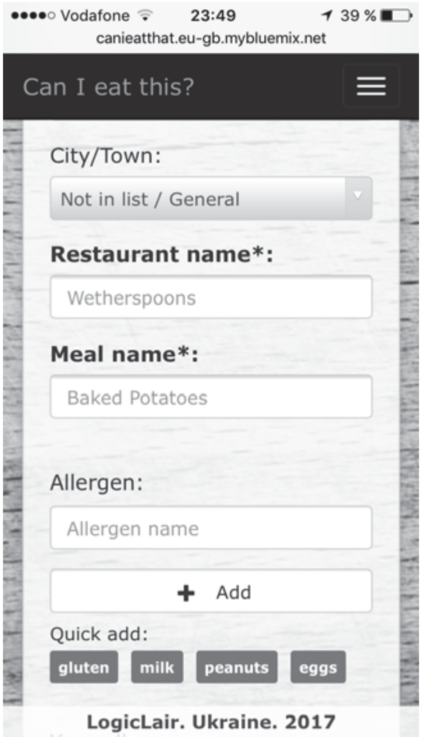

Fig. 3. Demo App Main Page on Mobile

For convenience, the fuzzy search is used for all fields that require typing as shown at Fig. 4.

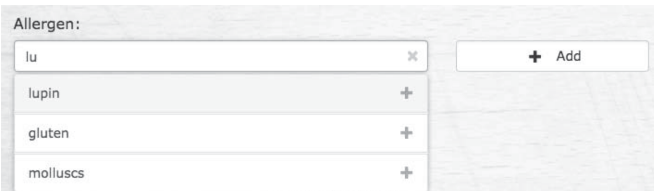

Fig. 4. Choosing allergen name

The user can choose multiple allergens at the same time. Fig. 5 shows sample results a user can get from the app. The user who is allergic to milk and gluten tried to check Minestrone soup at PARMA (Kharkiv chain restaurant). The app immediately shows the conclusion that this meal is unsafe for someone who is allergic to either milk and/or gluten. We also can see that the restaurant itself provides no information about the meal components, but there is information from relevant societies.

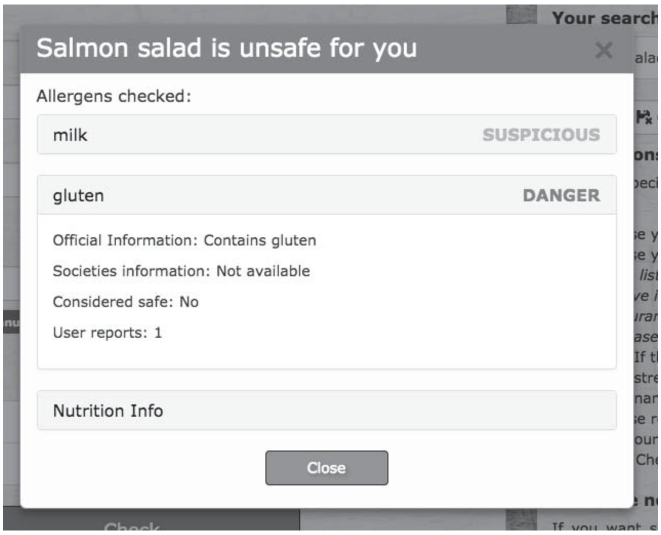

Fig. 5. Sample meal check results

The app saves the search history on the client side so that the user can check recent searches if needed. The chosen allergens are also saved on the client side so if the user revisits the page from the same device and the same browser the allergens are already added according to user's last search as shown on Fig. 6.

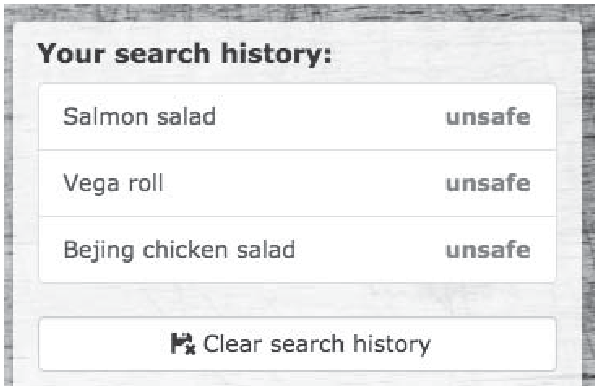

Fig. 6. Search history

III. Prospect features

Current implementation has several shortcomings. The data collected from different sources will have different structure, it will be hard to handle it with tradition relational database: it will at least require heavy pre-processing. One of the possible solutions for the production version could be Elasticsearch both as the search engine and schema-less NoSQL database [5]. This is a popular choice available from most cloud providers, including IBM [6]. The suggested scheme can be both used with SQL or NoSQL database.

This app has a simplified implementation. It was made on purpose as we intended to make it simple and straightforward. But it has a lot of planned features. The app was implemented as a sample app for Cloud Bluemix space (cooperation between IBM and Kharkiv National University of Radio Electronics).

It may seem that the app relies too much on manual input. However, we based our solution on the principles of utility, operability and sufficiency. Relying too much on smart technologies and on them only will significantly limit the app implementation and usage. However, enabling these smart features is an obvious next step.

Another shortcoming is that in the current version users must enter the name of the meal by typing it (at least some part of the name). The idea of the app is to make its usage seamless for the user. An ideal solution is to recognize a meal by simply taking a picture of the meal or meal name in the menu. I.e. it's possible to identify country, city/town and restaurant using geo-location services, and once these are defined, it would be good to identify the meal name automatically as well. There were currently some advances in that direction made by a group of scientists at MIT who developed a neural network that recognizes the meal ingredients by photo [7].

As the possible future solution the app could be extended as Android app and could be included into FRUCT collection at Google Play Market [12].

IV. Conclusion

The current implementation of the app allows the user to find out if she can eat the meal or not. The app gives the answer and the explanation why this answer was given:

- Is there any official information from manufacturer/restaurant and if yes, then what can we conclude?
- Is there any information from relevant societies (e.g. coeliac societies) and if yes, what can we conclude?
- Are there any reports from users that tried this meal and found it unsafe?

There are four things planned to be done for the next version of the prototype: 1) Implement web-scraping tools to automatically fetch data from the restaurants' menu. 2) Establish contacts with allergy societies which can provide information. 3) Establish contacts with food activists (people that have blogs about food, vegans, vegetarians), 4) Implement automatic detection of the restaurant based on data from geo-location services.

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This work was implemented as a part of the series of KNURE's "Mobile healthcare" projects and complements the solution developed in [10].

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