CPS592-M4: ChemScan: Your Guide to Chemical-Free Living

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# Abstract

The food scanning application is an innovative solution designed to meet the needs of health-conscious individuals. The app was developed after extensive surveys and feedback from different people to gather their requirements and preferences. This helped in designing multiple prototypes of the app before arriving at the final product. The app features mobile pervasive functionalities that enable it to be used on multiple devices, providing interoperability. The app is also scalable as it stores data on new products that come into the market, ensuring that users always have access to the latest information. The app also incorporates just in time functionality, which triggers notifications to users based on nearby grocery stores, ensuring that they have access to the freshest and healthiest options available. The app's graph visualization feature presents data in a clear and concise manner, allowing users to easily understand and analyze the information presented. Therefore, the food scanner app is a must-have tool for health-conscious individuals who want to make informed decisions about their food choices. With its extensive features and functionalities, the app provides users with a reliable and convenient way to track their food intake and make healthier choices.

# 1. Introduction

As consumers, we often put our trust in the products we use every day, but we are not truly aware of what we are putting into and onto our bodies? With the rise of health and environmental concerns, it has become increasingly important to be informed about the ingredients in our products. This is where development of ChemScan came into picture.

ChemScan is an innovative app that uses Data Scraping and Food Facts API to get the additives names and their properties and information of the products and uses mobile camera to scan the ingredients of consumer products and provide information about their safety by addressing the product in the form of Nutrition Score Which Rates from A to E, A being the best. ChemScan aims to fill this gap by providing a user-friendly and accessible tool for consumers.

**Challenge:**

Despite the widespread availability of information about product ingredients, it can be difficult for consumers to know which ingredients are safe and which are harmful. Product labels can be confusing and incomplete, and many harmful chemicals can still be legally used in consumer products. As new chemicals and preservatives keep on coming into the market updating those chemicals quickly is necessary which depends on the website from which information is obtained.

**Need:**

There is a growing need for consumers to be informed about the chemicals present in the products they use. With the increasing use of chemical-based products, it is essential for consumers to know what they are exposing themselves and the environment to. This information is critical in making informed decisions about the products we use and consume.

In design aspect the application should be user friendly and easy to understand and it will scan the ingredients using Barcode Scanner and after scanning the ingredients it will differentiate those ingredients into four categories which are Sugar, Fat, Saturated Fat, Salt. Create a Health Risk report after several scan of ingredients which can be shared with anyone firebase location-based trigger can be used for this.

**Contributions:**

ChemScan contributes to a safer and more informed consumer culture by using advanced technology to scan product ingredients and provide information about their safety. The app uses the latest research and scientific data to provide information that is easy to understand and accurate. With ChemScan, consumers can be confident that they are making informed decisions about the products they use and can take control of their health and the environment.

It can be a valuable contribution to the field of consumer safety and health. By providing a tool that is accessible, comprehensive, and easy to use, we hope to make a positive impact on individual health and the environment. We believe that by empowering consumers with the information they need, we can create a better future for everyone.

# 2. Background/Related work

The presence of harmful chemicals in consumer products has been a growing concern for several decades. The use of chemicals in products such as personal care items, cleaning supplies, and clothing can have a significant impact on human health and the environment. Some of the most used chemicals in consumer products include phthalates, parabens, and triclosan, which have been linked to a range of health problems, including reproductive issues, developmental problems, and cancer.

Despite increasing public awareness and concern, it can be challenging for consumers to make informed decisions about the safety of the products they use. The information available on product ingredients is often limited and difficult to understand, and many harmful chemicals are not regulated or banned.

To address this issue, various initiatives have been launched to promote the use of safer and more sustainable consumer products. For example, the European Union has established a set of regulations on the use of chemicals in consumer products, known as REACH, which aims to protect human health and the environment by regulating the production and use of chemicals. Additionally, organizations such as the Environmental Working Group (EWG) have developed databases that provide information about the safety of consumer products and their ingredients.

Depending on the type of consumer goods, there are numerous rules and labeling for hazardous compounds. Some of these information sources are legally obligatory and must be shared by producers, while others are voluntary. The number of rules and restrictions make hazard information a tough and complex undertaking especially since legislation is not always consistent.

Many Ordinary items which are being used daily have which may have toxic compounds is not disclosed to the user and have no hazards pictograms on it as an example personal product, food, pharmaceuticals are some of the things which are exempted from the CLP regulations. People who need to avoid specific allergy do not rely exclusive on the ingredients and might not have the right know about if the ingredients are safe and not, they rely on trial and error to find if they can tolerate the products which can cause severe damages and studies have shown the ingredients listed are not always correct. As Mentioned by REACH Regulation consumers have right to know if the ingredients contain harmful chemicals which are high concern generally is it depicted using a colored label on product on the basis of harmful substances in it, but some products just have ingredients but no such labels which can be misleading for the user as he does not know all chemicals and cannot differentiate between harmful and safe.

People have created a faith in Homeopathic and ayurvedic products and surveys have proven that people think it is safe and natural to consume products related to this, but these products might contain active ingredients which can be highly toxic such as *Atropa belladonna*, arsenic or mercury that are more or less diluted in substances like water or sugar. Hence it may contain harmful chemicals in it. In addition to that these products do not undergo any standard official drug test like conventional pharmaceuticals. It must be noted that the declaration of the products to be safe does not preclude that the product can be safe we will have to do our own research and know the products we are using as per the research and papers even safe products had harmful chemicals in it.

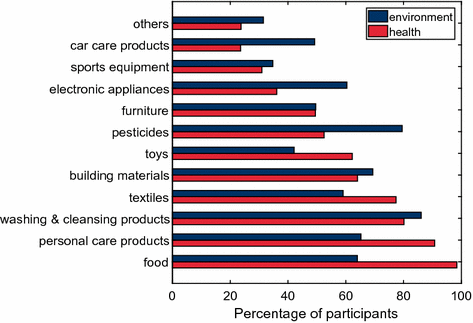
As per the surveys mentioned in the papers many people responded to survey positively main objective of this survey was known how many people have interest about knowing chemicals which are harmful for us.

Nearly all participants (98%) indicated that they were interested in chemicals which are harmful for human health or the environment and used in everyday products.

In total, 61% of the participants reported that their knowledge of chemistry was good or very good. Many young people (aged 20–29) in this survey indicated to be very good in chemistry (female: 42.3%, male 24.5%). Women from 60 years up reported most often to have no or little knowledge in chemistry (60–69: 63.8%, > 70: 78.6%). Of all the participants 34.3% declared that they were dealing with chemicals or REACH at their workplace.

Almost a quarter of the participants (24.8%) indicated that they themselves or a family member suffered from chemical intolerance with a slight maximum in the age groups between 50 and 69 (by comparison around 30% of the German population suffer from allergies (e.g., contact allergy, food intolerance or respiratory diseases).

In this survey most people were more interested towards human health interest products which had direct contact to the human body e.g., food personal care products etc. and regarding the environmental concerns people showed more interest towards furniture, pesticides and washing and cleaning products which had harmful chemicals.



However, despite these efforts, many harmful chemicals are still used in consumer products, and it can be difficult for consumers to access information about the safety of these products and to know what the levels of contents in it are. This is where this app comes in. By using advanced technology to scan product ingredients and provide information about their safety, ChemScan provides a valuable resource for consumers who want to make informed choices about their products. ChemScan also contributes to the existing body of research on this issue by providing a comprehensive database of product ingredients and their safety. This database can be used by researchers, regulators, and consumer advocacy groups to further understand the issue of harmful chemicals in consumer products and to promote the use of safer and more sustainable products this Database is being used as an API known as OpenFoodFacts API. ChemScan is an innovative solution that fills an important gap in the existing literature on consumer safety and health. By providing consumers with easy-to-use and accessible information about the safety of consumer products, ChemScan has the potential to make a significant impact on individual health and the environment.

# 3. Methods

**3.1 Study design**

In order to make the facts more applicable, we have done our survey on the targeted people such as people who frequently consume processed foods. The targeted people were some of my friends and family especially teenagers in the group. We have conducted survey on 9 individuals. We have gathered information on their dietary habits and food preferences. We have collected the samples on their favorite processed foods and analyzed the amount of each food chemical used in making the particular food product. We have recorded the chemical composition of each food sample. In this modern technology world, every person in relied on smartphones to make their work easy and they can know what chemicals should not be consumed on internet but instead browsing on internet takes a while. So, our group decided to create an application which shows the food chemicals by simply scanning the food product within the seconds. Thus, it will show accurate results based on the food product was scanned. It also recommends the swapping the food product by some healthy food products.

**3.2 Participants**

To get the most straightforward evaluation for creating the finest prototype, we have chosen 9 people. Out of them 5 were men between the age of 18 to 22 and 4 women between the age of 20 to 25. In the men, two are them are suffering from acidity and other three were suffering from the vitamin deficiency and out of the 4 women two pursues the pharmacy and other 2 women works in information technology. The men they are suffering from the acidity they consume lot of processed food that can be easily consumed unknowing of the food chemicals present in that instant food products. Among all the participants we have explained about our application that can be easily accessed by the their smartphones and they can know what food chemicals contain in their food products.

**3.3 Analysis**

Our group decided to analyze the idea of our application. Most of the people from the participants in the survey are the teenagers and young people. They simply crave for the junk food which they unknowingly consume harmful food chemicals. Which leads to the health issues such as acidity, indigestion, constipation etc. so we asked them how often they consume junk food and processed food. However, we got some replies as “we crave for lot of fast food which looks good and tastes good”. Also some of them said “we don’t have much time to freshly prepared food so, we make instant processed food that saves our time.” They don’t know what food chemicals they are consuming on their daily habitat, so our team decided to come up with the solution where people can scan their food products while purchasing them anywhere and anytime within their smartphone through our application.

# 4. Finding

Questions

1) what chemicals contaminate food while cooking in aluminum or Teflon and ceramic coatings?

2)How are they harmful to us? As per the interviews conducted and recorded, while interacting with participants, we noticed a few behavioral issues. People who were addicted to chemicalized/processed food usually find it a bit of hustle to overcome this behavior. Pesticides, food additives, contaminants from packaging materials, environmental pollutants, and naturally occurring poisons produced by plants and animals cause this behavior, which are a few of the sources of chemical risks in food. Heavy metals like lead and mercury, acrylamide formed during high-temperature cooking, and food colors and additives that may trigger allergic reactions or other health issues are a few examples of chemical risks in food. When consumed, breathed, or in touch with the skin, some substances can have immediate and detrimental impacts on health. Acute poisoning can cause symptoms like nausea, vomiting, headaches, disorientation, and confusion. Severe cases of acute poisoning can also result in unconsciousness and death. To preserve food safety and safeguard public health, food products must be routinely inspected and tested for chemical pollutants. Now, let us investigate a few case studies.

By stressing the contaminated water as per the recorded interview in India, some chemicals are added to the water to eradicate pests by using a few pesticides to kill the bacteria and fungi. “This water should bathe or wash stuff, not to drink, and I regret it because it made me sick,” said Mr. Mohan. Depending on the quantity and methods of exposure, pesticides leave a residue that contains harmful chemicals that can be hazardous to people and have both short-term and long-term health consequences. This behavior can also cause hazardous health effects, such as cancer. Typhoid, diarrhea, and so on, are also some health issues that can be caused by consuming it. It is critical to routinely test your tap water for dangerous substances and to take the right measures if necessary. Using bottled water or a home water filtration system are further possibilities, albeit they might not completely rid your water of impurities.

Graphical user interface

Description automatically generatedMain Screen

Graphical user interface, application, website

Description automatically generated

History Page

In the interview about street food, Mr. Mark mentioned that “Avoid eating street-fast food, which made me obese and resulted in diabetes.” Street food is all about cost-cutting and using cheap items to pack food such as ‘Plastic covers’ and ‘Plastic containers’ resulting in a hazardous chemical named, ‘Phthalates’. This chemical can cause Infertility, pregnancy difficulties, diabetes, obesity, and cancer have all been related to this family of substances. We can find them in vinyl flooring, plastics, lotions, cosmetics, personal care items, and other everyday household things. However, they can also be present in the plastic wrap, boxes, and gloves used in food preparation. Phthalates may contribute to respiratory issues like asthma and other chronic respiratory disorders, as well as irritation of the eyes, nose, and throat. I have found the endocrine system to be affected by phthalates' disruption of hormone action. Reduced fertility, reproductive, and developmental issues, as well as hormone imbalances, are just a few of the health issues that can result from this.

Graphical user interface, text

Description automatically generated

Scanned Output Page

 In the interview report on using utensils that play a significant role in adverse health effects, we observe that different utensils have different layers of coating on them. Perfluorooctanoic acid (PFOA) is a substance that is used to create Teflon and other non-stick coatings for cookware and other items. Hormonal disturbance, difficulties during pregnancy, and an elevated risk of cancer have all been related to Perfluorooctanoic acid exposure. The major health issue caused is the ‘leaky gut.’ As Mr. Sam, who was affected by leaky gut bacteria, said, “Stainless steel is the way to go! Coatings will never help.” Medical experts have suggested Mr. Sam eat good food containing nutrition, which contains a high consumption of fiber, fruits, and vegetables; probiotics help to keep the gut bacteria clean and can reset the leaky gut bacteria. Herbal supplements made from slippery elm, licorice, and marshmallow root may aid in calming the intestines and lessen inflammation.

# 5. Application Design

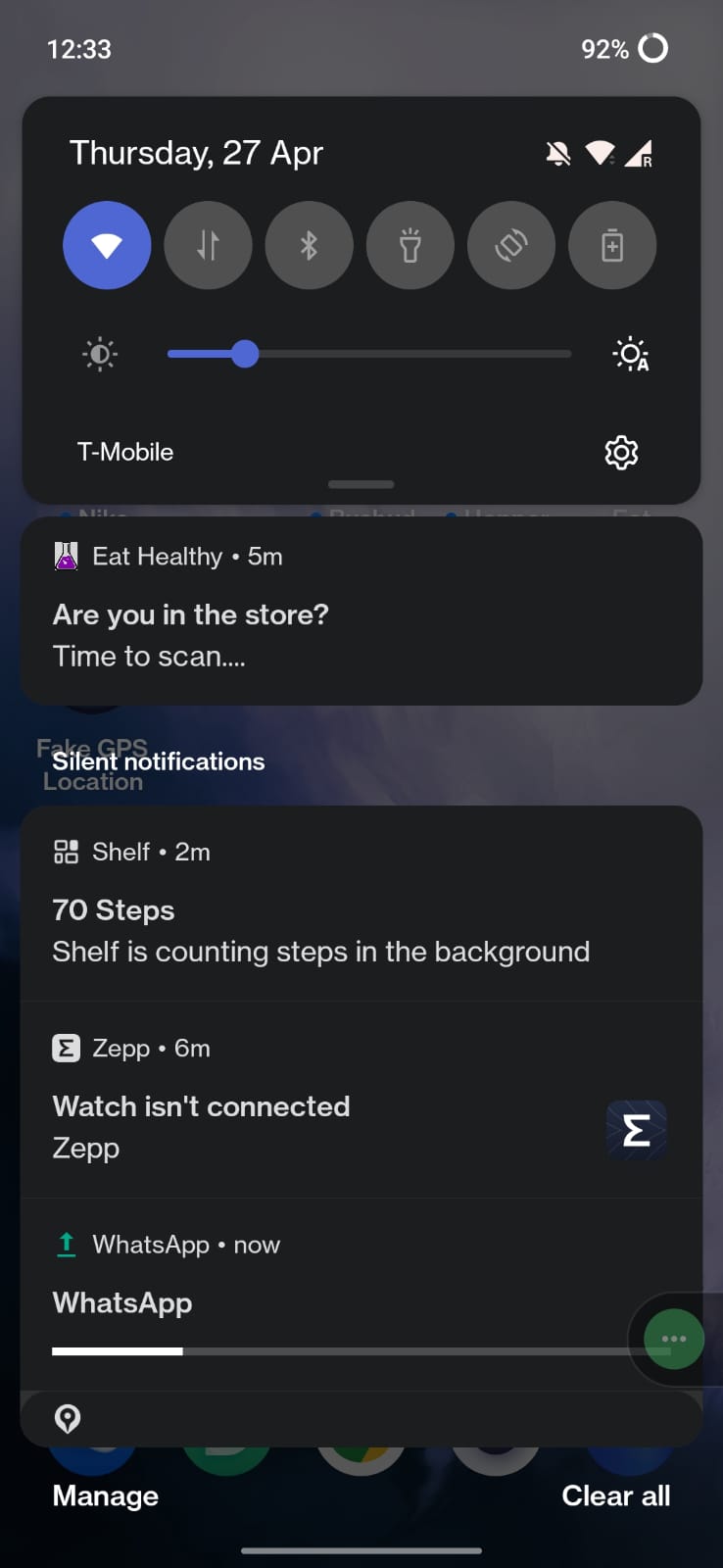
Graphical user interface, application, website

Description automatically generated

Search Page

# 5.1 Design Recommendations

One of the main aspects of this app is the user interface of the app should be intuitive and user-friendly. Users should be able to easily navigate through the app's various features and functions without getting confused. And it should be quick and responsive. The use of clear and concise language and visual cues can help users understand the information displayed by the app.



Notification Trigger

Visualization of the data in terms of graphs is the second aspects where the graph can be calculated in various aspects such as fat sugar salt contents of the products. The app should also provide a detailed explanation of the data presented, allowing users to make informed decisions about the food products they are considering purchasing.

Integration with social media: The chemical scanner app should be able to share the latest news regarding food safety. This can help create a sense of community among users of what is the current situation in the world. For gaining the data which need to be shown to the user we will need to partner with some companies which store data about every product and user there data to showcase that information,

Chart, sunburst chart

Description automatically generated

Graph Report

Barriers to the implementation of these recommendations include the availability of data, the accuracy of the machine learning algorithms, and the strategies to overcome these barriers include providing incentives to users to share their data with the app. By implementing these recommendations, the chemical scanner app can become a valuable tool for consumers, providing them with accurate and detailed information about the food products they are considering purchasing.

# 5.2 Prototyping

**5.2.1 Exemplar objects**

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| Category | Examples |
| Packaged Foods | Cereal, pasta, canned soup, frozen meals, chips, snacks, candy |
| Beverages | Soda, juice, sports drinks, tea, coffee, energy drinks, alcoholic beverages |
| Fresh Produce | Fruits, vegetables, herbs, spices |
| Cooking Ingredients | Spices, oils, condiments, baking ingredients, sweeteners, vinegar |
| Allergens and Additives | Gluten, dairy, nuts, soy, food coloring, artificial sweeteners |
| Nearby Stores | Grocery stores, supermarkets, health food stores, farmers markets |

**5.2.2 Design studies**

The idea for the food scanner app was generated based on the need for consumers to make informed decisions about the food products they are purchasing. The initial phase of the design process involved conducting surveys and taking feedback from users to understand their requirements and expectations from the app. Based on this feedback, different functionality was implemented in the app, such as news widgets, graph screens, and sharing of graphs, to make it more user-friendly and intuitive. The app consists of a main page with navigation buttons for scanning, history, search, and reports. After scanning, users get detailed information about the products, including their nutrition score, additives, allergens, and other nutritional aspects such as salt, sugar, fat, saturated fat, and ingredients. The app also generates notifications based on the user's location, triggering notifications if they are near a grocery store. The barriers to the implementation of these recommendations include the availability and accuracy of data, which can be overcome by providing incentives to users to share their data with the app. Overall, the food scanner app is designed to be a valuable tool for consumers, providing them with accurate and detailed information about the food products they are considering purchasing.

**5.2.3 Proposed designed for implementation.**

1. Just-in-time notifications: This feature utilizes the user's location data to trigger notifications when they are near a grocery store. This component of the app leverages the pervasive computing concept of context-awareness, where the app is aware of the user's location and can provide timely and relevant information. The notifications can be displayed on the user's mobile device in an unobtrusive manner, demonstrating the feature of invisibility.
2. Graph visualization of data: The app generates graphs based on the four main aspects of food products such as salt, sugar, fat, and saturated fat. This feature utilizes the concept of smartness, where the app processes data and presents it in a visually appealing and easily understandable format. The graph visualization component can be scalable, where it can accommodate new products as they are added to the app's database. Additionally, this feature allows users to make informed decisions about the food products they are considering purchasing, demonstrating the feature of interoperability.

# References format

[1] [*Environmental Sciences Europe*](https://enveurope.springeropen.com/) **volume 29**, Article number: 29 (2017)

[2] Open Food Facts

[3] Food Allergy Research & Education. (n.d.). Retrieved from <https://www.foodallergy.org/>

[4] FoodData Central. (n.d.). Retrieved from <https://fdc.nal.usda.gov/>

# Appendix

**Rohan Patil:**

**Learnings**: Gained deeper understanding on harmful chemicals used in the projects and regarding consumer safety. Products even after titled to be safe can contain harmful chemicals in it so it is very important to know the contents of the products, we consume awareness of the products is very important as an example in this fast life people are relying on frozen foods which can contain harmful preservatives. To overcome this creating an app consists of various aspects user opinion user liking the way of using the app keeping this aspects in consideration is the most vital thing for creating an application

**Contribution: Designing first and final prototype, Presentations, Research of datasets of products (OpenFoodFacts),**

**Development of the application, User Authentication**

**Report- Introduction, Application Design**

**Abraham Vincent Prannoy Kumar Mulaka:**

**Learnings:** I have obtained a lot of information about food safety and consuming food that is organic or free from chemicals. Must avoid eating junk/fast food     which contains chemical substances in order to stay healthy without any medical problems. “Prevention is better than cure” is the best way to describe it. Awareness of food safety must be educated to children from a very small age.

**Contributions: Designing of First and Final Design reports - Findings, Development of the Prototype.**

**Reports- Background research.**

**Pavan Kumar Medevelli:**

**Learnings:**  I have acquired the knowledge on the harmful food chemicals that effects our body. We should be more conscious of the many chemicals utilized in the food products we consume on the daily basis as our world continues to develop. The food chemicals are so dangerous that endanger our health and wellbeing is disturbed. Understanding the kinds of the chemicals used in food processing and how they are employed is crucial. Considering all the food chemicals that we have made an application that not only shows the harmful food chemicals it also shows the suggest the healthy food instead of the junk food that contains dangerous chemicals.

**Contribution : Designing first and final prototype, Presentations, Analyzing the harmful chemicals, Debugging the application, Mapping APIs according to the barcode content.**

**Report- Methods**

Joshua Praneeth Moorathoty:

**Learnings:**Acquired good knowledge in chemicals used in food resulting various problems.I thoroughly researched in Just in time functionality,notification based triggering,and also I have involved in managing datasets.

**Contributions: Documentation, Search Screen Designing Research on Notification triggering based on location using firebase.**