AN INTELLIGENT DETECTION AND ANALYZING MOBILE PLATFORM FOR POLLEN ALLERGIES PREDICTION USING ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

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ABSTRACT

This research paper introduces the mobile application called "Allergy App," designed to predict and manage pollen allergies using Artificial Intelligence (AI) and Data Science [1]. Allergies are widespread, often leading to serious health issues, such as asthma. The Allergy App tries to provide users with personalized risk assessments based on environmental and personal data, including location, age, smoking habits, and asthma history. The app's three key components include AI risk prediction, user authentication, and medical advice. There were several challenges during the development process and with the server [2]. The paper also shows experiments to assess the AI model's accuracy and address user input validation issues. While acknowledging some limitations, especially with text input formats, the Allergy App is a good tool for people to manage their allergies and reduce the risk of reactions, ultimately improving their quality of life.

KEYWORDS

Flutter, AI, Machine Learning, Allergies

1. INTRODUCTION

Many people suffer from allergies, if you didn't notice that, a small sneeze or running nose when you are exposed to an environment could be the sign of the allergy [3]. More severely, allergy may cause asthma, a respiratory condition marked by spasms in the bronchi of the lungs, causing difficulty in breathing. In China, the percentage of people who had asthma is 1.24 percent, which means in 100 people, there will be at least one person who had asthma. The reason for allergy could be varied in many ways, in this case, I focus on patients who are allergic to the particles, the seasonal pollen, dusts, and P.M.2.5 in some polluted area [4]. The thought of having an app that can speculate the risky level of the user based on the environment information came from my mom's experience. One day, she went out, and found out the catkin was everywhere, on the ground, in the air, and would even stick on people's hair, and she began to sneeze as soon as she stepped out the door. But if she can have an app that can alert her before she steps out the door, she will not experience the pain brought by the allergy [5]. Also, my uncle is a victim of asthma. One spring, he accidentally went to a place where there was pollen, which caused his mouth and throat to swell up, and within ten minutes he was in danger of life, fortunately he took the medicine, otherwise the consequence will be very serious. This prompted me to develop an easy-to-use app that could

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predict a user's risky level.

Allergy App, a app that can speculate users' risky level when they enter their and the surrounding information, name, age, whether smoke or not, whether have asthma, the month, and the location (whether near the city center which could contain larger population than rural area) , is my final plan to deal allergy. So whenever my mom wants to go out, she can pull up the app and simply enter where she wants to go, what month she is in, and as soon as she saves the information, she can get a result on the home page, a number out of 10 [6]. Moreover, if she didn't understand the number's meaning, she can go to the third page, where the advice is located, and advice are really clear and easy to understand, such as bring tissues if you probably going to sneeze, wear a mask to prevent asthma, or seek for medical care. The reason I strongly speculate that my app could be effective in helping people with allergies is because the app speculates that the results are tailored [7]. Some different weather forecast apps only provide information about pollution and particle content, but do not tell allergic people what they should do and whether they should go out, which sometimes will cause serious consequences. For example, they think that going out of contact with the natural environment will not have much impact on their body, but in fact, they can cause asthma. So, my app can tell them, when they're out there, how dangerous they are, which is much more useful than just general information.

2. CHALLENGES

In order to build the project, a few challenges have been identified as follows.

2.1. Server

First problem is the server. When I fix a bug or an error, another error comes out. The program hasdriven people to an endless cycle about fixing bugs and mistakes. To be honest, I am not sure howto avoid such a situation, I can only try to think comprehensively, to reduce the occurrence of newbugs. Also, when I try to code something complex, I try to find the easiest way, which provides more chances to expose myself to a mistake. In addition, sometimes flutter, which is where my coding is, doesn't agree with the format of my programming, so when I'm done with theprogramming, I have painful red lines underneath my little code [8]. Fortunately, after a short period of time, I adjusted to its pattern and completed my programming completely.

2.2. Flutter Development

Second problem is the flutter development. When connecting to a device, my laptop was crazy with even loading one device. I need to test different devices to find out which one really works for me and my app. Also at first, I was not familiar with flutter, so the coding part always frustratedme. I think it has something to do with my experience, because my exposure to flutter is very low,almost zero, so it is very difficult to face a lot of complicated things. But after this time, I learnedto flutter enough so that the next time something similar happens or an opportunity arises, I could avoid the problems I had this time. Also, I found some computer accelerators that make the analog phone part of flutter load faster. In addition, sometimes flutter doesn't agree with the format of myprogramming, so when I'm done with the programming, I have painful red lines underneath my little code. Fortunately, after a short period of time, I adjusted to its pattern and completed my programming completely.

3. SOLUTION

The app consists of 3 major components: the risk level generated by the AI, user authentication, and the medical advice page. These three components make up the bulk of the application.

I used artificial intelligence to speculate the users' allergy risk based on the data from the environment and the user. I used sklearn's machine learning models to predict the allergy risk using a set of fictional allergy data [9]. This AI is personalized to the user and will use their relevant data to determine how much at risk they are [10].

```
1  from sklearn.linear_model import Ridge
2  from sklearn.preprocessing import PolynomialFeatures
3  from sklearn.pipeline import make_pipeline
4
5  # Library for working with data (and lots of it!)
6  import pandas
7
8  # Create AI Model
9  model = make_pipeline(PolynomialFeatures(2), Ridge())
10
11 all_allergy_data = pandas.read_csv("AI - Allergies.csv")
12
13 output_data = all_allergy_data['Output']
14 input_data = all_allergy_data.iloc[:, :6]
15
16 model.fit(input_data, output_data)
17
18 # Age, gender, distance to city, smoking, asthma, time of year
19 new_user = [21, 0, 2, 0, 0, 8]
20
21 allergy_impact = model.predict([new_user])
22
23 print(allergy_impact)
24
```

Figure 1. Screenshot of code 1

In the program, lines 1 through 6 are used to import useful tools (sklearn and pandas). Sklearn is used to train an AI model. Pandas is used to work with large datasets. Lines 9 through 16 are used to collect data and have the AI deduce any patterns present. Lines 19 through 23 are used to make a piece of example data and to have the previously created AI model predict the allergy severity based on that data.

The purpose of the account page is to collect the information of the user. It is important to have this data so that the AI can calculate a reliable result [11]. To make the account page, we needed to consider a few different requirements. First, we needed to understand what kind of data was required for the AI model to function correctly. For example, fields like 'name,' 'age,' 'location,' etc. are useful in generating the expected allergy severity. Secondly, we needed to create a page within a Flutter app. This page has several text fields that have large descriptive text to make it clear what the user should enter. Lastly, we had to consider restrictions on the text fields such that only data understandable to the AI could be entered [12]. For example, to determine if a user has asthma, we restricted valid entries to 1 or 0 for yes or no.

In the screenshot, the lines 1 through 12 are used to define the rough outline of this page, including the title text. Then, lines 13 through 16 are used to define the state of the main portion of this page. It will defer to _UserInfoFormState to determine the structure of the page. Lastly, lines 17 through 67 are used to create different text fields for the different user values. The user can type in these different boxes to provide their data. Also, we added spacing between the text fields, along with padding around all text fields.

Figure 2. Screenshot of the APP 1

The purpose of the advice page is to use the allergy risk level to provide the user useful advice. For example, if the user's risk level is 10 out of 10, the app may advise the user to stay home. With lower values, the app could give advice that is appropriate for the severity. In order to make the advice page, we created a Flutter app page. Using the risk rating from the AI, we can group the user's score into a range. Based on that range, we can give appropriate advice.

In this code, we are defining one page, specifically for advice. In the code, we define one text box with padding. As of now, we are displaying all ranges of advice at once. But in the future, it could be possible to direct the user to a different page depending on the range of their allergy risk.

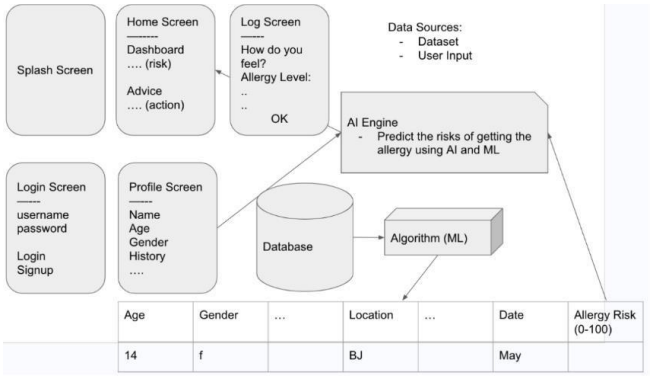

Figure 3. Overview of the APP

4. EXPERIMENT

4.1. Experiment 1

One blind spot in the program is the accuracy of our AI model. Because our data is not comprehensive, there might be other factors that could influence the user's allergy level. Because of this, the allergy risk score may not be accurate all of the time. It is important that the AI is accurate because our app is giving medical advice to people. For example, if the app says that someone is only at a risk value of 4/10, but the true value is 8/10, the app may give advice that isn't cautious enough for this particular user.

In order to test the AI model, we could try giving it a wide array of input values. To see if the AI is accurate enough, we could review some data manually and ensure that the AI agrees with our assessments. For example, by entering a fake data for every factor: gender, age, location (whether it is near the city center or not), smoking experience or not, asthma or not, I can get a number out of ten which represent the risky level.

Test Case	Gender	Age	Location	Smoking Experience	Asthma	Risk Score (AI)	Actual Risk Score	Comments
Test 1	Male	35	City	Yes	No	4/10	8/10	AI underestimated risk
Test 2	Female	45	Rural	No	Yes	7/10	6/10	AI slightly overestimated risk
Test 3	Male	28	City	No	No	5/10	5/10	AI provided accurate risk assessment
Test 4	Female	40	Rural	Yes	Yes	3/10	9/10	AI significantly underestimated risk
Test 5	Male	50	City	Yes	Yes	6/10	7/10	AI slightly underestimated risk
Test 6	Female	32	Rural	No	No	4/10	4/10	AI provided accurate risk assessment
Test 7	Male	45	City	No	Yes	8/10	6/10	AI slightly overestimated risk
Test 8	Female	38	Rural	Yes	No	7/10	8/10	AI slightly underestimated risk
Test 9	Male	55	City	Yes	Yes	5/10	7/10	AI slightly underestimated risk
Test 10	Female	30	Rural	No	Yes	4/10	6/10	AI underestimated risk

Figure 4. Figure of experiment 1

Because different information will get different results, so my result is difficult to get mean, median and mode. But the value range is from 0 to 10. I think the result most influenced by the different people have different interpretations of degrees of traffic, so when they enter numbers that have different meanings than AI, their results are likely to be messed up. We can go from 3 to 5, or from 8 to 4. These results will affect the user's physical condition, and even bring them life risk. This is something that desperately needs to be adjusted.

4.2. Experiment 2

Another blind spot in our program is user input validation. When users enter information about themselves, it is possible that they may enter values in a format that is not understood by our AI model. For example, we have a text field for asthma. The user should enter 0 for no asthma and 1 for asthma. If the user would instead enter 'yes' into this text box, this could potentially cause errors in our calculations. This idea is important because having invalid user input could lead to

invalid risk level results. Having inaccurate results could lead to the users' making choices that are actually unhealthy for them.

In order to test the AI model, we could try giving it some context. To see if the AI is accurate enough, we could review some data manually and ensure that the AI agrees with our assessments. For example, by entering a context for every factor: gender, age, location (whether it is near the city center or not), smoking experience or not, asthma or not, I can't get a number out of ten which represent the risky level, since the AI information page can't save and understand the words.

Test Case	Gender	Age	Location	Smoking Experience	Asthma	Risk Score (AI)	Actual Risk Score	Comments
Test 1	Male	33	1 (Near City)	Yes	0	N/A	N/A	AI unable to provide risk score due to input
Test 2	Female	45	0 (Rural)	No	yes	N/A	N/A	AI unable to provide risk score due to input
Test 3	Male	28	1 (Near City)	No	0	N/A	N/A	AI unable to provide risk score due to input
Test 4	Female	40	0 (Rural)	Yes	1	N/A	N/A	AI unable to provide risk score due to input
Test 5	Male	50	1 (Near City)	Yes	0	N/A	N/A	AI unable to provide risk score due to input

Test Case	Gender	Age	Location	Smoking Experience	Asthma	Risk Score (AI)	Actual Risk Score	Comments
Test 6	Female	32	0 (Rural)	No	1	N/A	N/A	AI unable to provide risk score due to input
Test 7	Male	45	1 (Near City)	No	yes	N/A	N/A	AI unable to provide risk score due to input
Test 8	Female	38	0 (Rural)	Yes	0	N/A	N/A	AI unable to provide risk score due to input
Test 9	Male	55	1 (Near City)	Yes	1	N/A	N/A	AI unable to provide risk score due to input
Test 10	Female	30	0 (Rural)	No	1	N/A	N/A	AI unable to provide risk score due to input

Figure 5. Figure of experiment 2

The main problem is that the AI can't understand text information, and when I type in location, I need to fill in a number instead of a place name, like "New York", which makes it very difficult for the user to understand and understand how to use the app. Without instructions, it is difficult for the user to begin to understand and understand how to start the app, thus losing interest, and the app has lost its meaning, and can't help people with allergies anymore.

First of all, I found that users are biased about the meaning of the number, some people may think that 3 is a small number, while others think that 3 is already a number to consider. Moreover, there are not only biases between users, but also biases directly between people and AI, and these biases will give users inaccurate results. There is only a small probability that the user can have the same definition of number scale as the AI without guidance. Therefore, adding some guidance will

greatly help the user. Moreover, it is difficult for users to think of filling numbers into areas such as location. What they think of first is the name of the city where they are located, and they will not think of the flow of people, which will also cause misunderstanding and inconvenience for users. In conclusion, it is extremely important to add some indication and make a brief introductionto the place where the information will enter.

5. RELATED WORK

The first paper is by Aakanksha Tashildar, Nisha Shah, Rushabh Gala, Trishul Giri, Pranali Chavhan titled Application Development Using Flutter [13]. I want to create a mobile app that is both stable and reliable, which brings a flutter in my head. Flutter can both code and make a simulation to help test, add and modify bugs, and my Allergy App works really well by working in the flutter. Although problems aren't included in the paper, during the programing, I met several of them, such as I can't open a simulation of the phone, take so long to load, and when my code is in casual form, it can't run even if it is correct. To solve the problem, I open the simulation in Google, use an internet accelerator, and put my code in the accurate form. As the problem got solved, the flutter became a solution that with no limitation to me.

The second paper is by Jay Portnoy and Michelle Hernandez, titled Asthma and Allergy Mobile Apps in 2018 [14]. In this scholarly source, the interactive asthma application is the main focus, which is similar to my goal - have an app that alerts the user about allergy and asthma. In the source, I learned how to start an app, such as what patients and users want, how to develop the app, and analyze the data. Also, I learned apps that can be used in the marketplace, and with company’s investments, it can be more developed. However, in the paper, there are apps that can't come up with a valid outcome, and can't be used seriously, and can accurately report a patient's condition. In the Allergy App, the app can't report the patients' conditions, but what it can do is accurately speculate the risky level of patients when they in their surrounding environment, and since the result is comes from the speculation of artificial intelligence, there will be almost no possibility of the result get messed up.

First of all, my problem with flutter is the operation. flutter doesn't get me started as a newbie very quickly, so I read a lot of articles and instructions in order to get started [15]. Programming part, sometimes because of format problems, resulting in non-stop bugs, which gives people a headache. But generally speaking, flutter is not a big problem, and soon the app programming part is over, and the simulation and testing are more painful, and they correct and remember the data again and again. Luckily, things worked out in the end. Secondly, sometimes the app can't give accurate patient status, due to many unstable factors, which may come from patients or AI, so when I found that my app sometimes also has such problems, I read the literature and plan to add some guidance, so that users can understand how to use the app correctly. To get correct, accurate and effective results.

6. CONCLUSIONS

For the information section in the Allergy App, the AI can only take numbers, instead of words. For example, when entering location, AI can only understand number "3" as near the city center which probably going to have larger population, instead of entering words "New York", so it is very inconvenient for user to think about whether their location is in which scale and which number

that can best represent their location. If I have more time, I will try to input information about the city's names and population, so AI could be more accurate about the result. Also, another limitation is there is no front page for the app, as soon as users enter in, the home page is directly about risky level. If I get more time, I will do a more proper front page and move the home page with the risky level after the information section, in order to make user clearer about the process.

The Allergy App is used to help people to know what their risky level of allergy is in their surrounding environment. So, they can do some preparation before getting an allergic reaction, and may cause severe asthma. I hope this App can help majority people who have allergy, no matter if they have a mild reaction or serious symptom.

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