

AcneBot: Creating a Facebook Messenger Bot to Assist Individuals in Assessing Their Skin Condition

Preksha Kashyap

Department of Electrical and Computer Engineering

University of Toronto

Toronto, Canada

preksha.kashyap@mail.utoronto.ca

Abstract— This paper examines the feasibility of using a conversational chat bot to provide telemedicine to individuals trying to determine if they have acne. The chat bot, known as AcneBot, was created as a Facebook messenger bot. It presents a user with a series of structured questions, and captures their responses in order to perform a simple differential diagnosis. Resultantly, the bot informs the user if they have acne, no acne, or a condition that presents itself similarly to acne. For users diagnosed as having acne, a list of possible treatments is offered.

Keywords—*chat bot; telemedicine; healthcare; Facebook; acne; skin conditions;*

I. INTRODUCTION

Acne vulgaris, colloquially known as acne, is a common medical condition that afflicts nearly 50 million people just in the United States of America alone. While it typically affects individuals aged 11 to 30, it is not unheard of for those in their forties and fifties to also experience the condition [1].

Aside from physical impacts, such as changes to skin texture, with the possibility of permanent scarring, acne may also have secondary psychological impacts – often through the forms of lowered self-esteem, anxiety, and depression [2].

Many forms of low-grade acne can be successfully treated with over the counter (OTC) treatments provided sufferers understand the severity of their condition and how to target it. More severe grades of acne require prescription strength treatments, though it should be noted that several options exist to suit the circumstances of different individuals [3].

A. Motivation for the Chat Bot

The main goal of AcneBot is to provide an easily accessible avenue through which individuals can determine if they qualify for an acne diagnosis. It can be an especially useful tool for people without immediate access to healthcare, or those who are hesitant to visit a medical provider. In fact, it has the potential to greatly lower the barrier to healthcare access by being hosted on Facebook – a platform with 1.23 billion daily active users (as of December 2016) [4].

While the internet is also an extremely useful educational tool, it also contains a lot of misinformation and can be overwhelming for some individuals to maneuver through. AcneBot rectifies this issue by curating relevant and

scientifically backed research needed to identify and treat conditions. By presenting a simple quiz, it not only provides a quick and efficient process for users to make a determination, but may also help quell instances of incorrect self-diagnosis. Incorrect self-diagnosis can occur if patients over or underestimate the severity of their acne, causing them to potentially choose an inappropriate plan of treatment. Some examples of different use cases for the bot might be:

- A user does not have immediate access to a health care professional, but is curious to determine whether they have acne.
- A user has acne and is wondering if there are OTC treatments that they could use to treat their condition.
- A user wants to be educated on acne conditions and their potential treatments.
- A user does not want to visit a doctor yet, but thinks they might qualify for an acne diagnosis

II. DESIGN

AcneBot, from conception, was determined to be a Facebook bot, and therefore was built using web technologies compatible with the platform. In particular, it was built using Node.js and was deployed using Heroku. It makes use of Facebook's webhooks to pull data being sent from the user in real time, and the Facebook API to send appropriate responses.

The design of this chat bot can be grouped into three major components – picking the questions, determining the user flow, and developing the user experience.

A. Curating Questions

For a quiz or questionnaire to be successful, a user should not be fatigued by the process [5]. Therefore, it is important that the quiz be as succinct and efficient as possible. With the goal of maximizing the amount of information obtained from the user while minimizing the amount of time they must spend on the quiz, the list of questions was developed.

Through research (from journals and medical websites such as the American Academy of dermatology) the following major points were repeatedly brought up. Therefore, they were used as the basis for building the questions the bot would ask:

- All grades (low, moderate, severe) of acne augment skin texture. [6][7]
- Acne can be separated into non-inflammatory (whiteheads and blackheads) and inflammatory (papules, pustules, nodules). [6][7]
- Non-inflammatory acne is low grade and can be treated with OTC treatments. [3][7]
- Some cases of inflammatory acne are eligible to be treated with OTC treatments, while others require prescription based treatments. [3][6][7]
- Folliculitis, which presents itself like pustular acne, typically occurs on the face of men due to shaving. [7]
- Papulopustular rosacea, which can be mistaken for acne due to the presence of papules and pustules, is only present in the central regions of the face, and includes persistent, extreme redness. [7]

Due to time constraints, the scope of AcneBot was confined to more the more commonly seen variations of acne, as well as differential diagnoses that present like acne (folliculitis and papulopustular rosacea). The result is that the bot screens for the conditions summarised in Table I. Additionally, the types of treatments available to treat acne, broadly categorized into OTC and prescription, are summarised in Table II.

TABLE I. CONDITIONS ACNEBOT SCANS FOR

| Condition | Description |
|------------------------|--|
| Folliculitis | Infection of hair follicles in the beard zone area; usually occurs in males. [6][7] |
| Rosacea | Persistent, extreme redness in the central region of the face, accompanied by papules and pustules. [6][7] |
| Low grade or mild acne | The presence of non-inflammatory acne only – such as whiteheads or blackheads. [6][7] |
| Moderate grade acne | The presence of moderately inflammatory lesions, such as papules and pustules. [6][7] |
| Severe grade acne | The presence of moderately inflammatory lesions, such as papules and pustules, as well as severely inflammatory lesions like nodules. [6][7] |
| Nodular acne | The presence of only nodules. [6][7] |

TABLE II. ACNEBOT'S ACNE TREATMENT RECOMMENDATIONS

| | |
|------------------------|---|
| Over the Counter (OTC) | Benzoyl peroxide, salicylic acid. [3] |
| Prescription | Azelaic acid, isotretinoin, tretinoin, cortisone shots. [3] |

B. Program Flow

Once the fundamental questions needed to be asked to the user were determined, the overall program flow was developed. While a few different organizations were tried, the one found to be most suitable is shown the figures below. This is because it was not only the most technically straightforward, but also put the least amount of burden on the user with respect to time commitment and procedural complexity. Figure 1 demonstrates the initial flow of the program that helps separate users with no textural issues from ones who have textural issues. Additionally, it shows a disclaimer button, which the

user can click to understand that the bot is *not* a replacement for proper medical advice from a licensed practitioner. Figure 2 further explores the outcome options for those with smooth skin, while Figure 3 is what the bulk of users will probably walk through. The flow in Figure 3 outlines how the outcomes for those with textural issues are determined – from folliculitis and rosacea, to the different levels of acne.

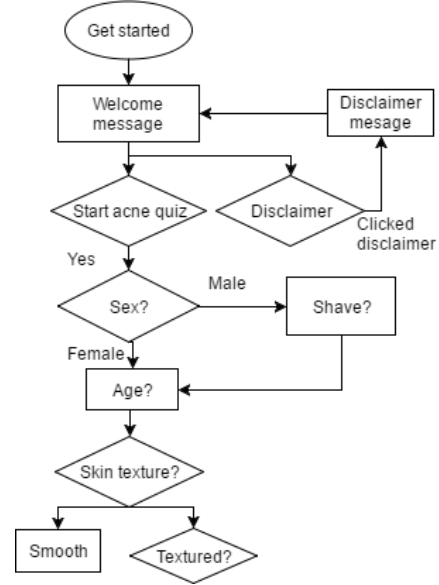


Fig. 1. Common pathway all users traverse for the bot to get background information on them.

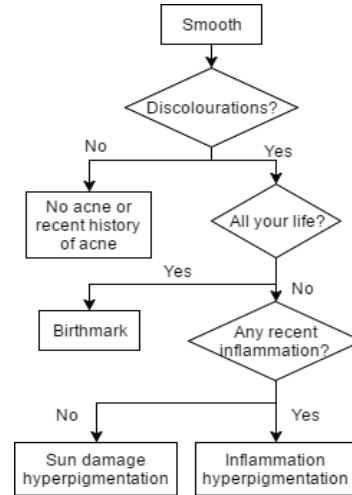


Fig. 2. Pathway users with smooth skin may traverse.

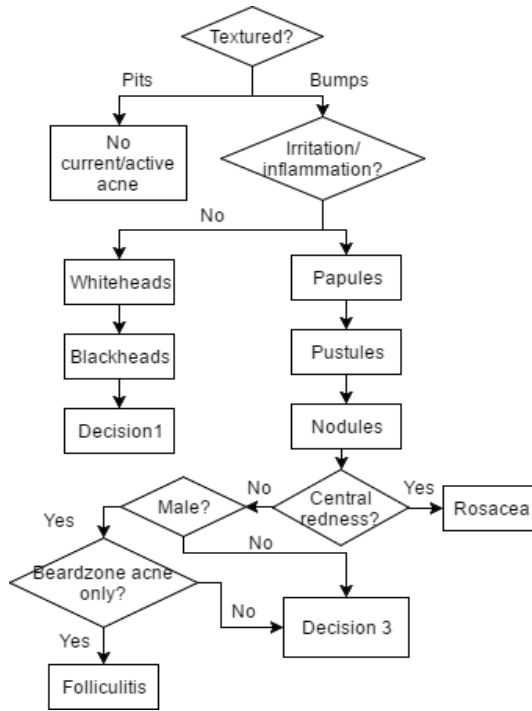


Fig. 3. Pathway users with textured skin may traverse.

Once the user completes the quiz, the backend of the program determines which condition to diagnose them with based on the combination of flags set to true. There are four major decision pathways in the program: one for low grade acne (Decision 1), one for moderate or severe acne (Decision 3), one for folliculitis, and one for rosacea. Table III shows the combination of the flags (Y="yes", N="no") used to determine the result for the Decision 1 node shown in Figure 3, Table IV shows the combination of flags (Y="yes", N="no") used to determine the result for the Decision 3 node shown in Figure 3.

TABLE III. RESULTS FOR DECISION ONE PATHWAY – LOW GRADE ACNE

| Whiteheads | Blackheads | Result |
|------------|------------|----------------|
| Y | Y | Mild acne |
| Y | N | Very mild acne |
| N | Y | Very mild acne |
| N | N | No Acne |

TABLE IV. RESULTS FOR DECISION THREE PATHWAY – MODERATE TO SEVERE ACNE

| Papules | Pustules | Nodules | Result |
|---------|----------|---------|---------------|
| Y | Y | Y | Severe acne |
| Y | Y | N | Moderate acne |
| Y | N | Y | Severe acne |
| Y | N | N | Moderate acne |
| N | Y | Y | Severe acne |
| N | Y | N | Moderate acne |
| N | N | Y | Nodular acne |
| N | N | N | No Acne |

C. Development of the User Experience

As the application was developed for Facebook's platform, there were some limitations imposed on how it would be able

to deliver content to, and receive content from the user. In terms of sending messages to the user, the Facebook API offered: text, image, video, audio, and file based messages – all with the option to add buttons for user response.

With respect to practicality, it was decided that a combination of text and image based messages would best serve the application. Between the two, users would be able to receive succinct and descriptive prompts and visuals to clearly understand the questions being asked (e.g. Figure 5 and Figure 6).

With regards to user input, the three main options presented by Facebook were: text, persistent buttons, or quick response buttons. Persistent buttons, shown in Figure 4, are useful in scenarios where the buttons do not need to disappear. In the case of AcneBot, they were a suitable choice for use in the menu (seen in Figure 4) as users might be alarmed if the menu options suddenly disappear. On the other hand, the fact that they inherently disappear after a choice is made is why quick response buttons (Figure 5) were chosen as the best input method for the actual quiz. By utilising the Facebook quick response button, users would not be able to double tap buttons to older questions or be allowed to explore undesirable behaviours.

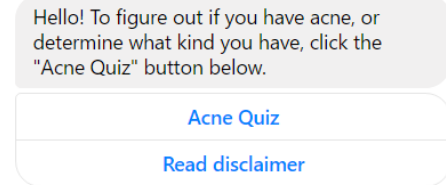


Fig. 4. Persistent buttons used for the main menu.

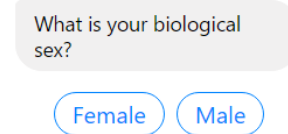


Fig. 5. A text only question using quick response buttons.

While at first it would appear that text input would be a suitable choice for a conversational bot, in the context of a medical diagnosis tool, it is more efficient to stick to predefined responses that the user can choose from. From a technical standpoint, less checks need to be put in place to detect spelling errors and ensure that the end user is staying on track to finish the quiz. Ultimately, button presses are also quicker for the user, and are convenient on both desktop and mobile. The only instance where user typing is detected and acted upon is when the user types "quit", which takes them back to the main menu. In all other instances, they are redirected to a message by the bot stating "I'm sorry. I didn't get that. Please try to follow the prompts".



Fig. 6. A question delivered using a mixture of text and visuals, and quick response buttons.

III. USER TESTING AND RESULTS

To examine the usability of the product, seven individuals were observed using AcneBot. The participants ranged in ages, from 21 to 55, and spanned both sexes. Additionally, participants had varying ethnic backgrounds and skin conditions (clear, acneic, or scarred). Table V summarises the general response of the testers.

TABLE V. SUMMARY OF USER TEST QUANTITATIVE GRADES

| Rating | # Responses |
|--|-------------|
| Excellent Experience | 0 |
| Good experience – needs some improvement | 5 |
| Okay experience – needs a lot of improvement | 2 |
| Bad experience – does not work | 0 |

Based on the results of user testing, it is seen that the application was received in a largely positive light. As expected for a proof-of-concept, there was some functionality that was not implemented but desired by the users. The major points and suggestions brought up were:

- More non-linear navigation was desired with respect to re-doing answers to questions.
- More granularity with the provided images: users felt that some of the provided pictures were on the extreme end for the respective category.
- Less lag in delivering content after a button click.
- Clearer language: terms like “pits” and “textured” confused some individuals.

These points will be addressed in the following sections.

IV. LIMITATIONS

Since AcneBot is currently just a prototype, its ability to accurately conclude a diagnosis is limited to the few conditions it has been programmed to recognise. However, this can be rectified easily by adding more logic to the backend in order to recognise more cases. The trade-off with this, however, is that the overall quiz may become more complex and taxing.

Something else to contemplate is that the bot’s ease of use and performance are tied to the technologies it uses. The Facebook bot platform has some limitations regarding the kinds of interaction that the user is offered. Checkboxes are valuable forms of input employed in designing online quizzes, as they allow for multiple relevant answers to one question. Currently, Facebook offers no good analog to checkboxes in the form of discrete inputs like buttons. The only current option would be to use text input, which is not ideal. A example question that could highly benefit from using checkboxes would be “what areas of your face are affected?”

V. WAYS TO EXPAND ON ACNEBOT

A possible future extension of AcneBot could allow for users to submit an image of their skin to the bot. The bot would then be able to conduct image processing on their picture to perform automated skin analysis. Ideally, the bot would then be able to accurately (the accuracy would be dependent on the quality of the image provided) report back to the user the issues they have. This would especially be useful in differentiating issues like rashes, which often have very defined boundaries and shapes, with acne.

Another feature to consider would be to poll the user on their skin colour, using something like the Fitzpatrick scale. Once this information is known, the bot can present more tailored images to the user based on their skin colour. For example, a brown skinned individual would be presented with example images of whiteheads, blackheads or nodules on brown skin. This functionality was hard to achieve for the current prototype because most of the images on the internet were of individuals with lighter skin tones.

Lastly, an improvement that could be made to the quiz questions would be leveraging the assistance of a usability expert. Some testers did not find the experience optimal, or language clear. A usability expert might be able to further optimize the program flow and augment the language used in questions to be simpler and easier to understand.

VI. CONCLUSIONS

AcneBot, a prototype used to examine the feasibility of delivering medical assistance, was able to successfully work with individuals to determine if they had acne or not. Having been hosted on Facebook, it has the potential to deliver care to a wide range of users provided its complexity is developed to consider the nuances of different individual cases.

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