Designing an application to capture and visualize *Apis mellifera* (honey bee) colony data

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Introduction

Honey bees are pollinators across the globe and are the most economically valuable pollinators of crops worldwide (Klein et al., 2006); however, their populations are declining at a concerning rate.

The Animal and Plant Inspection Service conducted the National Honey Bee Disease Survey (NHBS) to gather data on active threats to honey bees across the United States and ensure new pests have not entered the United States (Fahey et al., 2019). Honey bees are under threat by parasites, diseases, and pesticide poisoning. Many of these threats have preventative treatments which can be applied to prevent infestations and infection, but knowledge of the most prominent threats locally can refine which treatments beekeepers choose to apply.

The application developed for this project will give beekeepers a concise, online resource to know what honey bee threats have impacted apiaries near them to inform preventative treatments. It will also offer apiarists a place to store information from visual inspections of hives and labs conducted on their colonies through apiary inspection services. This app can also improve the efficiency of the NHBS reporting system and reduce data input errors.

Methods and Materials

To begin this project the NHBS database was accessed and processed. For this data set, processing is focused on removing errors in location entry. Alongside processing the historic data set for the application, a wireframe version of the app was completed on paper to give the developing team a design guide of how the activities of the app should flow during use and an approximation of what each activity should look like. Some informal interviews were conducted to get test user input on the design of the application.

Based on the expected user population of beekeepers in the US, both iOS and Android apps were built for this project. The iOS app was completed in Xcode by Dr. Webster, and the Android app was completed in Android Studio using Flutter by Dabraham Martinez and Marleigh Steel.

Methods and Materials (continued)

Next, the ability for the NHBS data set to be displayed and user data to be input was assured through usability tests. Usability tests were conducted with two test groups, one knowledgeable with bees to represent the expected user population of beekeepers and a second group with technological literacy, as it is hypothesized that this group is more likely to identify device failures. Seven beekeepers and two non-beekeepers were tested. Each test user navigated through the iOS and Android applications based on a set list of user tasks. They conducted a cognitive walkthrough while testing the app and then completed an interview section to collect subjective feedback.

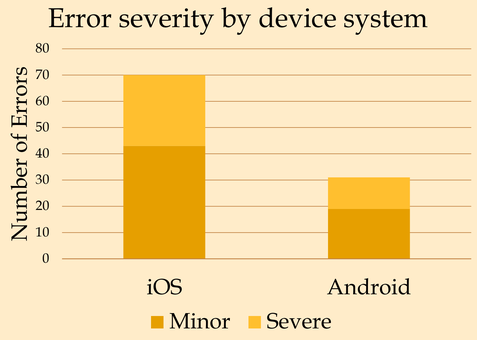
Results

Figure 1 (left): Screenshot of the lab data screen of the iOS version of the app.

Figure 2 (center): Screenshot of a data view in the Android version of the app.

Figure 3 (right): Screenshot of the map view in the Android version of the app.

Graph 1 (right): Stacked bar chart showing the count of errors found in the iOS and Android versions of the application separated into error severity. Minor errors caused discomfort to users, but did not impede function. Severe errors partially prevented proper functioning and critical errors ceased functionality. No critical errors were found.



Results (continued)

System usability scores (SUS) are out of 100 points and ratings are out of 5. The iOS app had a mean SUS of 76 ± 19 and a projected rating of 4.39 ± 0.49. The Android app had a mean SUS of 85 ± 13 and a predicted rating of 4.44 ± 0.53.

Conclusions

The purpose of this project was to create an app which can store and display colony data for beekeepers and simplify data entry. Based on the subjective feedback given by test users, the Android version of the application is slightly preferred because of the simplicity of the Flutter tools implemented during development. Both apps succeed based on a star rating system by receiving higher than an average 3.75 projected star rating.

There were more total errors found in the iOS app. The most common feedback type were issues, followed by suggestions and errors. The proportion of feedback types (error, issue, and suggestion) stayed roughly consistent between device systems.

In future versions of the app, the proposed risk control measures and suggestions by test users can be implemented to reduce issues and improve user experience. Additionally, further usability testing can be completed after revisions are made to ensure issues in the application have been reduced and check that new problems have not been introduced.

References

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