

Lab 1 - Pest Patrol Product Description

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1 Introduction

Pests are everywhere, from nuisance mosquitos, voracious termites, and deadly bobcats, pest encounters in communities are a common and sometimes daily occurrence. However, despite pest encounters being so common in the community, rarely does the community become aware of these pests and work together to mitigate them, as most pest encounters are isolated and there are few ways to report them. This is troublesome, as it has been shown from the prevention of the spread of Spongy Moth in the United States (Coyle, 2021), 90% reduction of invasive sea lamprey in the Great Lakes (Bugg et al., 2020), and eradication of invasive Japanese beetles in parts of California ("Japanese beetle repeatedly eradicated from California," n.d.), that awareness, communication, and coordination are crucial for the successful mitigation of pests. None of which are possible without the means to report pests to the community and collaborate with community members.

A means for reporting pests and collaborating with community members is necessary now for mitigating pests, and may become more necessary as the occurrence of pest encounters is likely to increase in the near future. Due to warmer winters, the prevalence of pests will increase ("How warmer winters affect pests - Varment guard wildlife services," 2018); for example, without a cold winter to encourage hibernation, pests like mosquitoes and termites will continue to reproduce and spread throughout the year, potentially leading to more encounters with these pests. As well, as more habitats are encroached on for construction, more wildlife is displaced, which may lead to nuisance pests moving into populated areas (Abell, 2021); notably, adaptable and opportunistic animals such as raccoons and bears may remain in the same area despite construction, leading to potential encounters with them.

Another key problem is that most pest encounters are preventable, and yet they still occur due to the lack of real-time community awareness. For example, if a community member has a rat infestation in his house, but does not make the community aware of a potential rat problem, then these rats will find it very easy to migrate to his neighbor's house and cause another infestation. Pests can and do spread, and the lack of preparation and strategies to prevent this will just make their spread easier.

Members of the community are not the only people who are affected by the lack of pest awareness. Cities, researchers, and outdoor businesses all have an interest in knowing what pests are in their areas. Cities, for instance, need to know when an invasive species enters their area, as this pest could harm local wildlife or negatively affect local agriculture. Researchers need to know the locations of pests in order to predict their spread and create ways to mitigate it. Outdoor businesses have to know what pests are in their work area and how hazardous they may be; a mosquito swarm may not be a problem, but a bobcat in the area could be a liability.

There are many applications that can serve as potential solutions to this problem, but none of them fully address the need for collective awareness and collaboration within a community to manage pests. Nextdoor and Facebook, for example, are community oriented applications that could be used as a solution, however, their focus is not on pests and they lack the ability for tracking pests and alerting users of nearby pests. Similarly, iNaturalist, an application for crowdsourcing animal and plant identification and locations, does not focus on pests specifically, and does not alert the user of nearby pests or allow users to collaborate with each other to manage pests.

Pest Patrol addresses the lack of community pest awareness and collaboration by giving community members the means to report their pest encounters, find consolidated information

about local pest sightings, and collaborate with neighbors to manage pests effectively. By using pest alerts and an interactive map containing pest incidents, members of the community can stay informed about the pests in their area and be able to track pest outbreaks. As well, with the ability to communicate with other Pest Patrol users through the application, community members can collaborate with each other to share effective pest control strategies and manage pests together.

2 Pest Patrol Description

Pest Patrol is a Web-based application that enables members of a community to report sightings of pests and see the locations of pests in their area. Pest Patrol makes communities safer and minimizes the severity of pest problems by giving its users an enhanced awareness of potential pests that may be nearby. With heat maps, predictive modeling, and the knowledge collected from prior pest sightings, members of the community can more easily recognize, prevent, and manage any pests that they may find in their community.

2.1 Key Product Features and Capabilities

Pest Patrol is a cross-platform application that will work on any machine equipped with a web browser that conforms with W3C standards, such as Mozilla Firefox or Google Chrome. This means that Pest Patrol can be used on Windows, Macintosh, and Linux, as well as mobile operating systems such as Android.

Upon logging in to Pest Patrol, users will be greeted with a dashboard where they can access all other features in the application. Here the user can select his preferred view mode, where he can see the incident map or see discussion threads regarding recent pest incidents. The user can also combine both the incident map and the discussion view in a hybrid view mode, where he can interact with both the map and a discussion thread simultaneously.

The incident map displays reported pest incidents near the user's location, which is defined as the user's community location when using Pest Patrol on a desktop or the user's physical location when using Pest Patrol on a mobile device. Which pest incidents are displayed can be customized by the user. For instance, a maximum distance can be set that will only show pests spotted within a certain radius from the user's location. The user can also display incidents that were reported within a certain time frame, as well as display only specific types of pests, such as just insects or all pests but birds. From the incident map, the user can also report a new incident. The incident map can also display a heat map that can show the user, at a glance, the recency and prevalence of certain pests in an area.

Users can also receive pest alerts to their mobile device that will notify them about recent pest incidents that have occurred in their vicinity. Like the incident map, users can customize which pests the app should prioritize when sending alerts.

From the dashboard, the user can access discussion threads that he has participated in or created. These threads can be related to a specific pest incident or they may stand alone. Threads which the user has subscribed to can be accessed here in one place.

A tab containing recent activity in the user's community can also be accessed from the dashboard. Here the user can view new incidents and discussion threads that were created since the last time Pest Patrol was used. With machine learning and analyzing the history of prior incidents, preemptive alerts can be sent to users to warn of potential pest incidents, such as the emergence of mosquitos and other insects at different times during the year.

Pest Patrol also allows users to interact with each other through the community tab in the dashboard. Here the user can follow others, report users for malicious behavior, or, when learning to manage a certain pest, audit users for the validity of their suggestions based on the

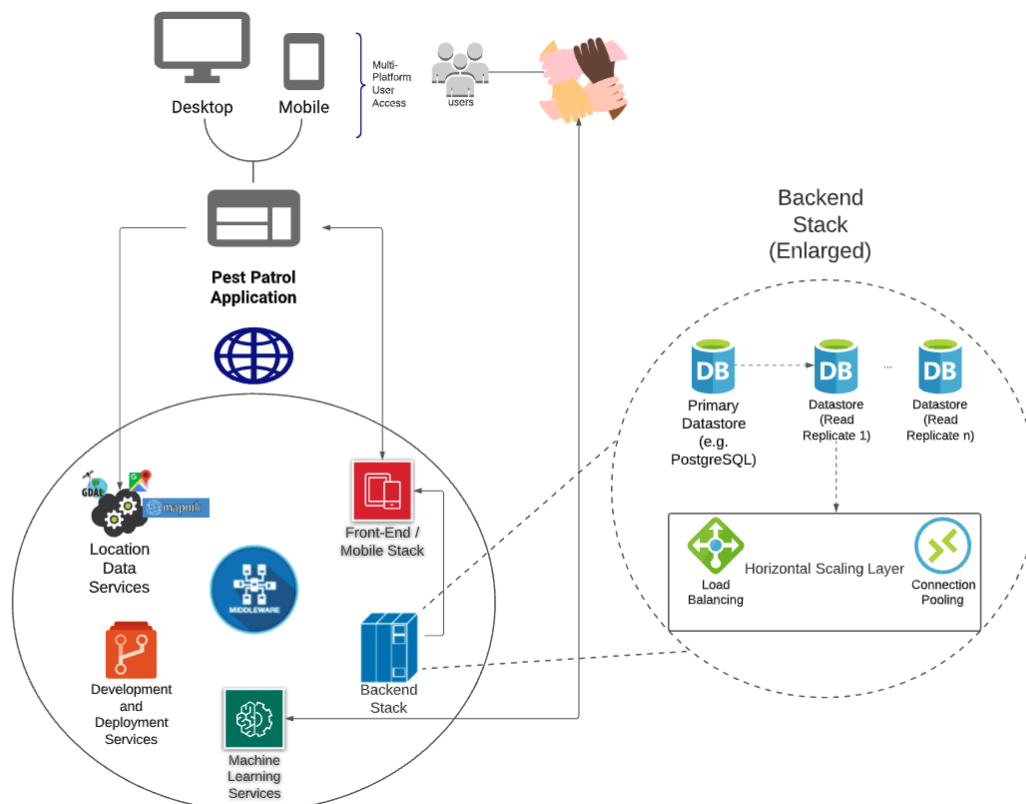
content of their prior discussion posts. Outside of the community tab, users can also customize their own profile with a name and password, as well as send a direct message to other users.

2.2 Major Components (Hardware / Software)

Pest Patrol is produced for a Web browser, so that it may be used on any device so long as it is connected to the internet. This application consists of a frontend and backend, with the former being the UI which is presented to the user and the latter which exchanges data from the frontend to the database, and vice versa. A complete diagram of Pest Patrol's components can be seen in Figure 1, which displays the interaction between the frontend and the backend.

Figure 1

Pest Patrol Major Functional Component Diagram



The front-end is designed using Angular.js in order to make the Pest Patrol application reactive. This makes it possible for dynamic Web pages within the app, so that new pest incidents and thread posts can be displayed to the user in real-time. Using Angular.js also makes it simple to translate the desktop app UI to a mobile device.

Pest Patrol uses Node.js to manage interactions between the frontend and the database. Node.js asynchronous design will allow Pest Patrol to handle multiple connections at once. As well, the application can be scaled by using multiple servers and setting up a Node.js load balancer, to keep the application available during times of heavy traffic.

Pest Patrol uses GitHub for code management. Using GitHub to manage Pest Patrol's code base allows for the use of CI/CD and a platform for publishing its documentation to the Web. Microsoft Visual Studio Code is used for developing Pest Patrol and interacting with Git issues and repo management directly.

A PostgreSQL database is used to store transactions and user data, such as profile settings, login information, and authorization. The database will also store information about pests, incidents, and discussions; this information can be used to track the movements of pests, determine the best ways for managing them, and predict potential occurrences of pest incidents in the future.

Pest Patrol utilizes machine learning for bot moderation and pest identification. Discussion thread posts that have been reported by a user and have been reviewed by a human moderator can be used to train the machine learning AI to recognize potentially malicious content. As well, images of pests with their correct identification can be used to train the AI to automatically recognize the species of pest when a user uploads a pest incident report.

Pest Patrol uses the Google Cloud Platform to manage virtual private servers, cloud SQL instances, and interact with its map API. Google's cloud storage is also used for storing blob data, such as images. Google Cloud's SQL instances can be used to host Pest Patrol's PostgreSQL database.

3 Identification of Case Study

Pest Patrol's main users are members of a community and outdoor enthusiasts, such as hikers and campers. These users, due to being involved in the community and the outdoors, are more likely to notice and encounter pests in their daily lives. Because of their ties with the community, they would be more likely to report these pest incidences to other members of the community or seek assistance from others in the community to manage these pests.

Cities, outdoor businesses, and pest control companies are secondary customers of Pest Patrol, as these customers are less likely to make direct contributions to Pest Patrol, but may be inclined to use it. These secondary customers can use the same options as Pest Patrol's main users to view the locations of pests in their area.

The purpose of Pest Patrol is to give members of the community the means to report, monitor, and communicate pest activity in their community. With this information, community members can collaborate with each other to manage pests that are affecting them. In this case, Pest Patrol's secondary customers can work with community members to help manage pests; for instance, a pest control company can see a heat map of pest activity in a community, reach out to its community members, and offer its pest control service. As well, outdoor businesses can use the information from pest incidents to plan their activities and mitigate potentially hazardous pests. Cities can set pest alerts to be notified when an invasive species is spotted in their area, and plan accordingly to prevent its spread.

Pest Patrol may also benefit a wider audience. Homeowners' associations may use Pest Patrol to observe the pest activity in their area, who can then act as representatives of their community to create plans to mitigate pests. Researchers can use the data collected from pest reports to estimate a pests population size, range, and time of year when the pest is most active. Similarly, government agencies such as the United States Fish and Wildlife Service can use Pest Patrol to track invasive species.

5 Glossary

Pest: Any animal or plant harmful to humans or human concerns

Community Member: A member of a community, see Community definition

Community: The people with common interests living in a particular area broadly the area itself

Incident: An occurrence or sighting of a pest reported by a user

Bot Moderation: The automatic screening of user content to ensure proper user behavior

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