Lab 1 – Pest Patrol Product Description

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1. Introduction

Pests have maintained a constant presence in human society throughout its entire existence and are an unavoidable fact of life. Although most interactions are benign and carry no long-term ramifications, the more serious incidents can have major negative impacts to an individual's health, property and/or finances. When viewed in the aggregate, many of the related underlying figures can be staggering.

Many common community pests are known to be vectors of diseases. Some diseases like rabies and the West Nile virus are potentially fatal and others like Lyme disease are chronic and debilitating. In total, they are contracted by ~300,000 people annually (CDC, How many people get Lyme disease?, 2021). These diseases alone also impose significant financial burdens as treatments cost the United States more than 1.8 billion dollars annually, with West Nile Virus costs reaching $57 million (Doucleff, 2014), rabies costs ranging up to $510 million (CDC, 2019), and Lyme Disease costs totaling up to $1.3 billion a year (Desmon, 2015). The overall health costs for all pest-borne diseases is undoubtedly higher.

Based on the available data, property costs – related to pest removal and damages - are both wider reaching and more severe. In 2020, of the 128.45 million households in the US (Department, 2022), 12.8 million had problems with roaches and/or rodents (Sellner & Wicht, 2021) while another 600,000 were infested with termites (Parkman, 2022). On the low end, the respective exterminator costs to a single household for roach and rodent removal starts at $350 (HomeAdvisor, How Much Does Fumigation Cost For Roaches?, 2021) and $354 (HomeAdvisor, 2022). Property damages add another minimum $150 to the total but can far exceed $4,500 (HomeAdvisor, 2022). For termites, households spend between $1,000 and $3,000 just for extermination services (Termite Statistics, n.d.), and the collective annual cost exceeds $5 billion (Termite Statistics, n.d.).

Over the last several decades, these statistics have been increasing overall (Fernandez, 2021). The primary cause is due to the current warming trend of the planet. Warmer winters result in less insect die off and greater populations in the spring and summer (Guard, 2018). This has also simultaneously led to a reduction of biodiversity – available food sources – for predatory animals (Abrahms, 2021). The lack

of resources combined with habitat destruction from human expansion has resulted in more contact with these forms of wildlife (Abrahms, 2021).

Many scientists predict our planet's warming pattern will continue for the long term (UCAR, n.d.). Under these conditions, communities can expect more unwanted interactions with pests. Although this expectation is likely, it is not a certainty. It is possible to change the status quo but doing so involves addressing its inherent problems.

One of the main problems is that communities have no reliable way of staying informed on local pest encounters. This information is not consolidated in a centralized platform, which means reports about pests are fragmented over multiple social media applications like Facebook and/or Nextdoor. These applications also cater to a generalized audience and have no specialized functionality for pest tracking. These two factors decrease the likelihood that all incidents are being reported. Being fully apprised on the information available involves actively monitoring multiple applications concurrently, which is not feasible.

Another problem is that a lack of real-time awareness results in pest encounters that would otherwise be preventable. The lack of geolocational data makes it difficult for individuals to pinpoint where pest encounters are occurring even if they are reported on an existing application. Even if the location is communicated, none of the applications translate the information to a geolocational tag on a map. They also are not able to alert users of potential impending danger if they happen to be close to it – especially if the report occurred within the last 10-15 minutes. Users would need to have the application open, read the information posted, and triangulate the location relative to their own. The more likely outcome is they fail to receive the necessary information in time to avoid the encounter. They enter the situation unaware of the danger and are at greater risk for bodily harm.

The lack of effective tracking in the present also extends to the past which highlights a third problem. The experience and lessons learned from previous pest issues are not retained. Many pest issues currently affecting a community have likely occurred before but were not catalogued. Any valuable

information that could be leveraged by other community members is lost. Without this data, the baseline response to future occurrences fails to improve.

Finally, when planning outdoor activities or trips to other locations, it is difficult to effectively prepare for active pest problems because the information does not exist. Individuals are unable to modify their preparations according to the current threats or they fail to make alternate arrangements when it is more cost effective to do so. This puts them at greater risk of bodily harm and wasting time and money.

Pest Patrol is a software solution that aims to protect neighborhoods and communities from the pests that inhabit them by promoting localized information exchanges and transparency. Pest Patrol users will be informed of pest encounters in their area through user-generated updates of sightings and encounters, which will in turn prevent or limit future pest encounters. This result is also supported through the application's heat-mapping feature, which highlights areas with significant user reports indicating a potential outbreak. The application will also aggregate data from previous user posts to assist users with future incidents. Lastly, the application will include up-to-date, location-specific data that will enable users to make informed preparations for outdoor activities or trips.

2. Pest Patrol Product Description

The Pest Patrol mobile and PC application relies on aspects of social media to crowdsource pest-related sightings and incidents to increase public awareness of potential threats in their area. Users can offer guidance to one another regarding pest types and solutions for managing pest problems. These user contributions build a knowledge base for future users to draw upon when faced with similar pest situations. Heat-mapping and predictive modeling are also central features of the application. These features increase awareness among users about potential outbreaks or significant pest issues within their community, which can provide insights to them and pest control companies enlisted to mitigate pest-related issues.

Pest Patrol's overarching goal is to cultivate safer communities by minimizing unexpected pest encounters. While the application may not prevent all pest-related incidents, the aim is to mitigate these potential issues and lessen the severity of problems that do occur. To carry out these goals effectively, the

app will have a streamlined, intuitive interface for users to report and learn about pest incidents in their

community or within an area of interest. To ensure users have actionable information, users will tether

their sightings and reports to a precise location. The interface will also facilitate user-to-user

communication, with these discussion threads and posts being aggregated into a user's feed.

2.1 Key Product Features and Capabilities

The Pest Patrol application will be available on both the PC and mobile device and will be

supported by the Windows and Android operating systems. Although it is accessible without creating an

account, non-registered users are limited to view-only access; all interactive functionality is disabled. The

account setup process is relatively basic in terms of mandatory information. New users are only required

to provide a valid email address, password, and home community. Upon verifying their email address,

the interactive capabilities are unlocked.

One of the key features of Pest Patrol are the pest alerts. Pest alerts are real time notifications that

trigger whenever there is a new pest incident within the user's vicinity, and they help them avoid

unwanted pest encounters. These alerts are sent to the mobile device and appear as a Pest Patrol logo in

the notifications section. Upon initial receipt, the user will either receive an audible cue from their mobile

device or it will vibrate. The user can determine which manner they wish to receive the notification or

decline receiving any notification. They can further customize alert settings based on the type of pest,

and they can define a geographical radius – around their location – from which the alerts will trigger.

Due to its limited utility on the PC, the alert notification is only available for mobile devices. It is the

only feature not available between the two versions.

Once users have logged into Pest Patrol, the first interface that loads is the dashboard. The

dashboard is the foundational piece of the application on which all features are rooted; it provides access

to every feature within Pest Patrol. The dashboard display can be set to one of the three display modes:

Incident Map, Discussions, and Hybrid. The Incident map displays a map of the community and reported

pest incidents, Discussions display the discussion threads related to the incident reports, and Hybrid mode

divides the interface to display both the incident reports and discussion threads together. As the dashboard initializes, the application will compile all new notifications – thread discussion updates, new messages, new reported incidents, etc. – for the user's convenience. These updates will appear as updates under the "Recent Neighborhood Activity" section of the dashboard. In addition, the user will receive A.I generated tips, predictive modeling based preemptive alerts, guides, and recommended incident discussions based on their activity and historical pest activity.

The Incident Map is the main interactive feature of Pest Patrol, and it provides users a comprehensive view of all reported pest threats in their area. With just a glance of the map, users can gain complete awareness of what pests are in their community and their locations. If users are not satisfied with the default settings, the incident alerts that appear can be customized based on discussion thread content (based on key words), user id of the incident submitter, pest type, and age of the report. These customizations can be saved in the user's profile settings or applied temporarily using the ad hoc controls in the dashboard panel. Each reported incident can be clicked or tapped to open a pop-up interface that displays all related user discussion threads. The incident map can also be set to an alternative heat mapping display. This alternative view displays pest activity over a set period of time and highlights where pest activity is most prevalent; it is useful for identifying potential emerging pest problems. New reported incidents are also submitted through the incident map.

The Discussion view serves two primary purposes. It provides quick at-a-glance information related to the reported incidents on the Incident Map, and it acts as the historical repository for all discussion threads that have occurred within a community. Users with current pest problems can leverage this information to devise more effective mitigation strategies. This information is also ingested by a machine learning API with the intent of providing additional assistance/guidance. Users can also choose to follow discussions they are either actively engaged or are interested. Followed discussions are automatically made available through the dashboard interface for convenience purposes. Users will also be notified whenever one of these threads has new activity.

Aside from the discussion threads, other community interactive aspects of Pest Patrol are its direct messaging and community features. The direct messaging interface is a straightforward interface for users to contact one another directly. The community feature is accessible through the dashboard interface and lets users add each other as friends. Another feature dedicated to user interactivity is A.I based bot moderation. The purpose is to police inappropriate conduct as well as inappropriate application use (e.g. deliberately reported erroneous pest incidents).

2.2 Major Components (Hardware/Software)

Pest Patrol is a web application and is accessible with any modern web browser. The application consists of PC and mobile front-end interfaces by which user interaction occurs. The front-end interfaces will run primarily on JavaScript and it will use Node.js as the middleware by which all components displayed in the MFCD will communicate.

The back-end data stores will be based on a google based cloud storage solution. Transaction text-based data will be accessed with PostgreSQL and will be available in cloud SQL instances. Geo-locational features will leverage Google's Maps and APIs services, and the machine learning aspects will be based on Google's TensorFlow platform.

Development of Pest Patrol will use Microsoft Visual Studio Code as the source code editor. Github will be used for the collaboration environment and implementation tracker.

3. Identification of Case Study

3.1 Primary User Groups

Pest Patrol is a community resource meant to increase the collective awareness of potential pest-related threats. As such, individual community members are a significant user group. Within this user group are hikers, campers, and outdoor enthusiasts. Businesses with outdoor work environments and cities/municipalities would also be members of Pest Patrol's targeted audience. Table 1 outlines these groups' motivating self-interests and examples of messages that cater to those interests.

Table 1. User Group Communications

User Group	Motivating Self-Interests	Key Message
Community Members	Personal safety, potential risks pets and children	Download Pest Patrol to keep yourself and those you love safe from potential pest-related threats including stings, bites, and diseases.
Hikers, Campers, Outdoor Enthusiasts	Proper planning for outings, safety	Know before you go! View Pest Patrol's map feature for latest pest sightings along your route. Use this info to pack accordingly.
Businesses with Outdoor Work Environments (e.g., landscapers, loggers, dog walkers)	Employee and customer or client safety, minimizing potential negative impacts to business due to pest-related incidents	Avoid project delays by preparing your employees for potential pest-related threats with updates from Pest Patrol. Avoid negative reviews and keep your clients safe by staying up to date on pest-related threats in your area with Pest Patrol.
Cities/Municipalities	Overall community safety	Identify emerging pest-related threats and opportunities for community engagement and education with updates from Pest Patrol.

3.2 Secondary User Groups

In addition to the primary user groups, Pest Patrol has a broader applicability to users interested in using the app for data-driven decision-making. Pest control companies could leverage Pest Patrol data to inform their marketing efforts. For example, a pest control company could identify hot spots where mosquitoes are highly prevalent. Based on this, the company could initiate a door hanger campaign in that specific area or a direct mailer campaign offering a unique promotion for mosquito treatments.

Homeowners associations would also be invested in Pest Patrol's data as they have a vested interest in community safety and maintaining a neighborhood's positive reputation.

Lastly, Pest Patrol data could also be used for scientific purposes. Government agencies, such as the U.S. Fish and Wildlife Service, could monitor sightings for reports of invasive species, allowing them to track and potentially address these pests. More broadly, researchers could use Pest Patrol data for population tracking studies or other research purposes.

3.3 User Testing & Feedback

Pest Patrol will be tested using the Hiker, Camper, and Outdoor Enthusiast user group. The team will recruit participants using Facebook Ads targeted toward outdoor enthusiasts with an interest in camping, hiking, outdoor recreation, and hunting. We will not limit age, demographics, or education of the targeted audience. Volunteers will be asked to take a brief survey to confirm they are interested in the outdoors and to obtain contact information. These volunteers will then participate in a virtual one-on-one user testing session to assess their thoughts about the Pest Patrol concept, determine usability of the app, and gather user feedback on the experience.

4. Pest Patrol Product Prototype Description

4.1. Prototype Architecture (Hardware/Software)

4.2. Prototype Features and Capabilities

4.3. Prototype Development Challenges

5. Glossary

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

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

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

- **Geo-tagging**: The process of appending geographic coordinates based on the location of a mobile device

- **Geo-targeting**: Method of determining the geolocation of an application user and delivering different content to that visitor based on their location

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

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

6. References

Abrahms, B. (2021, July 30). *Human-wildlife conflict under climate change*. Retrieved from Science:

https://www.science.org/doi/10.1126/science.abj4216

CDC. (2019, June 11). *Cost of Rabies Prevention*. Retrieved from Centers for Disease Control and

Prevention: https://www.cdc.gov/rabies/location/usa/cost.html

CDC. (2021, January 13). *How many people get Lyme disease?* Retrieved from Centers for Disease

Control and Prevention: https://www.cdc.gov/lyme/stats/humancases.html

Department, S. R. (2022, February 22). *Number of households in the U.S. from 1960 to 2021*. Retrieved

from Statista: https://www.statista.com/statistics/183635/number-of-households-in-the-us/

Desmon, S. (2015, February 5). *Lyme Disease Costs Up to $1.3 Billion Per Year to Treat, Study Finds*.

Retrieved from John Hopkins Bloomberg School of Public Health:

https://publichealth.jhu.edu/2015/lyme-disease-costs-more-than-one-billion-dollars-per-year-to-

treat-study-finds

Doucleff, M. (2014, February 12). *The High Cost of Treating People Hospitalized With West Nile Virus*.

Retrieved from NPR: https://www.npr.org/sections/health-shots/2014/02/11/275262857/the-high-

cost-of-treating-people-hospitalized-with-west-nile-virus

Fernandez, L. (2021, July 7). *Market value of the United States pest control industry from 2010 to 2021*.

Retrieved from Statista: https://www.statista.com/statistics/1134191/us-pest-control-market-size/

Guard, V. (2018, January 15). *How Warmer Winters Affect Pests*. Retrieved from Varment Guard

Wildlife Services: https://varmentguard.com/blog/warmer-winters-affect-pests

HomeAdvisor. (2021, June 11). *How Much Does Fumigation Cost For Roaches?* Retrieved from

HomeAdvisor: https://www.homeadvisor.com/cost/environmental-safety/roach-fumigation/

HomeAdvisor. (2022, January 10). *How Much Does Rodent Control Cost?* Retrieved from HomeAdvisor:

    https://www.homeadvisor.com/cost/environmental-safety/rodent-removal/

Parkman, K. (2022, February 17). *Pest control statistics and trends*. Retrieved from ConsumerAffairs:

    https://www.consumeraffairs.com/homeowners/pest-control-statistics.html

Report, S. (2019, July 1). *Vector-Borne Diseases on the Rise*. Retrieved from Meigs Independent Press:

    https://meigsindypress.com/2019/07/01/vector-borne-diseases-on-the-rise/

Sellner, M., & Wicht, J. (2021, April 21). *Residents of 14 Million Housing Units Reported Seeing*

    Roaches, 14.8 Million Saw Rodents in Last 12 Months. Retrieved from United States Census

    Bureau: https://www.census.gov/library/stories/2021/04/how-many-american-homes-have-

    pests.html

Termite Statistics. (n.d.). Retrieved from Orkin: https://www.orkin.com/pests/termites/termite-statistics

UCAR. (n.d.). *Predictions of Future Global Climate*. Retrieved from Center for Science Education:

    https://scied.ucar.edu/learning-zone/climate-change-impacts/predictions-future-global-climate