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MAVI
COMMUNITY APP

AN AI-BASED COMMUNITY APP THAT CONNECTS MUNICIPALITIES WITH MARKHAM RESIDENT CONCERNS

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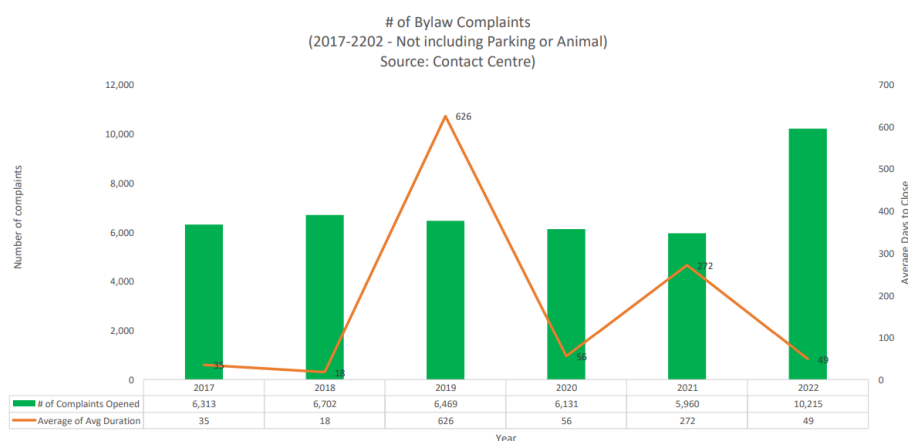**Table of Contents**

Introduction

In recent years, cities worldwide have been embracing the concept of smart urban living, leveraging technology to enhance citizens' quality of life. In this context, the integration of Artificial Intelligence (AI) in community services has emerged as a transformative force, enabling more efficient and responsive governance. This project explores the development of an AI-based community application designed to bridge the gap between citizens and their local government, specifically focusing on the critical aspect of bylaw enforcement. By harnessing the power of AI, this app aims to streamline the reporting of violations, enhance access to bylaw information, and foster a stronger sense of community participation in maintaining urban order and harmony.

Problem Statement

Effective bylaw enforcement is crucial for fostering a thriving city. It directly contributes to the safety, cleanliness, sustainability, and social well-being of the community, ensuring a higher quality of life for all residents. However, Markham, like many other Canadian cities, faces significant challenges in effectively enforcing its bylaws. First, the most pressing issue is the difficulty residents face in accessing bylaw information. They often find it difficult to search for information from existing mobile apps and websites. Second, it takes a high cost and effort to resolve bylaw violations reported by its residents. According to a Markham city review, it takes an average of 49 days to resolve a complaint, and only around 600 issues are resolved per year (Bylaw Enforcement Service Delivery Review). Each investigation of an issue takes about 0.97 hours, costing the city $52 per hour in staff time. It necessitates an increased budget, which puts further strain on the residents in the form of property taxes. Finally, community

participation in reporting bylaw violations is low. This is partly due to the lack of faster resolution

for reported issues, for example, parking violations require immediate action for enforcement.

Additionally, the current mobile app and website are difficult to use, especially for elders and

residents who are not savvy with technology.

Bylaw Activities – Complaints vs Average Time to Resolve (2017-2022)

# of Bylaw Complaints
(2017-2202 - Not including Parking or Animal)
Source: Contact Centre)

	2017	2018	2019	2020	2021	2022
# of Complaints Opened	6,313	6,702	6,469	6,131	5,960	10,215
Average of Avg Duration	35	18	626	56	272	49

# of Bylaw Complaints (2017-2202 - Not including Parking or Animal) Source: Contact Centre(Bylaw Enforcement Service

Delivery Review, 19)

Project Aims and Functionality

The rise of digital technology and Artificial Intelligence offers powerful tools to address the

challenges of effective bylaw enforcement. A study conducted by the McKinsey Global Institute

highlights that cities that effectively utilize technology can increase their operational efficiency by

up to 30% (McKinsey & Company). By leveraging these advancements, cities like Markham can

not only improve the efficiency of their bylaw enforcement processes but also foster a stronger

connection between residents and their city, creating a healthier and more sustainable

community. Markham City already has a community mobile app for its residents and also has

systems to handle and resolve incidents reported by the residents. The following proposed solutions to improve the current mobile app and operational systems aim to achieve these goals, promoting positive and smart urban living.

1. Enhanced Bylaw information access with Gen-AI-based chat interface (MaVI)

The first solution addresses the challenge of accessing clear and accurate bylaw information by developing MaVI, a Gen-AI-powered chat interface. MaVI will leverage a vector database populated with authoritative sources like Markham's Good Neighbour document. When a resident queries the system through the community mobile app, MaVI will use Retrieval Augmented Generation (RAG) to retrieve relevant information from the vector database and then refine the response using a Large Language Model (LLM) such as OpenAI's ChatGPT-3.5 (or a suitable alternative). Careful prompt engineering will be employed to minimize hallucinations and ensure responses remain strictly within the context of the loaded bylaw information. While OpenAI was initially chosen for its ease of integration, the project will explore open-source LLMs to reduce long-term costs and ensure viability for the city. The solution will significantly improve accessibility for all residents, regardless of their technical proficiency, empowering them to quickly and easily understand and comply with local bylaws.

2. Streamlined Bylaw violation reporting

This solution focuses on enhancing the user experience of the community mobile app for reporting bylaw violations. The app's interface will be redesigned with a focus on simplicity and accessibility for all residents. Key improvements will include reduced data entry, and minimizing the required information for reporting to essential details only. Automated location capture will integrate GPS functionality for automatic location tagging of violations. An intuitive camera interface will be implemented for easy photo capture of violations, including clear instructions and image preview. Enhanced usability will be achieved by utilizing large, easy-to-tap buttons and minimizing the number of clicks required to submit a report. This streamlined design will empower residents to quickly and efficiently report bylaw incidents, increasing community participation and improving the city's ability to address violations promptly.

3. Gamified community engagement through rewards and recognition

This solution aims to incentivize community participation in bylaw enforcement by implementing a reward system. Residents will earn points for reporting valid bylaw violations, with higher total points leading to increased star ratings. This gamified approach not only recognizes and celebrates "community heroes" but also fosters a sense of ownership and encourages greater involvement in maintaining community standards. Furthermore, the star rating system provides the city with valuable information, allowing them to prioritize bylaw enforcement actions based on the

credibility and track record of the reporter. This creates a "silent task force" of community guardians, enhancing the city's ability to address violations effectively.

4. Streamlining incident resolution through intelligent merging

This solution addresses the challenge of lengthy incident resolution times by implementing an intelligent merging system. Related incidents will be automatically grouped based on proximity (e.g., within 100 meters), timeframe (e.g., within 48 hours), and category. This aggregation will significantly reduce the workload on city officials, enabling them to resolve issues more efficiently and improve response times. Furthermore, the system will prioritize incidents reported multiple times by different credible residents, ensuring that the city focuses on the most pressing concerns. This approach will lead to increased citizen satisfaction through timely action and more sustainable resource allocation.

5. Real-Time Bylaw enforcement dashboard for enhanced situational awareness

This solution proposes a real-time monitoring dashboard, integrated with Markham City's existing CRM or ticketing system, to provide city officials with a comprehensive overview of reported bylaw violations. The map-based interface will display all reported issues in real-time, allowing officials to quickly assess the situation and identify hotspots. Key features include visualized incident tracking, with a map interface displaying all reported

issues with location pins, allowing for quick identification of problem areas. Integrated data access will provide direct access to reported issue details, including photos and user-provided information. Feedback and validation tools will allow city officials to validate or invalidate reported issues, automatically adjusting user point totals and star ratings. Finally, integration with the user rating system will provide prioritization tools to prioritize enforcement actions based on reporter credibility. This real-time dashboard will significantly enhance the city's ability to monitor, manage and respond to bylaw violations, leading to faster resolution times, improved resource allocation, and a more proactive approach to community safety.

Technology and Coding Platform

1. Gen-AI Based Bylaw Access / Chat Interface (MaVI)

The MaVI knowledge base is the AI brain for the community app. The Markham Good Neighbour Book downloaded as a PDF copy from the Markham.ca website is used as the information containing Markham city bylaws and good neighbour etiquette. node.js library is used to read the PDF file and split the text of each line into chunks. OpenAI library is used to create embeddings for the chunks of text files (Embedding is a procedure to convert the text into a natural language model). The embeddings are inserted into a vector database using the Vectra library. This knowledge base will be used in the community app to build the MaVI virtual agent application.

2. **MaVI Community App**

The community mobile app is a prototype to demonstrate the new capabilities that will help Markham residents interact better with Markham City.

The application prototype is built using web application technology. Below is the technology used to build the application.

- **Web Application Development**

  - HTML: Structure the web application interface.

  - CSS: Style the application for a visually appealing layout.

  - JavaScript: Handle interactivity and dynamic content updates.

- **Backend Development**

  - Node.js: Utilize Node.js to create the server-side application for handling requests and managing data.

The app has the following features and special open-source libraries are used for the features as in the table below,

Feature	Purpose	Special APIs / Library Used
MaVI Chat Page	Simple chat interface to allow users to ask questions about Markham Bylaw and good neighbour etiquette. This AI app uses information in Markham's good neighbour book and answers questions accurately.	OpenAI library to provide an interactive chat interface. Uses the MaVI knowledge base created in the earlier step.
Incident	Simple app to capture the photo of	Google Maps API to enable users to

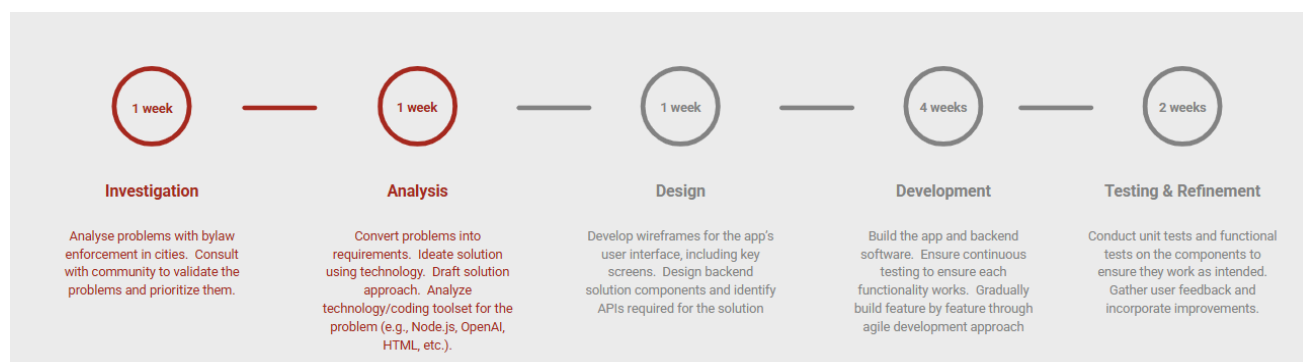| Reporting Page	the issue and location in Google Maps. It helps to report the issue with easy steps.	report the location of the incident. Media library to capture and save images as proof of the incident.
User Profile Page	Show user profile along with rating. Rating helps community members to be motivated to be good citizens and contribute to community improvement.	Maintains user points in a file. Based on the user points show the user rating in the user profile in the app.

3. Markham city incident monitoring dashboard

A simple dashboard built using Google Maps interface and web application to help Markham city officials monitor the issues reported by the members. This also is built using HTML, CSS and Javascript for the front end and node.js for the back end. Google API library is used for building the dashboard. The reported incidents are in a file which is loaded into arrays and then related incidents are merged before inputting them into the Google Maps dashboard. The user points are retrieved from the user points file and based on the validity of the issue, the user points are updated back into the file.
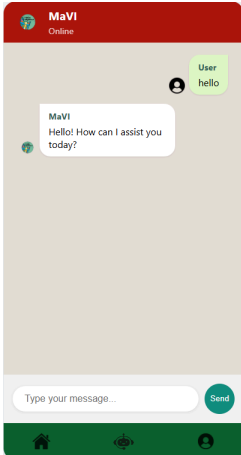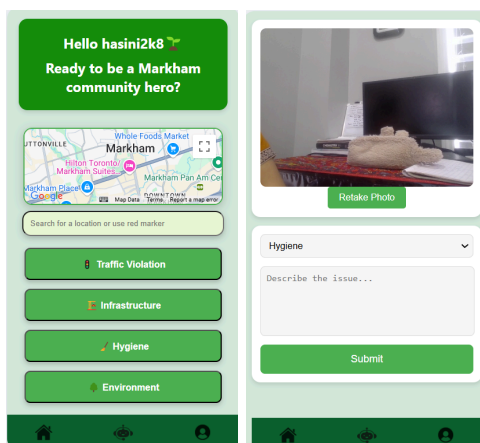
Github link to app code

https://github.com/hasini2k8/MaVI

Timeline

User Experience

Below are some of the screenshots of the application built,
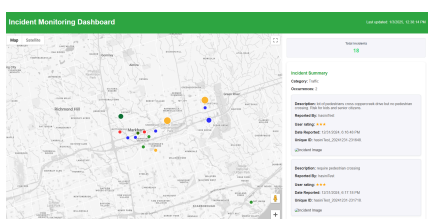
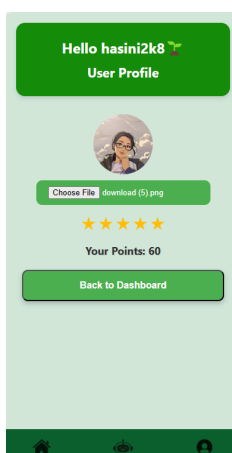| MaVI chat app	
	The chat app provides accurate answers based on the Good Neighbour PDF book. If an invalid question is asked, it says sorry. If a valid question about Markham is asked then it gives relevant answers to help the user.

Incident Reporting App	This app captures location coordinates using Google Maps and captures a photo using the camera. It stores the issue description, issue category, user ID reporting issue, Google Map location coordinates and photo. This is later used in the monitoring dashboard.
Incident Monitoring Dashboard	Shows the incidents in the Google Map interface. Similar issues are merged - a bigger circle indicates more issues are merged helping prioritization to handle them faster. On click of each circle, the relevant incident details are shown in the right sidebar along with the details, picture of the incident and user rating.
User Profile Page with Star Rating	If a community member reports more valid issues, the member gets higher points. If reporting invalid issues, points are reduced. The points are converted into star ratings and shown on the user profile page. This will motivate members to be more constructive to get good star ratings.

Limitations & Next Steps

The current limitations in the project include the need to transition the mobile app prototype to a native application using Flutter which provides a more native Android or IOS experience. Furthermore, expanding the monitoring dashboard for city officials to include immediate dispatch services has not yet been implemented, potentially impacting its efficiency. The integration of MaVI features into the "Access Markham" app remains pending, preventing the creation of a unified platform for all municipal services. Additionally, the knowledge base expansion to train the AI component with more bylaw documents is yet to be completed, limiting user responses' accuracy and comprehensiveness. Lastly, essential accessibility features, such as larger font sizes, screen reader compatibility, and alternative text for images, have not yet been integrated, making it challenging to serve older adults and users with disabilities effectively.

Conclusion

In conclusion, this AI-based community app represents a significant step towards a more connected, efficient, and citizen-centric approach to urban governance. By leveraging the latest advancements in artificial intelligence, and mobile technology, the app has the potential to transform the way citizens interact with their local government. The features of streamlined violation reporting, AI-powered bylaw information access, gamified community engagement, intelligent incident merging, and real-time monitoring dashboards collectively contribute to a more responsive and effective bylaw enforcement system. While the project is still in its nascent stages, the potential for future enhancements and broader integration with other municipal services is immense. Ultimately, this app embodies the principles of smart urban living, fostering

a stronger partnership between citizens and their city, and paving the way for a more harmonious and sustainable community.

<u>References</u>

Works Cited

About the project. About the Project | Smart City Strategy | Your Voice Markham. (n.d.). https://yourvoicemarkham.ca/smartcitystrategy/widgets/118758/documents

City Projects & Initiatives / Major City Projects. City Projects & Initiatives / Major City Projects | City of Markham. (n.d.). https://www.markham.ca/about-city-markham/city-hall/city-projects-initiatives-major-city-projects

Monopoli, M. (2023, July 22). *Understanding youth and child civic engagement in Canada.* Abacus Data. https://abacusdata.ca/youth-and-child-civic-engagement-rhf/

Project: Bylaw Enforcement Service Delivery Review. (n.d.). https://www.markham.ca/sites/default/files/about-city-markham/by-laws/Bylaw+Enforcement+Service+Delivery+Review+Final+Report+Jan+2023+++Summary.pdf

Smart Cities Challenge. Smart Cities Challenge | City of Markham. (n.d.). https://www.markham.ca/about-city-markham/city-hall/city-projects-initiatives/current-projects-major-city-projects/smart-cities-challenge

Smart city strategy. Your Voice Markham. (n.d.). https://yourvoicemarkham.ca/smartcitystrategy

SuperSimpleDev. (n.d.). *JavaScript Tutorial Full Course - Beginner to Pro (2024)*.

YouTube. https://www.youtube.com/watch?v=EerdGm-ehJQ

Woetzel, L., Remes, J., Boland, B., Lv, K., Sinha, S., Strube, G., Means, J., Law, J.,

Cadena, A., & Tann, V. von der. (2018, June 5). *Smart cities: Digital Solutions for a more*

Livable Future. McKinsey & Company.

https://www.mckinsey.com/capabilities/operations/our-insights/smart-cities-digital-solutions

-for-a-more-livable-future