

# City Alive: Interactive Tools to Improve Local Civic Engagement

*Odysseus Pyrinis*

Electrical Engineering and Computer Sciences  
University of California, Berkeley

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#### Acknowledgement

I sincerely thank Professor Eric Paulos for his feedback and guidance over the course of this project. His suggestions were invaluable to further refining the research design and considerations explored in this paper. I also want to thank Molly Nicholas, Sarah Sterman, Katherine Song, and Eric Rawn whose support and feedback shaped the research direction of this project and initial prototype design.

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**City Alive: Interactive Tools to Improve Local Civic Engagement**

by Odysseus Pyrinis

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**Research Project**

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**Committee:**



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Professor Eric Paulos  
Research Advisor

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(Date)

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Professor Terri Bimes  
Second Reader

May 12, 2022

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(Date)

## **Abstract**

A common theme documented in previous studies indicates a lack of trust between the citizenry and civic authorities which is exacerbated by the public's "black box" view of public projects approved by city governments. Proposed solutions predominantly focus on improving civic engagement by designing platforms enabling active channels of dialogue between elected officials and the citizenry such as public polling efforts or civic tech initiatives. These solutions place the people in a position to actively identify problems and develop viable solutions to be employed by the appropriate civic authority. Although designing tools to enable a more convenient and actionable platform for civic engagement is of great importance in overcoming the sense of mistrust between governments and the people, developing an easily accessible and intuitive platform that informs the citizenry of public initiatives and projects is of equal value. People adopting a position that democracy is stagnant at the local level or that their opinions would not be considered by elected officials even if conveyed in a public setting contributes to an unwillingness to engage with civic authorities, even if accessible platforms and tools were made available. This paper presents an analysis of user studies conducted prior to and following the introduction of a prototype application designed to provide quick and easily interpretable information regarding publicly funded development projects. We also discuss the limitations associated with this design and future research of incorporating bi-directional dialogue between the community and city governments in a greater capacity than simply reporting issues regarding infrastructure failure.

## **Author Keywords**

civic engagement, digital civics, community

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## Introduction

From the very idea of a democratic form of government, the need for an active and engaged citizenry voicing their opinions and concerns to civic leaders is critical to the health of a functioning democracy. However, despite best efforts, traditional communication channels used by civic leaders at local and even national levels of democratic society have proven inadequate in supporting a level of civic engagement that would be expected from a healthy democracy [4]. Prior research in this field has even indicated that due to the poor scalability in bi-directional communication of more traditional governing methods, such as face-to-face town halls and live public hearings, a deeply rooted sense of mistrust between the citizenry and civic leaders exists and inhibits further engagement of community members with civic affairs [2, 6]. The HCI community has devoted considerable effort in recent years to further understand and develop digital civic solutions designed to further assist elected officials and civic leaders by improving civic engagement through the use of modern technologies.

This paper first explores the literature that exists on the topic of civic engagement. We organize a subset of the literature which is pertinent to this study into three schools of thought for approaching the issue of civic engagement: understanding the causes of mistrust between members of a community and civic leaders in order to better design solutions that attenuate this mistrust, focusing on the needs of community members to best design interaction tools that enable the citizenry to engage with their civic leaders, and understanding the needs of civic leaders to better design tools that assist with the collection and analysis of solicited feedback from the community. Prior literature on the topic of civic engagement has focused predominantly on designing solutions to incorporate ideas, opinions, or observations such as reporting infrastructure failures or encouraging more immediate public response tailored to the needs of both the community and its civic leaders. These solutions are designed to increase the scale of dialogue between civic leaders and members of the community, thereby reducing the level of mistrust already present between the citizenry and elected officials.

We contribute to the current literature by prototyping and assessing the effectiveness of a novel digital solution designed to increase public interest in the civic process rather than focusing on developing another crowdsourcing platform aimed at collecting public opinions that are made available to civic leaders. As pointed out in a conceptual discussion by Reynante et al., it may very well be the case that technology only attracts the members of the community who would otherwise already be interested and willing to engage in the civic process as opposed to engaging other members of the community who would otherwise express a lack of interest in public participation [10]. Thus, to effectively improve the level of civic engagement for an entire community, it is important to consider the means of motivating community members who lack any interest in engaging with the civic process.

This report focuses on better understanding the current means by which people interact with their local governments and the resources they use to obtain information regarding publicly funded projects. In so doing, we determine that in addition to a general sense of mistrust between community members and civic leaders that has been reported in prior literature, disengaged members of the community adopt a perspective that democracy at the local level is stagnant and

are of the belief that civic leaders would be unreceptive to their feedback even if it were offered. These same members of the community are also unaware of ongoing community projects and therefore lack the ability to express opinions on such matters due to lacking the appropriate knowledge of the project in the first place. After prototyping a potential digital solution designed to address this community shortcoming, we determine, with the aid of a user study, that wide-reaching technology can be an effective means of engaging members of a community who lack interest in civic affairs and are unaware of the dynamic nature of local governments and democracy. Tools such as the one proposed in this paper can be effective at improving the confidence and motivation of weary community members who would otherwise not engage in the civic process even with the availability of other digital civic solutions proposed in prior literature.

## **Related Work**

Prior literature on the topic of civic engagement concerns a broad spectrum of approaches and insights ranging from theoretical research to better understand natural interaction mechanisms between a community and civic leaders to digital prototypes of tools whose effectiveness at accomplishing a civic engagement task are assessed through the aid of case or user studies. This paper was motivated by a subset of the current literature which is explored in this section. We group this literature into three thematic categories: determining the underlying causes of mistrust between the community and civic authorities, focusing on approaches and interaction tools used by community members to engage with their civic leaders, and understanding the needs of civic leaders to design better tools that best aid their needs when analyzing feedback from the community.

The first group of literature seeks to gain insights into the causes underlying a lack of trust between the community and civic authorities which is noted to negatively impact civic engagement [2, 6]. Harding et al. identified that the lack of trust between the community and civic leaders stems from a black-box view of city infrastructure decisions and an overall lack of communication between the community and civic officials [6]. In an attempt to attenuate the sense of mistrust between community members and their officials, Corbett and Dantec presented several potential strategies, one of which was to mediate expectations of the community [2]. Corbett and Dantec explain that mediating expectations addresses the mistrust generated from the speed of progress of civic projects which is commonly unknown to the community [2], or as Harding et al. would describe it, the black-box view of city infrastructure [6]. Expectations of a faster response than is actually observed can induce mistrust on the basis that civic authorities are not committed to solving what the community views as urgent issues. On the other hand, development projects changing the community's landscape at a rapid pace, beyond what the community expected, also contributes to mistrust from the rapid change in landscape that the community now finds unfamiliar and is fearful of further change [2]. By understanding both the needs of community members and a potential source of their mistrust against civic leaders, Harding et al. prototyped a highway reporting application, shown in Figure 1, that allowed the community to witness for any damages or hazards on the highway that needed to be addressed by the city while also developing

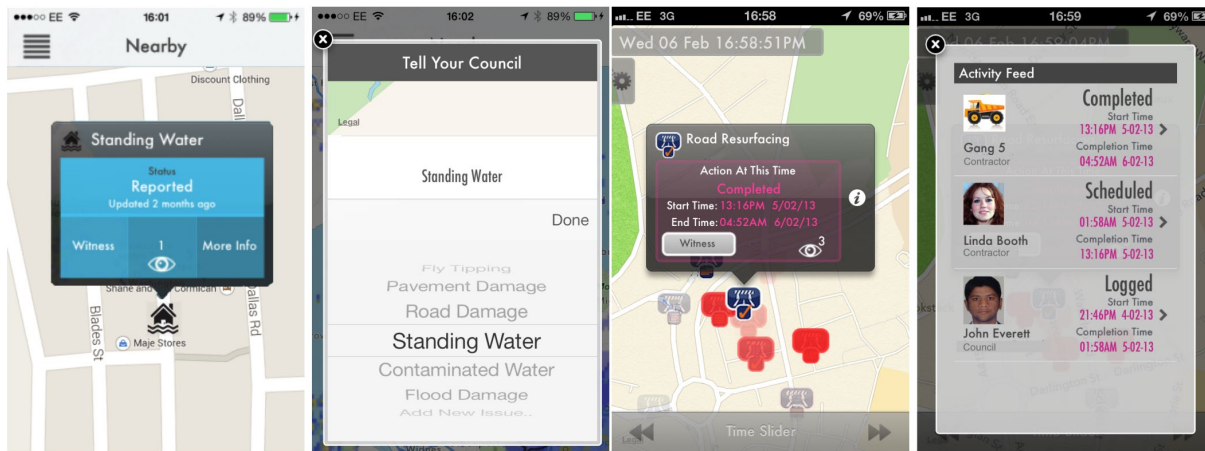


Figure 1: Harding et al. prototype of reporting application that allows community members to witness for damages or highway issues in need of attention (left two screens) and keeps community members informed about the status of the repair (right two screens) to foster greater trust between community members of civic officials [6].

a web interface which allowed city officials to respond to service requests and keep the public up-to-date with the status of the repair [6].

The second body of literature focuses on exploring different approaches and technologies that can help improve the effectiveness of current efforts to increase a community’s level of engagement. Hamm et al., identified that most technology-based civic initiatives are short-lived and outlined key factors contributing to the success and adoption of civic tech initiatives. A few of these factors included: (1) identifying and addressing an issue of public concern, (2) establishing an initial background network and further networking to gather expertise and further develop the solution while achieving greater public adoption, and (3) actively finding the means to attract new community members to participate in the initiative and use the platform [5]. In addition to the suggestions presented by Hamm et al., Corbett et al. argued that the needs and strategies employed to improve the level of engagement within a community need to vary based on civic department and the particular needs of civic leaders [3]. A theme discussed by Corbett et al. was the need to raise awareness with respect to municipal operations [3]. A citizen with greater knowledge of current projects and city departments is likely to become more willing to participate in dialogue with a given city department. In a more tangible case study analysis, Coenen et al. focused on improving current methods of polling opinions from the community [1]. Coenen et al. explored a different means of polling people in public spaces using public polling displays, highlighting their effectiveness in gathering informative and accurate polling data and the challenges that stakeholders may face. One such advantage was that the poll was dynamically available in locations pertinent to the polling questions. This allowed respondents to be provided with a certain level of context to more accurately respond to the poll [1].

Although the literature focused on developing community-side solutions aimed at improving civic engagement are of great importance, the third group of literature would contend that the public’s perspectives comprise only half the picture and that understanding the needs of civic leaders and designing tools to best aid their analysis efforts when soliciting feedback from

the community is of equal value and importance. Harding et al. noted that prior efforts to improve civic engagement through pervasive technology were unsuccessful since they failed to account for both the needs of the citizenry and the elected officials [6]. These pervasive technologies were typically introduced as crowdsourcing platforms for the public that did not interface well with governments [6]. Additionally, Coenen et al. identified that one of the challenges faced when deploying their public polling stations was the ability to extract insights from collected polling data. Some stakeholders simply do not possess the resources to evaluate thousands of responses and extrapolate a public course of action to address the themes brought up in the responses [1].

Mahyar et al. identified the same challenge when conducting interview studies with civic leaders. They determined that face-to-face meetings with the community are preferred due to the ability to gather qualitative data rather than strictly quantitative data; however, even though technology is capable of scaling and diversifying the opinions collected within the community, civic leaders have to outsource the analysis of the data which is expensive and time consuming [9]. Another concern with respect to outsourcing the analysis of qualitative data is the lack of transparency in the process which "...raises the potential of bias and uncertainty" [9]. The authors proposed one solution that keeps in-person, face-to-face meetings with civic leaders while publishing the discussion notes so that they become accessible to the entire community for further comment. Jasim et al. furthered the research of Mahyar et al. by conducting a more focused study to determine what features were most important for civic leaders when trying to analyze community feedback. With new technologies available, lowering the cost of submitting feedback to city leaders by members of the community, civic leaders are often faced with increasing quantities of data while lacking the necessary analytical skills and time to fully analyze the community's input. After interviewing several civic leaders, the authors determined that it would be beneficial to categorically label submitted comments as excited, happy, neutral, concerned, or angry along with additional visual aids such as the number of comments for each project to gauge in which proposals or topics the community is most interested [8].

Additionally, civic leaders desired a means of summarizing the community's comments since visualizations and categorical labels sometimes fail to capture the true context of the community's input [8]. To further test their conceptualized solution, Jasim et al. prototyped a web-based solution called CommunityPulse, shown in Figure 2, to assist civic authorities with analyzing free-response comments collected from the community [7]. Assisting with the automated analysis of feedback sentiment, Jasim et al. employed a bidirectional encoder representation from transformers which was trained on the CrowdFlower dataset to assign sentiment labels on submitted comments [7]. Additionally, the solution allowed for easy exploration and comparison of comments within the same community project or between different projects assisting with the extraction of more general themes expressed by the community.

This paper contributes to the current body of literature by assessing the effectiveness of a novel digital solution aimed at motivating otherwise disinterested members of the community to partake in the civic engagement process. As the first group of literature identifies, there exists a deep mistrust between members of a community and their civic leaders that negatively affects civic engagement. Although significant research has been conducted to better understand the sources



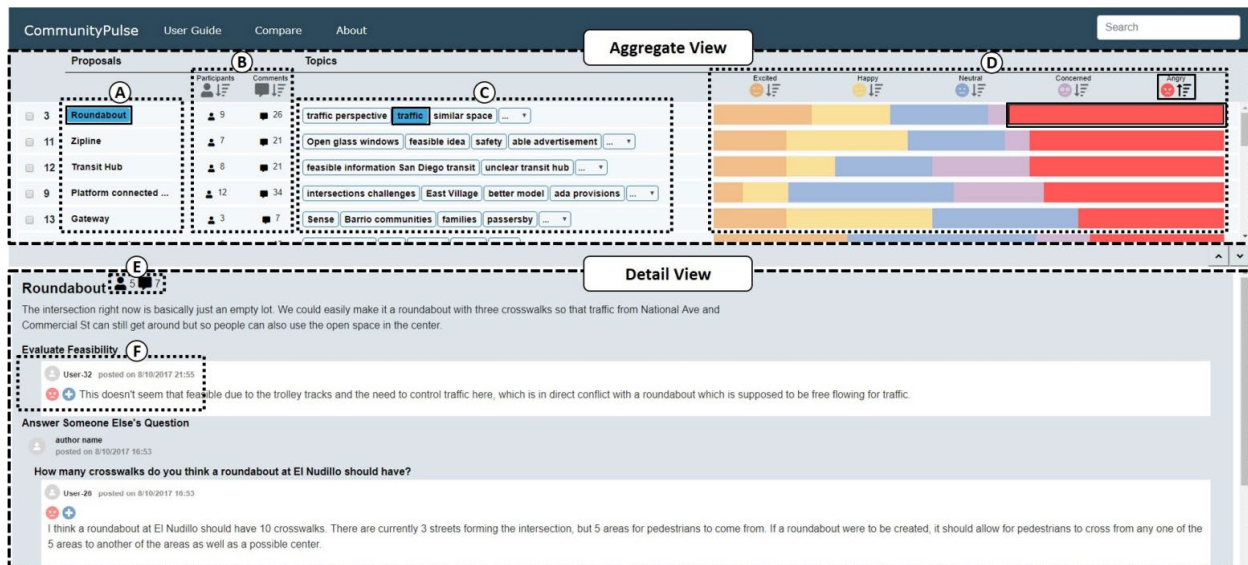


Figure 2: “A snapshot of CommunityPulse. The Aggregate View shows (A) a list of Proposals (Roundabout is selected), (B) the number of people and comments for each proposal, (C) a list of topics for each proposal (Traffic is selected), and (D) emoticons to sort the proposals based on emotions and stacked bar charts to present people’s emotion distribution and drill down to actual comments (In this view, the proposals are sorted by *Angry* emotions and angry comments from Roundabout are selected). The Detail View is rendered and updated based on the filters used in the Aggregate View. This example shows € Meta-information based on the user-selected angry comments, and (F) user information for each comment, with icons to represent associated emotions and option to save the comment as a note” [7].

of this mistrust, this paper addresses a void in the current literature which lacks a formal user study determining the potential effectiveness of digital civics in motivating otherwise disinterested members of the community to actually utilize other engagement solutions presently being offered. Additionally, we designed some of the prototype’s features, such as location-based listing of projects, based on the guidance and insights provided by the second body of literature focused on improving engagement by understanding the needs of the community members. Likewise, the proposed future direction of this project is highly motivated by both the second and third groups of literature aimed at better assisting civic leaders understand and analyze the vast amounts of data collected from the community by digital sources.

## System Prototype Overview

Our digital solution prototype consists of two main components: the On Track system and AR Projects. On Track is a location-based progress tracking system that shows information about nearby community projects that are under consideration, have been approved, or are under construction and funded by the city government. The main project list page of On Track, as shown in Figure 3, is designed to provide at-a-glance information about each nearby development project which includes: the name of the project, the current development stage of the project as defined by the city government (Pre-Application, Pending, Approved, Under Construction), the amount of time since the last update for that particular project, and an easy to view progress bar to graphically

display the progress and time remaining before completion for the current stage of development. The number of development stages and their respective labels are determined by each city government though the four included in this prototype are representative of a city’s typical planning and development pipeline. In addition to the displayed information, a community member can elect to follow each project to receive push notifications on their mobile device as soon as a new update for the project is published by the city. For additional information, a user can select one of the projects which will display an update timeline for that project from which the user can view additional information or update images (Figures 4 and 5) for each entry in the timeline. Additionally, a more detailed view of the project’s progression history, allocated budget and description (Figures 6 and 7), and answers to frequently asked questions (Figure 8) can be viewed by selecting the details category from the project’s information page.



Figure 3: List-view of city projects displayed in the On Track system.

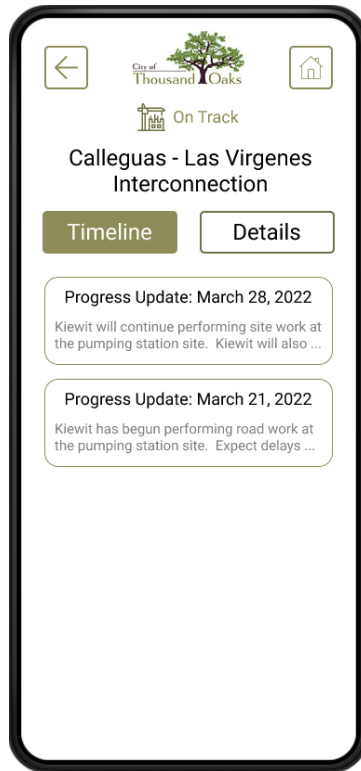


Figure 4: Timeline view of posted updates for a selected community project.



Figure 5: Posted project update selected from timeline view as shown in Figure 4.

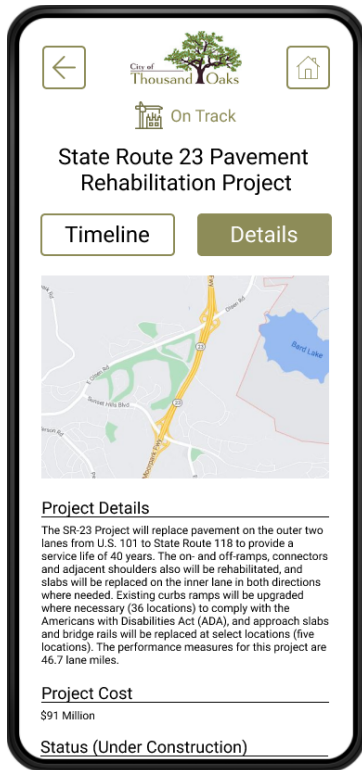


Figure 6: Details view for a selected community project.

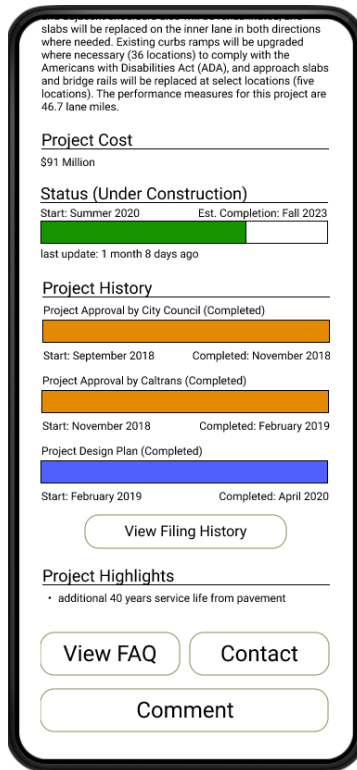


Figure 7: Continuation of the details view for a selected community project.

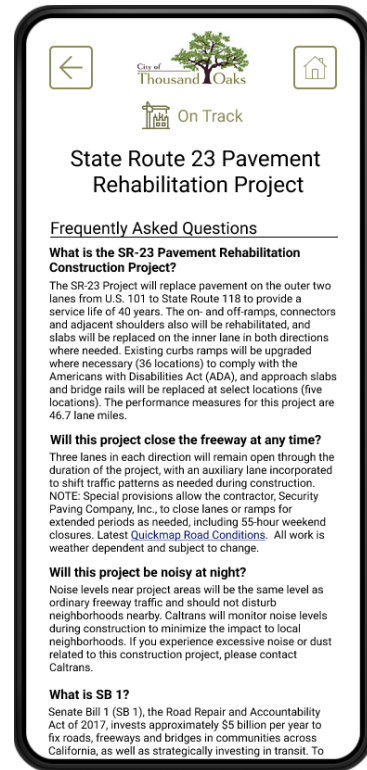


Figure 8: Frequently Asked Questions (FAQ) page for a listed project.

On Track is designed to keep the community informed of civic development projects, their estimated time frames and progress updates as they are reported to the city. This feature employs one of the strategies discussed by Corbett et al. of mediating expectations to reduce the level of mistrust between the community and citizenry with respect to development projects changing the city's environment [2]. Additionally, On Track is designed to provide context of current city projects that are otherwise unknown to the community, since most community members do not check their city's website on a regular basis. By providing this additional context, we hope to encourage community members otherwise disengaged from discussion with civic leaders to be more active in voicing their opinions.

The second component of our prototype is a feature called AR Projects in the application. It is an augmented reality preview feature for proposed large-scale construction projects that typically have public notice signs erected at the project site. Through the application, community members can use their smartphone to view how the proposed structure would look next to the already existing structures as depicted in Figure 9. As with On Track, a project viewed in augmented reality can easily be followed by toggling the follow button displayed on the smartphone which will provide the user with push notifications as soon as a project update is published by the city for that particular development. Similar to the goal of On Track, AR Projects is designed to provide additional context and information to community members about planned

and ongoing development projects around their community with the hope of conveying a much more dynamic view of local government while motivating disengaged citizens to become more interested and engaged with the civic process.



Figure 9: AR Projects prototype design overlaying rendered model of proposed construction (top with AR 3D model outlined in red) on top of real-world scene (bottom) as captured by a mobile device in real-time.

### User Study Procedure

In order to evaluate the effectiveness of our prototype design, we conducted a user study consisting of eleven participants all of whom were at least the age of eighteen. We utilized the user studies to collect qualitative data from which we could gain additional insights into potential mechanisms

that arouse curiosity for the civic process in disengaged citizens. These insights are then used to inform changes or design additional features that community members would be interested in seeing to further develop their interest in civic affairs.

The purpose of the user study is to assess the current state of how ordinary citizens interact and participate with their local city governments and whether a new software tool for novel interaction with city development projects improves a citizen's willingness to more actively engage in the democratic process at the local level. As previously introduced, our hypothesis is that these new tools will provide a heightened sense of awareness with respect to ongoing city projects which in turn would promote a more consistent and ubiquitous dialogue between the whole citizenry and elected officials. To evaluate the effectiveness of the tools, participants took part in a user study evaluating our tool through a pre-interview and post-interview. The pre-interview consisted of several questions assessing the participant's current level of engagement with their city and the resources they use to keep-up with major developments in their city. For example, a couple pre-interview questions followed the general structure of asking *what was the last development project you noticed in your city?* and *how do you typically find out about upcoming or ongoing construction projects in your city?* The post-interview was conducted after demonstrating our prototyped software tool to the participant. These questions assessed whether the participant felt more confident, more interested, and was more willing to take an active role within their municipality or simply felt more connected with their city's activity.

## **User Study Analysis**

In general, participants of the user study expressed interest in our prototype and agreed that if their city offered this platform as a means of easily accessing and interacting with community project information, they would feel more informed, confident, and willing to engage with civic affairs in their city. The On Track system we prototyped received favorable comments from all participants in addition to suggested features that would further improve the interaction and engagement of community members with city officials. On the other hand, most participants stated that they would not use the AR Projects feature simply because it would be too inconvenient for them to stop mid-transit to their destination just to visit a proposed construction site and view the project in augmented reality. Alternatively, most participants preferred having access to multi-perspective renderings of the proposed construction or a 3D model of the project they could explore on their mobile device during their own leisure time without needing to physically visit the construction site. The following analysis highlights common discussion themes and suggestions that were brought-up during the user studies.

Push notifications for followed projects were received with mixed-enthusiasm among the user studies. All participants expressed a lack of time or unwillingness to search for information on their own, especially when trying to navigate poorly designed and convoluted websites that are typically deployed by local municipalities. Therefore, participants agreed that providing a means of conveying updated information regarding projects of interest, as determined by the projects a user of this prototype application would decide to follow, was extremely important.

Approximately half of the user study participants were enthusiastic about the push notification feature, describing how push notifications on their phone fit well into their current practices of getting news, communicating with friends, or browsing social media, making them more likely to keep up-to-date with community development projects. On the other hand, the other half of participants explained how they would not desire push notifications on their phone since city project updates are not of the same importance to them as work-related or other social media notifications. These participants preferred getting email updates instead of push notifications which would provide them with the flexibility of viewing the posted update during their own leisure time. Despite the mode by which updates are sent to community members, all participants agreed that this prototype offers a more convenient means of accessing city project updates thereby making participants feel more confident and informed about their city.

Another common discussion that surfaced during the user studies was whether the timeline view (Figures 4 and 5) or the detail view (Figures 6 and 7) for a particular project should be displayed first. Some participants favored viewing the timeline view upon first exploring a project, stating that the detail view was too overwhelming with information. Contrasting with this opinion, other participants preferred looking through the detailed view of the project first to get a better sense of what the project is about before viewing the project's update timeline. Two possible methods to rectify this difference in opinion include either creating a user setting for which view is first displayed when selecting a project in the On Track system or providing some background information in the timeline view, such as a sliding gallery view of renderings for the construction project, a map of the project's location, and a brief description of the project.

With respect to sharing information from within the application with friends and family, the user study participants generally were not interested in such functionality. In particular, several participants suggested that the circumstances under which they would share project status information with friends or family depended on whether a particular project would significantly affect their friend's or family member's daily routine. For example, participants would be interested in sharing a project update with their friend if that particular project related to a community feature or development that addresses a complaint their friend has been making for several months.

Although the functionality of sharing project information outside the application through other communication applications such as social media platforms, email, and text messages was not highly valued by user study participants, having an in-application commenting function was favorably received. Most participants particularly emphasized the need for comments to be publicly viewable, as opposed to submitting a comment on a project through the application and having that comment only visible to city officials as if they were completing an online survey. Participants wanted to read through community comments on projects of interest as to determine their own idea about how the community feels about the project. Additionally, participants who suggested an in-application commenting feature also desired an upvoting system with similar mechanics to platforms such as Reddit so that they could read the highest rated comments first. We also believe an upvoting system for community comments would be beneficial to city officials when reviewing public comments on community projects. One participant also expressed interest

in the continued accessibility of completed projects that they previously followed and the ability to comment on the project's appeal post-construction.

Another popular theme among participants regarded the lack of trust in city officials to genuinely consider the community's feedback that is posted within a project's commenting thread. To help rectify this dilemma, a couple participants suggested that integrating some kind of feedback mechanism suggesting when city officials have used one of their comments to inform a decision would greatly assist in providing more confidence that civic authorities are taking their feedback seriously. Some examples of potential feedback mechanisms include: displaying how many times each of a community member's comments were aggregated to generate some kind of statistic used by city workers, when their comment was opened and read by a city official, or a notification that their comment was used to inform and enact a particular change in the city.

With respect to the augmented reality view of proposed construction projects, most participants were not interested in this kind of functionality. The few participants who did express interest in AR Projects described a use case scenario when they would take a leisurely stroll or ride their bicycle through the city and were not pressed for time. For the most part, participants would prefer viewing either multi-angle renderings of a proposed construction project or exploring a 3D model on their phone stating that they were unlikely to stop at the project location just to use the augmented reality feature.

Overall, user study participants expressed great interest in having either a web-interface or mobile application with easily accessible information about publicly funded projects in their city. All participants agreed that our prototype succeeded in addressing many of their barriers and concerns of currently acquiring public project information stating that they would feel much more informed and confident to comment on city projects if our prototype solution was made available in their city.

## **Insights Learned**

Conducting the user studies offered a more detailed view into the specific needs of community members with respect to encouraging future engagement in the civic process and the shortcomings of current solutions aimed at improving civic engagement. These insights can be classified into three categories that are vital to encouraging the otherwise disengaged citizen to partake in the civic process: (1) providing information to members of the community, (2) offering a mechanism by which city officials can provide feedback on how community input is being considered, and (3) designing a tool that tailors information to the interests of the user.

*Informed Citizen:* Perhaps one of the biggest barriers to civic engagement identified during the user studies was the lack of information members of the community possessed with respect to ongoing and future city development projects. Participants in the user study stated that they would be more willing to voice their opinions on a development project if they were aware of that project's details. In some instances, participants were not even aware of current development projects within their city. It thus follows members of the community who are unaware of

development projects would inevitably never express their opinions regarding those projects. Other participants were generally aware of nearby development projects within their city but like the participants who were unaware of any projects in their city, these participants expressed a lack of interest in voicing their opinions because they lacked the necessary, detailed knowledge of the project. All participants were also in agreement that they would not spend time trying to navigate their city's website to find additional details regarding the development project. Therefore, a civic engagement solution must consider the ease by which information is conveyed to the user since a more informed citizen is more likely to actively participate in the civic process.

*Active Feedback from City Officials:* Another concern expressed by participants in the user study was their perception of city officials and how seriously the city was considering their comments and feedback to enact changes within their city. Participants explained how it would ultimately be pointless to provide public comments on development projects if those comments fell on deaf ears. Furthermore, as identified in prior literature and through our user studies, community members generally express distrust for civic authorities and assume the default perception that offering their comments to civic authorities would be a waste of their time. To address this barrier in the civic engagement process, it is important to design a feedback mechanism that notifies members of the community how their public comments are being used by city officials and what changes their comments influenced within their city. As described in the previous user study analysis section, a few possible mechanisms for implementing active feedback from city officials include: displaying how many times each community member's comments are used to inform a statistic used by city officials, notifying community members when their comment has been read by a city official, and identifying development projects or changes enacted in the city which were influenced by particular comments from members of the community.

*Interest-based Information:* A third common theme discussed in the user studies pertained to the unwillingness of most participants to spend a considerable amount of time sifting through what they consider to be irrelevant information. Most participants preferred viewing and commenting on projects that affected their daily lifestyle rather than staying informed about all community projects within their city. The functionality to follow particular, nearby projects within our prototype addresses this concern of information overload that would discourage further participation in the civic process. Additionally, as previously discussed in the user study analysis section, the inclusion of a project suggestion feature based on the prior projects a user chose to follow would further improve the effectiveness of our prototype at displaying information that each member of the community deems important. Future civic engagement tools should also consider personalizing the information presented to community members based on their interests to prevent information overload that would otherwise discourage a community member from further engaging with their city.

In summary, the user studies we conducted provided insights into the preferences and current barriers preventing disengaged citizens from actively participating in the civic process. These insights can be summarized into three categories that future research in local civic engagement should consider: providing community members with information regarding development projects within their city, incorporating a feedback mechanism that assures



community members that their public comments are being considered by civic authorities and are enacting change within their city, and including personalization features to prevent information overload that would otherwise burden a member of the community with unnecessary information that is unrelated to that community member's interests.

## **Limitations and Future Research**

As we prototyped and conducted the user studies, there were several limitations to our current solution which became apparent. One limitation was the inability to easily deploy our smartphone application in any city. The data displayed in the application is parsed from a JSON object that is sent to the user's smartphone via a Node server. However, short of custom building a MongoDB database with the necessary information as was done when prototyping the application, there does not exist a standardized format for civic data at the local level from which the necessary information can easily be retrieved. This limitation leaves room for future work to devise a standardized query interface ubiquitous across city governments that can be easily accessed, much like certain APIs with federal government information which are currently available.

Another possible limitation is the requirement for additional data to be processed and uploaded by city employees such as picture updates of construction sites featured on the project timeline page of On Track and 3D models of the proposed structure to be rendered in AR Projects. Both of these features would require either city inspectors or contractors to send picture updates back to the city for public posting, or require full 3D models rather than 2D renderings to be provided to the city planning commission, both of which would change the current workflow of public governments and private firms while adding additional responsibilities to city employees. Generating more work for public employees is undesirable especially since digital civics already has the potential of overloading civic leaders with qualitative feedback from the community [7, 8, 9]. Future work can explore different approaches to streamline the project update process, automating as many steps as possible to reduce the impact on local governments.

Reynante et al. provide a theoretical framework to improve civic engagement, drawing from the ideas of public participation, crowdsourcing, and design thinking in order to best achieve community goals such as "...inclusive and sustained participation in civics..." facilitating "...effective management of large-scale participation..." and providing "...a structured process for achieving effective solutions" [10]. Assessing these goals, it becomes apparent that current means of in-person interaction between community members and elected officials, such as town hall meetings, are plagued with issues and ineffective at community engagement at a large scale [10]. These more traditional forms of public participation typically suffer from the minority of highly vocal community members who overpower the opinions of the general community, they fail to scale well with the community, and they also offer very limited inclusiveness with respect to opinions expressed likely as a result of the high costs to participation, such as time, transportation, and childcare to name a few [10].

These drawbacks in more traditional face-to-face opportunities for bi-directional communication between community members and civic leaders serves as inspiration for future

development of this paper's prototyped solution to include a live polling functionality and enable real-time, live public hearing participation. Drawing from the research of Coenen et al., which showed that public polls administered at the location which the poll questions concerned provided respondents with additional context that improved participation rates and accuracy of the poll data, a future prototype of a live poll functionality implemented on a smartphone platform would make each applicable poll available to a community member based on their location. In other words, polls created by civic leaders would not be made available to a community member unless the poll contained questions pertaining to the community as a whole or the community member actively traveled near the vicinity that pertains to the poll. Additionally, another potential future direction for this project is to integrate a live public hearing feature that will allow community members to partake in public hearings in a synchronous and asynchronous manner without being required to appear physically before the city council.

## **Conclusion**

This paper considers a novel approach to easily and efficiently present public development project information to community members by means of a mobile application. The two features, On Track and AR Projects, were designed to better inform the citizenry on the progress and breadth of community projects, thereby uncovering a layer of the black-box view of city governments referenced by Harding et al. as a component sowing mistrust between civic leaders and members of a community [6]. This paper provides new insights to the current body of literature pertaining to civic engagement by identifying different methods to motivate the disengaged resident to become more curious and active in the civic process. We prototyped the two features which were then presented to a group of participants in our user study whose feedback confirmed our hypothesis and responded positively to having more live updates and an interactive means of viewing proposed and under-construction projects within their city.

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## **Iterative Design Process and Challenges**

This section describes the challenges encountered and the overall iterative process that ultimately shaped the research direction and focus of this paper. The discussion focusses on the underlying motivations that initially encouraged my research into civic engagement as well as how the initial idea of a mobile application transformed as the goals of the project changed from creating an interaction tool for public hearings to offering a solution that aims at addressing the more general issue of motivating community members to become more interested in the civic process so that they are more willing to use interaction tools in the future. I also discuss some of the challenges faced when attempting to design the backend server for the prototyped application.

## **Motivation and Iterative Design of On Track**

The idea behind using technology to further improve civic engagement at the local level was initially motivated by my own observations while attending a public hearing within my municipality. From a city with a population in excess of 100,000 residents, only a handful were in attendance at the public hearing and even fewer registered for public comment before the city council. After asking another community member in attendance whether the turnout I was observing was typical, which they confirmed to be true, I realized that there was significant room for improvement with respect to civic engagement at the local level within my city.

Preliminary ideas for a mobile application were devised approximately one year prior to this project. Basic interaction tools were to be included in the mobile application such as live polling capabilities, the ability to participate in public hearings remotely using the mobile application, and an easily navigable city calendar. It was not until after exploring prior literature on civic engagement, with prior studies prototyping interaction tools for communities and identifying mistrust between members of a community and civic officials, that the focus of this project was altered to finding ways at motivating disengaged citizens to be more interested and willing to partake an active role in the civic process.

The On Track system underwent the most revisions during the design process with the initial vision of the feature listing community development projects, a simple progress bar indicator for visually conveying the progress of the project, and additional information regarding the project such as allocated budget, the project's location on a map, goals for the project as outlined by the city council, and a frequently asked questions page for the project. In its initial state, On Track was just another portal to public information which provided the benefit of more convenient access to the same data that could be found through a city's website.

To create a more dynamic experience rather than another information retrieval system, additional features were eventually added to On Track. One such feature was location-based listing of community development projects. As was confirmed in the user studies, most members of the community only care about development projects that have an immediate impact on their lifestyle. By allowing users of On Track to filter projects based on locations they have visited, there is a higher likelihood that the listed projects are of some interest to the user. Additionally,

the ability to follow projects was added as a feature to On Track so that users of the application could receive notifications whenever an update to a project being followed was published by the city. This functionality offered a more dynamic view of city development and would assist with making members of the community more invested and interested in publicly funded projects. A final feature added to the On Track system at this stage was the ability for users to at-a-glance know when the last update for each project was posted. This feature was included with the thought of allowing community members to better assess the current progress of community projects and inquire when a project appears to have stalled in its current stage of development.

A final iteration on the design of On Track saw the inclusion of the timeline view for each project in addition the previously prototyped detail view of the project. The timeline view was included with the hopes of preventing community members from being discouraged upon initially viewing the detailed view for a project which includes significantly more technical information that is more difficult to quickly interpret. The timeline view offers a more intuitive interface for overviewing the development process of a project and the inclusion of pictures of the project site along with published updates provides a more personal connection that will hopefully assist in bringing residents of the city closer to and become more trusting of city officials.

### **Backend Server and Database Challenges**

A significant challenge with this project, and its future potential for public testing within a city, is the design of the backend server and how application queries are processed and exchanged with already existing city databases. Initially, we considered using Parse Server as the backend when prototyping our application since Parse Server offered an integrated package with all the functionality we needed which included a Database Management System using MongoDB, the ability to push new information to connected devices in real-time, and built-in support for push notifications whenever a new progress update was published to the database. However, there were two particular drawbacks to Parse Server and its integration with already existing city infrastructure that ultimately made building a custom Node.JS backend server a better idea. First, at the time of writing this report, installing the dependency packages of the latest version of Parse Server produced two critical security vulnerabilities when running Node's audit function. Secondly, municipalities lack a defined standard for storing information within databases; thus, the schema, database management system, and queries to access the stored information vary from city to city. Until a digital standard for storing public records at the local level can be devised and adopted by cities, deploying our prototype application within a city would require custom-building the query interface between the backend server and the city's already existing databases for public records. We also determined, for obvious reasons, that migrating a city's existing database into MongoDB used by Parse Server is unreasonable.

## **Future Outlook**

In conclusion, the insights learned and additional feedback gained from the user studies will inform further iterative revisions of both the On Track and AR Projects features prototyped in this project. Additionally, a future direction this project will explore is the feasibility of deploying the prototyped system in a city to help build a more adaptable backend server and better assess the application's effectiveness as motivating the disengaged citizen to be more interested in the civic process.