Lumicity: A Tangible Interface for Local Event Discovery in Smart Cities

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ABSTRACT

Lumicity is an interactive 3D map device that provides real-time updates on local events, making it easier for residents and visitors to explore Newcastle's vibrant community. Lumicity enhances the visibility of local businesses, emerging artists, and grassroots event organisers, helping them connect with a wider audience in an increasingly digital landscape. By bridging the gap between online promotion and real-world discovery, Lumicity is particularly beneficial for travellers, spontaneous explorers, and newcomers, including immigrants and international students, who seek to immerse themselves in the city. Given Newcastle's reputation as the UK's friendliest city, Lumicity fosters social connections and strengthens community ties. This report outlines our design journey, from addressing the "data well-being for social good" design brief to the development and implementation of Lumicity. We also discuss potential future applications, along with the challenges and limitations of our design.

Author Keywords:

Tangible interaction, smart cities, public displays; human-computer interaction, community engagement, event discovery

CSS Concepts:

Human-centred computing → Ubiquitous and mobile computing; Interaction design; Empirical studies in HCI; Hardware → Sensor devices and platforms; Information systems → Location-based services

INTRODUCTION

In an increasingly connected urban world, cities are becoming more than just physical spaces – they are evolving into interactive ecosystems that engage residents and visitors alike. Yet, many small-scale local events often go unnoticed due to limited visibility, especially among newcomers, tourists, and underrepresented communities. Event organisers, in turn, struggle with low outreach due to a lack of advertising resources or digital presence. This gap between community-driven events and public awareness served as the motivation for our project.

This report presents Lumicity, an interactive 3D event map of Newcastle upon Tyne designed to promote local engagement and make small events more visible to the public. The system combines a physical 3D-printed map, embedded with LED-lit buildings, with a digital event submission and display interface. Controlled by a Raspberry Pi, users can interact with the prototype using buttons and a joystick to explore events happening at different locations in the city.

Lumicity aims to be an inclusive, tangible, and intuitive system that enhances community awareness, social participation, and civic visibility – all while reflecting the "Living Well Together" ethos central to the CSC8604 design brief. Through integrating Human-Computer Interaction (HCI) principles, Internet-of-Thing (IoT) components, and community-focused design thinking, this project serves as a proof of concept for how technology can bridge the physical-digital divide and foster social good in smart cities.

RELATED WORK

Participatory mapping has gained traction as a tool for community engagement. Platforms such as Maptionnaire facilitate community-driven cartographic projects where local voices shape the spatial representation of areas. Similarly, Hoodmaps allows crowdsourced annotations to reflect urban experiences, while MindMixer supports civic engagement through idea-sharing for city planning.

Interactive physical installations have been widely used to promote tourism and community engagement. The Southern Scavenger Hunt, for instance, employs gamification to encourage the exploration of cultural landmarks [10]. Community art festivals, such as Oku-Noto Triennale, transform spaces into interactive exhibits, drawing attention to underappreciated locales [9].

A notable example of this is the Digital Town Crier prototype at Cardiff Bay, which senses visitor presence and announces nearby special offers [5]. Part of the 'Ideascape: Digital Placemaking for Porth Teigr, Cardiff Bay' project, it integrates digital technology into a public space to enhance the discovery of local opportunities. This approach aligns with Lumicity's goal of fostering community engagement through physical-digital hybrid installations.

While digital applications like PlaceSpeak facilitate location-based discussions and civic participation, they remain bound to online ecosystems that require active user engagement and account creation. In contrast, our physical 3D map serves as a passive discovery tool, accessible to anyone in the vicinity. It fosters serendipitous interactions, where individuals might stumble upon an event they wouldn't have actively searched for online. Additionally, a physical installation contributes to the urban aesthetic, enhancing placemaking efforts while serving as a recognisable landmark for community-driven activities.

BACKGROUND RESEARCH

The UK welcomes a significant number of immigrants and international students each year. According to the UK Home Office, 955,576 people arrived in the UK in 2024 for various reasons, including work, study, family, and humanitarian purposes [11]. While migration presents opportunities for personal and professional growth, many newcomers face difficulties adapting to a new cultural environment. Cultural differences can contribute to emotional challenges, particularly among immigrant and refugee youth. Studies suggest that those who perceive a significant gap between their native and host cultures may experience higher levels of stress and difficulty adjusting [2]. International students also face challenges such as academic pressure and loneliness, which can hinder both their social and academic integration [3,8]. These struggles highlight how difficulties in developing a sense of belonging can take a toll on the mental well-being of those who have recently moved to a new country.

To better understand these challenges, we conducted a user survey to explore how newcomers discover local events, engage with their communities, and maintain connections to their own culture.

Survey on How Newcomers Find and Engage with Local Events

We designed a structured survey using Google Forms, which was distributed among international students at Newcastle University through personal networks. The survey contained ten multiple-choice questions aimed at understanding:

- The primary sources through which respondents learn about local events and popular gathering spaces.
- The frequency with which they miss events of interest and the reasons behind this.
- The perceived accessibility of event-related information.

Survey results revealed the following key trends:

- 80% of respondents reported that they primarily discover events through social media and peer recommendations.
- Despite these sources, 40% of participants indicated that they frequently miss events due to inadequate promotion and the fragmented availability of information.
- In terms of trustworthiness, social media was identified as the most reliable source for event information, followed by word of mouth and official websites.
- A significant proportion of respondents expressed an interest in a centralised platform where event details are consolidated and easily accessible.

These findings suggest that while newcomers are generally interested in engaging with their local communities, inadequate access to event information serves as a barrier to participation. Addressing this gap through improved communication strategies and centralised information platforms could facilitate greater social integration and enhance the overall experience of newcomers in the UK, particularly in Newcastle.

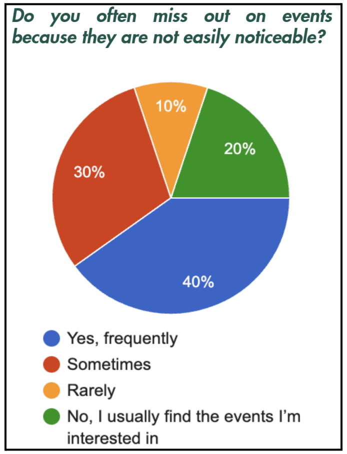

Figure 1: User Survey on Getting Event Information

Challenges of Online Event Promotion

While social media offers event organisers a platform to reach a wider audience, gaining visibility remains a significant challenge. Platforms like TikTok move at a rapid pace, where content is consumed quickly and easily overlooked, making it difficult for organisers and artists to capture and sustain public attention [12]. Additionally, social media algorithms primarily reinforce users' existing preferences, meaning people are more likely to engage with content related to artists, events, and places they are already familiar with. As a result, independent event organisers and grassroots artists often struggle to gain exposure compared to those backed by established labels or organisations [7]. Beyond visibility issues, the pressure to gain validation through likes, shares, and follower counts can contribute to anxiety and burnout among artists, turning self-promotion into both a logistical and emotional challenge [6]. In an era where information is abundant yet scattered, grassroots events, local cultural happenings, and emerging artists face increasing difficulties in attracting attention and maintaining visibility online.

PROBLEM SPACE

By analysing the findings from our survey alongside insights from academic literature on online promotion challenges, we identified two key user pain points:

1. Newcomers struggle to discover and engage with local events due to fragmented and unreliable event information.
2. Grassroots event organisers face difficulties in gaining visibility in a digital landscape dominated by algorithmic biases and short-lived audience engagement.

These challenges led us to explore how we could bridge this gap, helping newcomers easily access information about community events while also supporting grassroots organisers in reaching a wider audience. Research suggests that local festivals can play a crucial role in enhancing visibility and cultural identity, emphasising the importance of festivals in promoting sustainable tourism and fostering community participation in cultural expression [1]. Additionally, events should not only showcase performances but also create meaningful interactions between artists and audiences, allowing for greater engagement and feedback opportunities [4]. By connecting newcomers with grassroots event organisers and emerging local artists, our approach aligns with the design brief's objective of contributing to the 'social good' in smart cities. Furthermore, it supports the broader goal of responsible data collection for "living well together," ensuring that technology serves to enhance inclusivity, cultural exchange, and community engagement.

In the following sections, we will outline our methodology for collecting event data and detail the design and implementation of Lumicity, a centralised event platform/device. Lumicity is designed to bridge the gap between newcomers looking for social integration and local events struggling for visibility by fostering community-driven engagement. By enhancing access to event information and promoting local cultural activities, this initiative aims to create a more connected, inclusive, and culturally vibrant society, ensuring that both newcomers and long-term residents can live well together.

Potential Use Cases

The Lumicity prototype can be adapted for various real-world scenarios to enhance event visibility and community engagement. Firstly, it can be placed in public community spaces such as libraries, tourist centres, or high-footfall city zones to display local events, helping residents and tourists discover nearby cultural activities, workshops, or performances that typically go unnoticed. Secondly, within a university setting, it could be installed in student hubs like the Compass or Student Union building to highlight university-specific events, club meetings, festivals, or academic activities, addressing the common issue where students miss opportunities due to poor event promotion or information overload. Lastly, the system could be leveraged to showcase limited-time offers, discounts, or free food giveaways from local businesses, cafés, or university stalls. These are often only known via word of mouth, and a dedicated display in public spaces could ensure more inclusive access to such opportunities, especially for new students or those unfamiliar with local communities.

IDEATION AND LOW-FIDELITY PROTOTYPE

Before arriving at the final concept for the interactive 3D event map, our team engaged in open-ended discussions centred around the broader theme of "Living Well Together." A range of potential directions was explored, including emotional awareness, mental health interventions, relationship-building technologies, and systems to encourage community space engagement. After multiple rounds of reflection and user-focused discussions, our team chose to address a commonly overlooked challenge: the visibility and accessibility of local events, particularly for newcomers, international students, and small-scale event organisers in Newcastle upon Tyne.

The initial inspiration stemmed from observing individuals distributing paper pamphlets near Grey's Monument to promote their local performances. This analogue, low-visibility approach sparked the idea of creating a community-focused digital-physical system to surface such hyperlocal events to the wider public.

Many group members were international students and had just arrived in Newcastle. A shared concern emerged – despite the availability of social or cultural events within the university and around the city, many were missed simply due to a lack of awareness or visibility. For instance, events aligned with cultural festivals or specific communities were not listed on mainstream platforms like Google or event discovery apps. New students, seeking to connect with local culture or their communities, often struggled to "feel at home" due to the lack of accessible event information.

From the local event organisers' perspective, similar barriers existed. Many lacked the resources for digital marketing or paid advertising, meaning their events had limited outreach despite being culturally rich or artistically valuable. Emerging talents and grassroots performers often face difficulty attracting an audience due to these constraints.

To address this dual-sided problem, our team conceptualised Lumicity – a community-centric interactive event map that highlights small, hyperlocal events through a tangible, intuitive interface.

EARLY PROTOTYPING AND DESIGN IDEATION

Initial design ideas envisioned a flat map accompanied by a screen interface where users could press buttons to select specific locations and scroll through event details. However, during early sketching and storyboarding sessions, our team reimagined this setup into a more immersive and inviting design: a 3D-printed model of Newcastle, where key buildings would light up to indicate event activity. We drew inspiration from museum and historical site miniatures, which often captivate visitors. With Lumicity, we aimed to replicate this visually appealing and attention-grabbing aesthetic, making the installation stand out in the bustling city environment while attracting both locals and tourists through its interactive, physical format.

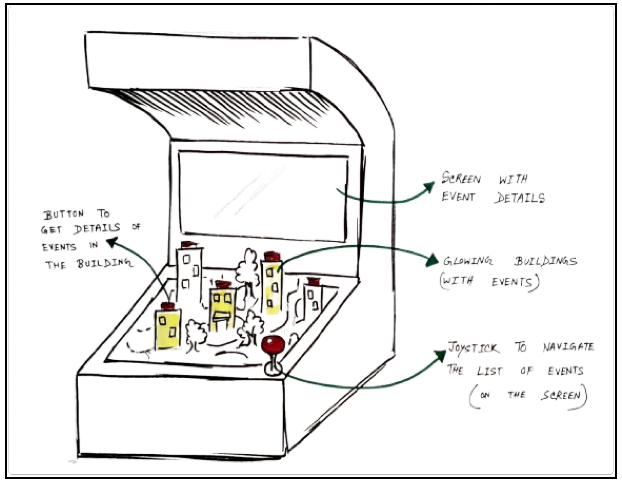

Figure 2: Initial Sketch of Lumicity

To enhance interaction and add a touch of nostalgia, a joystick was introduced to allow users to scroll through events by date and description. The interface was intentionally designed to be simple and accessible, accommodating users who may not be familiar with modern touch screens – such as elderly residents or tourists seeking a quick overview of local happenings.

This ideation process was heavily shaped by personal user experiences, contextual understanding of community needs, and feedback gathered informally from potential users during the planning phase. The resulting concept laid the foundation for a meaningful, inclusive, and locally resonant prototype that bridges digital visibility and physical engagement within community spaces.

Design Phase

During the design phase, our team initially considered placing individual buttons and small LCD screens on each building to display event information. However, this approach presented two major challenges. First, the small screen size would make it difficult for users to read the event details, potentially causing cognitive strain and leading users to disengage before completing the interaction. Second, given the geographic scope of Newcastle and the number of buildings represented, this solution was neither cost-effective nor feasible for scalability. As an alternative, our team explored using a small tablet screen positioned at the edge of the map to display information based on building selection. However, this too posed issues around visibility, particularly in group settings or for users interacting from various angles. Ultimately, the decision was made to integrate a large external monitor (measuring approximately 60.3 × 32.5 cm) placed adjacent to the map. This screen size closely matched the dimensions of the physical 3D map itself, allowing for a balanced and immersive visual experience. Moreover, it offered sufficient clarity and screen real estate to support future scalability, even if the physical map were to be doubled in size.

To simplify construction and interaction, our team did not replicate Newcastle's actual city map, as doing so would have introduced unnecessary complexity; instead, a custom layout was designed featuring six key buildings and one open auditorium/stadium to represent common event venues.

Storyboards

Storyboards played a crucial role in helping the team visualise and refine the user journey during the early stages of design. By sketching out step-by-step scenarios, we were able to better understand how users might approach, interact with, and respond to the Lumicity system in real-world settings. This process allowed us to identify key interaction points, anticipate usability challenges, and ensure that the flow between physical and digital elements felt natural and intuitive.

Figure 3: Storyboard: Data Collection

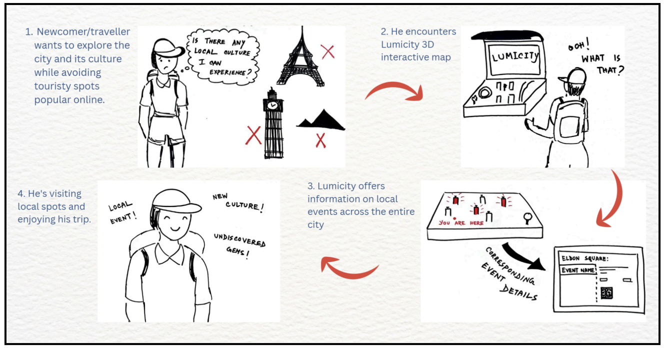

Figure 4: Storyboard: Event Visualisation

Low-Fidelity Cardboard Prototype

To validate the design of the interactive 3D event map before committing to laser cutting and 3D printing, our team constructed a low-fidelity cardboard prototype. This prototype played a critical role in shaping both the physical layout and user interaction model of the final product, moving beyond basic visualisation to provide hands-on spatial testing and early-stage feedback.

The cardboard model was not only used to test dimensions but also to simulate real-world user interaction in a tangible way. It enabled our team to assess the ergonomic placement of buttons and the joystick, ensuring comfortable reach and intuitive accessibility, while also validating the line-of-sight for LED indicators from various user heights and viewing angles. The prototype helped identify how users would physically navigate around the model, allowing adjustments to avoid spatial congestion. Initially, the map was designed on a flat, linear plane; however, during informal testing with fellow students, feedback suggested that a slanted surface would offer significantly better visibility—especially for standing users or those with limited height. Based on this insight, our team revised the model design to include a gentle incline, improving both the viewing experience and accessibility of the interactive components.

Figure 5: Cardboard Prototype

This preliminary model helped identify what could realistically be fabricated, which components might require modification, and how different elements such as buildings and interactive parts would fit together within the overall structure. It significantly reduced the likelihood of material waste or design errors during high-fidelity fabrication, ensuring a more efficient and accurate transition to the final prototype.

INTERACTIVE DIGITAL PROTOTYPE

Frontend Development

Due to time constraints and the complexity of backend development, we prioritised building the core input-to-output flow of the system. For the input, we developed a simple and user-friendly event submission form using HTML and CSS. The form includes essential fields such as event name, location, date, time, and description, allowing users to quickly post events without the need for excessive details. To address privacy concerns, we do not collect any personal information from users. Instead, the system only requests event details based on locations users come across in the city. For the output, we integrated the Bootstrap framework, which includes pre-built JavaScript functions and a vertical tab component. This enables users to browse all posted events at a glance and click on specific events to view more details, ensuring a smooth and intuitive user experience. Additionally, the event list only displays events happening within the next 48 hours, allowing spontaneous explorers to attend events as they become available while also giving users flexible options based on their upcoming schedules.

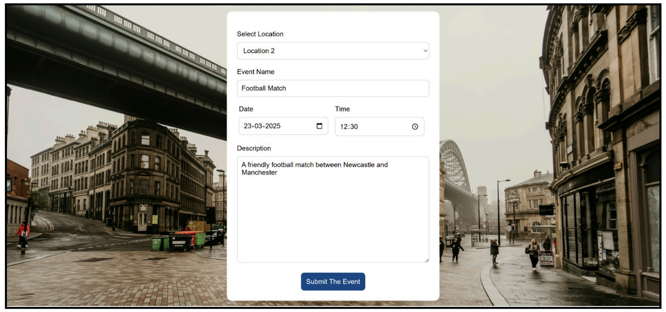

Figure 6: Data Collection Form

Figure 7: Screen with Event Details

Backend Development

The backend of Lumicity involves the files “events.json”, and “server.mjs” which uses the node.js runtime to allow for the pi to run javascript code outside of the browser. The framework implemented is express, which simplified creating the server/application and provided useful functionality like simplified routing. As well as these, socket.io is used to interface between the backend and frontend, allowing for requests to be made when GPIO interactions are detected, updating the appearance of the frontend to emulate how one would interact with html using a mouse and keyboard.

To detail, within server.mjs (the backend) the code can be broken down into configuration (including variable declaration and single-use functions), interval functions, routes (containing functions), and socket.io functionality.

The configuration includes specifying the correct LED and button GPIO numbers for the library in javascript to match the pins, setting today’s date and time in the correct format, padding the string written to the json to ensure it is read as an array, reading events from the json using custom separators and JSON.parse, as well as declaring variables used throughout the backend like the events array.

Most functions in the backend are called on a minute's interval, to ensure repeated checks for events that are now within 48 hours and removing outdated events (wholly new events are handled by the post route of form.ejs instead of an interval, to reduce delay). These include the following:

checkEvents: contains nested functions *setDateTimes*, *setLocationsActive*, and *setLocationsArray*. Also, refreshes the page on events changing.

setDateTimes (event): the date for each event is split into it’s separate components by “-”, and time is split by “:”. The *eventdates* array is updated with a new date consisting of this and “00” for milliseconds. This date is compared with today’s date, and if the event is in the past the LED for the respective location is turned off, then the event is removed from the array. If this is not the case, it is pushed to the array *newevents* which determines whether the page should be refreshed if it is equal to events.

setLocationsActive (event): checks if event within 48 hours and sets location to true and corresponding LED to on if so.

SetLocationsArray (event): pushes each event to a separate array for only events for a given location. This is used for socketIO to pass only these to the client on the corresponding button press.

As well as these, some functions are contained within the routes which allow for http requests to addresses, rendering templates. For example, in the post request for the form for booking events, formatDesc(string) is used to ensure that descriptions are padded with newlines so they don’t stretch past the browser width. Furthermore, makeString() is used to recompile all the events back into a string suitable to be written to the events.json file. This involves padding and JSON.stringify. Finally, refreshPage() ensures that other clients viewing events are refreshed upon a new event being booked.

This refreshPage function, and the watch functions for each GPIO are examples of socketIO being used to communicate with the client. For each of the latter, the GPIO voltage is watched, and upon changing, if equal to 0 (button pressed), emits a socket message to the client telling it that a button has been pressed, along with a list of events for that location.

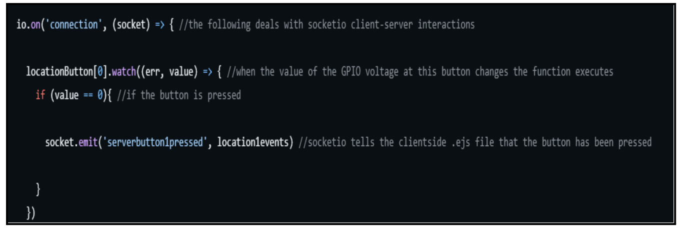

Figure 8: SocketIO is used to communicate button presses to the browser.

Further to server.mjs, the file events.json is a key component of the backend. All events are stored in this non-volatile file as an array to be accessed if the system is rebooted, namely events name, location, date, starttime, and description. A custom separator of “,,,, “ is used to avoid any issues with descriptions incidentally containing the separator and breaking the system. Use of a JSON file as opposed to alternatives was chosen since a database would increase the complexity of the system greatly, reducing our ability to overcome time constraints, whereas a typical csv file would require processing to be coded by hand rather than using built in javascript functions like JSON.stringify and JSON.parse.

Frontend-Backend Integration

As well as the HTML and CSS that made up the frontend of Lumicity, javascript was used in events.ejs to allow for changing information about events displayed to reflect the backend, and socket.io implementation for both GPIO interaction with the page and dynamic updates on response to form submission from other clients. The former used embedded javascript as allowed by the .ejs template to inform the template which information to display for each individual event, including building and date/time, whereas the latter used </script> tags to write more complex javascript to allow for refreshing the page on form submission and for loops to iterate over html elements for each event added, and assigning these to different states based on the button interface through GPIO.

One key aspect of the frontend allowed by the .ejs format was in assigning unique IDs to each event tab element and description element based on their default names being concatenated with an embedded script to fetch the event name. This event name was unique, since the html for the element was also within an embedded script to iterate through each event when loading the page. This meant that each tab and description element could be referred to in later scripts via their unique identifier that corresponded to an event on the server. Ejs was a convenient way of doing this as it allowed for iteration within the html itself, rather than in a <script> tag where references would have to be made to containers, reducing readability and increasing difficulty of programming.

Within the <script> at the end of the events.ejs file, socket.io is used to send messages to the client when a button is pressed, or when the page needs to be refreshed. For the former 3 messages were employed corresponding to the 3 buttons, and a list of events for that location is received alongside this message. Then, an array of event and description elements is created using their unique ids, which is used to set each to their default value. Following this, the correct event tab is set to *selected* using the button pressed and its counter (of how many times it has been pressed, which resets when reaching the length of the array of events for that location), and the matching description set to visible.

A refresh message from the server upon posting the form runs a function that reloads the URL, which allows for dynamic addition and removal of events.

Circuitry

To form the circuitry for the system, components were soldered together and connected to the Pi's GPIO pins. Namely, it was requisite that the circuitry included a button and an LED for each building, as well as a resistor for each LED, and grounding for every component. Ben, the makerspace creative technologist, kindly assisted with the soldering, and grounded each LED and each button into one ground pin each, simplifying the circuitry. Colour coding of the wires was also employed to assist in the final construction process. Further to this, each GPIO pin had to be coded to its corresponding value in the JavaScript library through a terminal command that revealed the mapping. This circuit was attached to the 3d model so that each building had a button-LED pair for its interactions.

Buttons and LEDs were chosen since other implementations either changed the design too much or increased complexity too much. For example, using conductive paint so that the user could touch the building to see its data would mean each building must be black, inhibiting the conceptual representation of a real-world map with coloured buildings and features. On the other hand, using other forms of touch sensitivity was beyond the scope of our knowledge and would have required more development time to properly implement. The same goes for having entire buildings light up rather than LEDs. Though, these options could be explored in a finalised product rather than a prototype, where the current implementation is suitable.

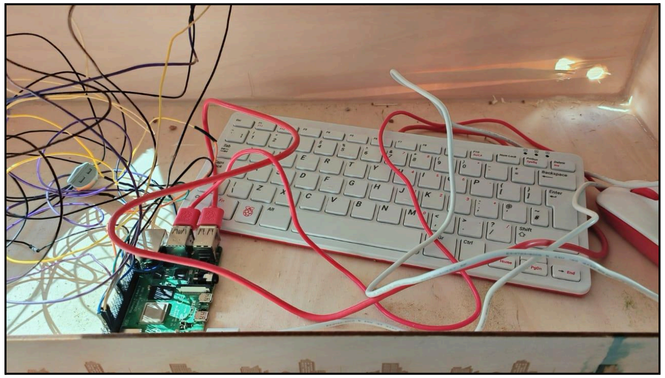

Figure 9: Circuitry

Physical Model Development with Components

The physical structure of Lumicity is designed to be both visually appealing and functionally effective in conveying real-time events and offering information to users. The construction process involved several stages, integrating digital and physical elements to create an engaging and interactive experience for tourists, newcomers, and locals alike.

<u>Stage 1: Material Selection and Design</u>

The structure consists of a 3D map representing key buildings in the local area. The materials were chosen based on durability, aesthetic appeal, and ease of integration with electronic components. The main components include:

- Base Platform: A sturdy wooden base to support the entire setup.
- 3D Map: 3D-printed models of buildings, stadiums and trees to ensure that the LEDs placed within shine through, ensuring accuracy in representation.
- LED Integration: Each building contains LED indicators that illuminate when an event or offer is active in the next 48 hours.
- User Interaction Mechanisms: Buttons and a Joystick allow users to interact with buildings and retrieve information.
- Aesthetic Enhancements: Roads were painted to mimic actual city layouts, while artificial grass, miniature stones, pebbles, and beach-like textures were added to represent green spaces and waterfront areas.

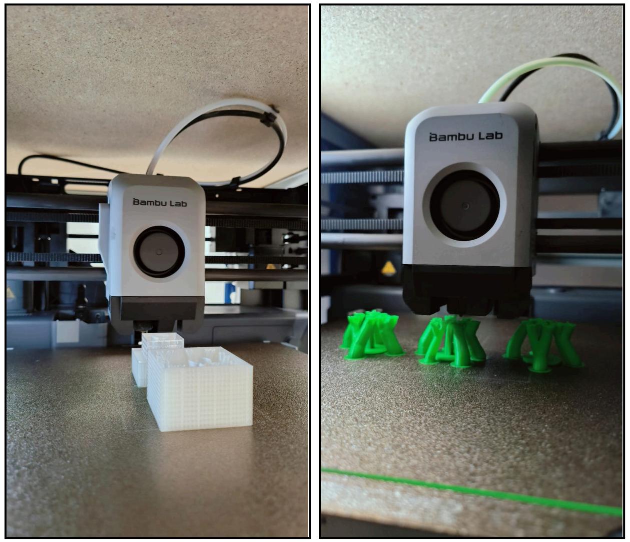

Figure 10: 3D Printing buildings and trees

Figure 11: Laser Cutting the base of the structure

Figure 12: Aesthetic Enhancement

Stage 2: Layout Planning

To guide the development of the physical model, the layout was initially hand-drawn on paper. These sketches mapped the relative positions of key buildings, roads, and interactive elements such as buttons and the joystick. This manual planning process allowed our team to explore spatial relationships, component placements, and wiring routes flexibly and collaboratively. The sketches served as a foundational reference during both the 3D printing process and the physical assembly of the model.

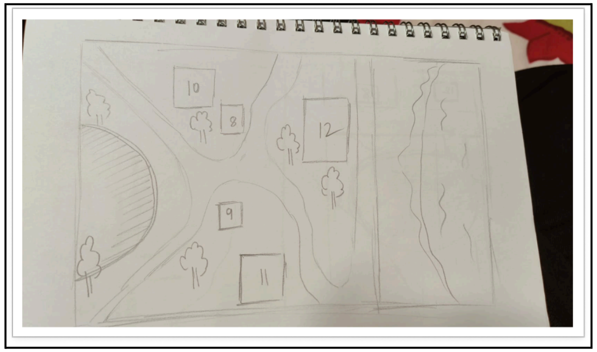

Figure 13: Map Sketching

Stage 3: Electronic Implementation

The heart of Lumicity's interactive experience is the seamless integration of electronic components, primarily powered by a Raspberry Pi. The major technical aspects include:

- Microcontroller & Raspberry Pi: The central processing unit that handles event data and user interactions.
- LED Circuitry: LEDs embedded in buildings are controlled based on real-time data updates from the backend.
- Button Interface: Each building has a dedicated button that, when pressed, triggers event details on an attached screen.
- Display Unit: A small digital screen connected to the Raspberry Pi that displays detailed information about active events or offers.

Stage 4: Software & Data Management

The functionality of Lumicity relies on a robust backend system that processes incoming event data and updates the interactive map accordingly.

- Event Data Collection: Event organisers submit details through an online form.
- Data Processing & Storage: Information is stored in a structured database and retrieved dynamically.
- Real-Time Updates: The system regularly refreshes to ensure up-to-date information is displayed.
- Assembly & Testing: Once all components were procured and prepared, the assembly process followed these key steps:
- Base Setup: Installing the main platform and securing the buildings in designated locations.
- Wiring & Electronics: Connecting LED circuits, buttons, and Raspberry Pi modules.
- Software Deployment: Installing and configuring the data retrieval and display software.
- Testing & Iteration: Running multiple user tests to ensure a smooth experience and refining the setup based on feedback.

Final Implementation

The completed Lumicity structure provides an intuitive and engaging way for users to explore local events and promotions. By bridging the digital-physical gap, it offers a novel approach to urban interaction and community engagement.

Figure 14: Final Model

Github Repository

https://github.com/JOpeel/CSC8604_Group2

FUTURE DEVELOPMENT

To better illustrate the full vision of how Lumicity could function as a complete system, we designed an interactive screen flow using Figma. While our current digital prototype focuses on collecting event data through a form connected to a Raspberry Pi and displaying it on a screen, the Figma prototype envisions Lumicity's event submission form as a mobile application that users can download from the App Store or Google Play or a more accessible and streamlined experience. With this mobile app, users would be able to quickly post events they come across in real time. The submitted event data would be stored on a central server managed by an authorised government agency or university. Once collected, this data would be automatically retrieved and displayed on 3D interactive map devices installed throughout the city. These physical installations would act as public event hubs, providing real-time updates and helping newcomers and residents easily discover and engage with local events. The physical installations will feature QR codes linking to the mobile app, enabling anyone to easily contribute and share interesting events they discover.

Additionally, the Figma design includes an optional location access feature. If users allow location access while using the app, Lumicity can automatically detect and log local events they come across, eliminating the need to manually enter the event location. However, for privacy reasons, this feature is not mandatory – users who prefer not to share their location can simply enter the event location manually instead. This ensures that Lumicity remains flexible and privacy-conscious, allowing users to engage with the platform on their terms.

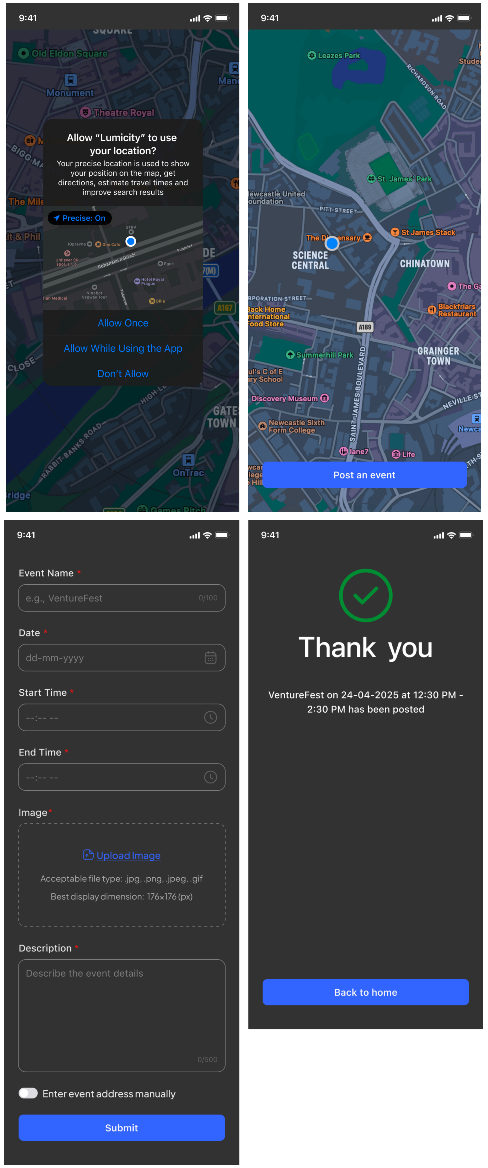

Figure 15: Lumicity mobile application

Figure 16: The design of the event listing screen

To enhance the usability of the physical installations, Lumicity will incorporate a joystick-based interaction system, allowing users to intuitively navigate the 3D interactive map. By tilting the joystick, users can move the cursor across illuminated event locations, and pressing the joystick button will display detailed event information on the screen. Sideward movements will allow users to switch between different days within a week, making it easier to plan and explore upcoming events. This intuitive control system ensures a seamless and engaging way to discover local events, making the installation accessible to all users, including those less familiar with mobile applications.

DISCUSSION

Throughout the development of Lumicity, our team explored how a physical, interactive system could make local event discovery more accessible and engaging, especially for international students, newcomers, and everyday passersby unfamiliar with what's happening around them. Our user research confirmed what many of us had experienced: information about events is often scattered across social media, hearsay, and posters, making it easy to miss out. Digital platforms tend to show people more of what they already know, making it harder to discover hidden gems or grassroots community events. With Lumicity, we aimed to flip that experience, instead of people searching for events, we wanted events to find them. The LED-lit 3D map invites curiosity and interaction. By combining physical exploration with real-time digital data, Lumicity encourages spontaneous discovery and strengthens community connection.

Still, this journey revealed key limitations. Physical installations have challenges: LED visibility in bright light, ensuring accessibility for all users, and the importance of placing the map in locations where people will naturally encounter it. We also had to face questions of maintenance, scalability, and usability: Would the system work as well with more buildings and events? These insights became important learning points for us as designers, helping us think not just about the idea, but about how it would function in the real world.

CONCLUSION

Building Lumicity was both rewarding and challenging. As a team, we navigated the complexities of prototyping a physical-digital hybrid system, often stepping far outside our comfort zones. From wiring up a Raspberry Pi and connecting GPIO pins to writing the backend logic and testing real-time updates, each part of the process taught us something new. Time constraints, hardware limitations, and our learning curves forced us to simplify and adapt. We could not make every feature work, like the joystick, but we did deliver a working, interactive prototype that communicated our vision.

Some of the biggest lessons we learned were not just technical, they were about collaboration, problem-solving under pressure, and embracing imperfections. When our circuitry did not work the first time or our code kept breaking, we learned to lean on each other, divide tasks strategically, and look for creative workarounds.

Looking back, we are proud of what we created. Lumicity is not just a prototype, it's a reflection of our shared vision: to build inclusive, playful, and human-centred tools that help people feel more connected to the cities they live in or are just beginning to explore. We hope this project inspires more ways to combine tangible interaction with smart technology, not just to inform but to spark curiosity, connection, and joy.

LIMITATIONS

Updating the 3D-printed structure to reflect new buildings or road changes is challenging and time-consuming, which creates a barrier to keeping the map current. Additionally, the digital companion, which serves as the event submission and viewing interface, requires active promotion to ensure users are aware of its existence and can engage with it effectively. The prototype also faces limited scalability, as the number of buildings and events that can be displayed is constrained by both the physical map size and the available hardware. Accessibility and usability present challenges, particularly for users with visual impairments or mobility issues, as interacting with buttons, lights, and navigation controls can be difficult. Location sensitivity is also a concern, as LED indicators can be hard to see in bright sunlight, and if the prototype is placed in a low-traffic area, user engagement could be significantly reduced. Finally, the prototype, being in a public space, is vulnerable to vandalism, tampering, or physical damage, which will require ongoing maintenance and repair to ensure its longevity and functionality. These limitations must be addressed in the long term, creating opportunities for further research and future development. This aligns with the project's original objective: leveraging public data for social good in the context of smart cities.

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