The Rise of Hackathon-Led Innovation in the MENA Region: Visualizing Spatial and Temporal Dynamics of Time-Bounded Events

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Abstract. Hackathons are poised to accelerate technological progress and redefine the technology innovation lifecycle. Time-bounded events have spawned a raw form of creativity that is rarely seen elsewhere in the digital innovation landscape. Efficient monitoring and analysis of data emerging from time-bounded events - and trends in the technology innovation process that emerge from encouraging developers, designers and entrepreneurs to go from the drawing board to a working demo - is of interest to both professional analysts and the general public. This research identifies the distinguishing characteristics of hackathons in the MENA region. It also introduces a visual analytics platform for uniquely identifying the technical, socio-cultural and contextual differences that define hackathon practices and the emerging hacking communities in the MENA region. The benefit of such understanding not only supports the continued growth of such activities in these countries, it also helps to disambiguate hackathon activities from other productive practices for software development, entrepreneurship and computing education.

Keywords: Hackathon · Software engineering · CSCW · Time-bounded events · Information visualization · Knowledge engineering

1 Introduction

As increasing volumes of data for time-bounded events are captured and become available, new opportunities arise for data-driven analysis that can lead to insights for researchers interested in the social dynamics and computer supported collaborative work in time-bounded events such as hackathons. The term hackathon was coined in 1999 [1]. Over the years, variants of hackathons have emerged across disciplines as a means of channeling creativity toward a common goal, contribution or theme.

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In recent years, a growing momentum of events for leveraging the power of hackers to deliver an accelerated digital product has emerged to redefine the technology innovation lifecycle. The contributions of these time-bounded events vary across a spectrum of deliverables ranging from prototypes of digital products, to capacity building and the creation of a community with a stronger collective technical domain knowledge, which is demonstrated and expressed through sustained collaborations and completed technical projects after the event. In the past two decades, the rise of the hackathon culture in the global context was fast and utilitarian [1, 2]. Time-bounded events began in the early 2000s as a collaborative effort towards pooling computing resources collectively to stress-test new software in advance of launch. They evolved to digital and tangible hacking contexts, and engaged people from across a wide range of disciplines [e.g. 3–6]. Hackathons often have the format of being decentralized and involve distributed development. The typical characteristics of hackathons are simple; participants engage in a focused, typically thematic effort that is resource-limited and goal-oriented. The typical resource limitations are time and expertise [1, 7]. The goals are often prescribed but the prescription may be as general as thematic notions, business goals or concepts.

In the Middle East and North Africa (MENA) region, the emergence of time-bounded events that are typically focused on the creation of a software application or hardware prototype development was slower than the global trend. Sustained growth in the past decade has been supported by an increasing appreciation of the contributions of time-bounded event towards innovation, community building, and accelerated technology development. However, our understanding of the trends and challenges in organizing time-bounded events in the MENA region is inadequate for the burgeoning analytics-driven strategic planning and decision making that is taking place in innovation-oriented organizations in these countries. As researchers in Human-Computer Interaction (HCI), we are often situated at the intersection of technology sectors from both industry and academia, and have the exposure to the multiple approaches, motivations, modes of engagement and characterizing features of time-bounded events. We anticipate that data-driven insights might be used as a heuristic or benchmark to align the communities that are (a) involved in organizing these time-bounded events in the MENA region and/or (b) engaged in researching these computer-supported collaborative work contexts.

This article is organized as follows. In Sect. 2, we begin by providing an overview of time-bounded events, along with the interactive platforms and tools used to find and visually explore data related to time-bounded events. In Sect. 3, we review the work on categorization of hackathons and describe some examples from the MENA region aligned with the categorizations and typologies of time-bounded events; in Sect. 4, we describe the interactive MENA Hackathon platform that we developed for data-driven analytics for the region; we conclude the paper in Sect. 5 with reflections on the review of time-bounded events, and future directions for research on insights from visual exploration of time-bounded events in the region.

2 Background and Related Work

Hackathons are gaining popularity and fast becoming a recognized approach for technological progress and innovation [2]. Accelerated development often occurs in contexts that provide rapid collocation of individuals who have diverse expertise in the problem domain, and the space (i.e. physical spaces and virtual spaces) for them to collaborate in tackling complex problems [2]. The popularity of such events started in the early 2000s, as they were sponsored by companies or investment entities in the tech industry for facilitating rapid development of software technologies along with exploring new avenues of funding and innovation [1]. Although hackathons started in technical domains, their popularity spread to other fields such as education, bioinformatics, marketing, healthcare, big data analytics, and dance composition [7]. Datathons are often aligned with the format of hackathons, but focus on crowdsourcing content or open-sourcing models to foster innovation and connect communities across various disciplines [4]. Motivations for organizing and participating in hackathons vary across a wide spectrum of intrinsic and extrinsic dimensions. Briscoe and Mulligan have highlighted that learning and networking are among the most cited motivations for participating in hackathons [1]. The concept of crowdsourcing in problem solving is not unique to hackathons. Boudreau and Kakhani [9] have outlined four models of crowdsourcing that are aligned with the typologies of hackathons. These include crowd contests (e.g., hackathons), crowd community collaborations such as those found in civic time-bounded events, crowd complementors in which developers build extensions or services linked to existing products, and crowd labor markets in which third party intermediaries match buyers and sellers [9].

Data-driven visualizations are becoming more abundant in the visual experience of online hackathon communities and the general public. Interactive information visualization take advantage of the relatively broad bandwidth between a human's eyes and the mind which helps users to not only see and visually explore, but also understand information in large amounts, all at once. Information visualization has been shown to be an effective tool for spatial and temporal exploration of dynamics datasets. Aligned with the emerging hackathon phenomenon, the need arises for interactive information visualizations to aid in the processing, comprehension, tracking, and retention of data on time-bounded events in static, animated, dynamic and interactive visuals. In recent years, interactive platforms for promoting and participating in hackathons have been introduced such as hackathon.io; where hackathons are featured and interactive tools provide event-related information (e.g. scope, schedules, rules, prizes and judging criteria) as well as computer-mediated communication tools for team formation and community building prior to the event and after the events as shown in Fig. 1.

In the context of an ongoing data-driven research study on social dynamics in time-bounded events for the MENA region, existing web platforms such as hackathon.com and hackathon.io and the extracted data sets were not sufficient for analysis-driven recommendations (an example of data extracted via the hackathon.com web site is depicted in Fig. 2). Sophisticated tools were needed for analysts, policy

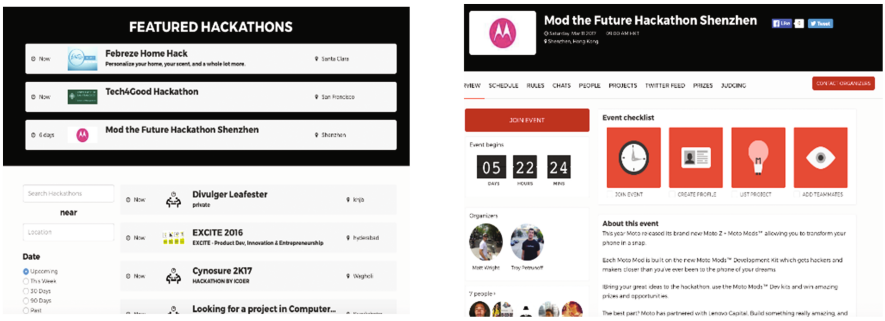

Fig. 1. Features and functionality of the Hackathon.io website

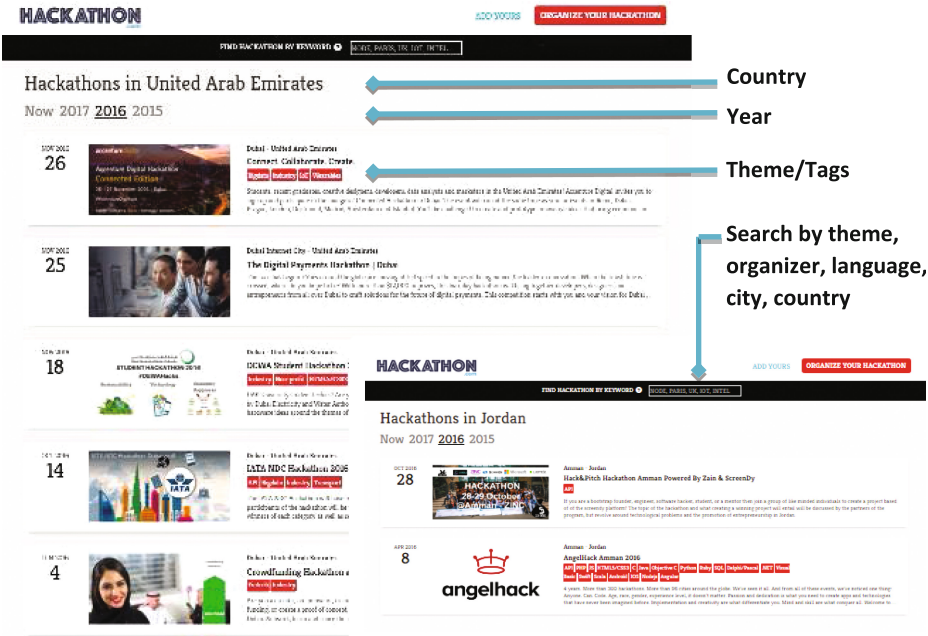

Fig. 2. Example of online hackathon platforms (Source: Hackathon.com)

makers and researchers to track, process, and communicate data about the phenomenon of hackathons and time-bounded events and how they contribute toward innovation eco-systems in the region. This motivated us to develop an interactive platform, described in Sect. 4, to visualize the phenomenon of hackathons in the MENA region and to provide the capability to visually explore the crowdsourced data sets (a) spatially by zooming in and out of regions and countries, and (b) temporally by exploring the data sets across different time frames.

3 Typology of Hackathons in the MENA Region

In this section, we outline a preliminary categorization of time-bounded events in the MENA region, referencing some of the events we have observed and their digital traces on the web. The categorization is aligned with Briscoe and Mulligan's high level classification of the type of hackathons, technology-centric and focus-centric groups [1]. Our observations have centered on time-bounded events in the MENA region that have emerged in the overlapping domains of academia, technology industry, government and civic organizations.

The technology-centric classification of hackathons focus on software development for specific technologies or applications [1]. Single application hackathons, such as the IBM Bluemix hackathons in Saudi Arabia in 2015 and 2016, the Blockchain hackathon in the UAE and the 2017 Blockchain Hackathon in Riyadh, Saudi Arabia focus on a specific technology platform. Application-type hackathons, which focus on a specific genre of applications (e.g. mobile apps), have also been observed in the MENA region. Examples include Microsoft's AppinAction hackathon in Riyadh, Saudi Arabia and the DevAppLB hackathon in Beirut, Lebanon for mobile platforms using the touch Cloud BaaS Backend-as-a-Service Baas; both hackathons were held in 2013. Similar application-type hackathons, sponsored by telecom companies in the region include the Zain Hackathon in Kuwait for telecom mobile applications, held in 2013 and the Vodafone hackathon in Doha at the Carnegie Mellon Qatar University in 2014[1].

Focus-centric hackathons, as noted by Briscoe and Mulligan [1] as well as Frey and Luks [2] target software development that addresses civic or social issues. These time-bounded events aim to spark civic engagement, bring together software designers, developers, and community organizers to solve their society's needs, and to tackle complex problems with technology-oriented solutions [8–13]. Johnson and Robinson [13] have shown that civic hackathons have spurred innovative use of open data which consequently led to the creation of applications and services for citizens and improved civic engagement. Examples of focus-centric hackathons in the MENA region include the NYU Abu Dhabi annual Hackathons for Social Good which started in 2011 [11], the Saudi Computer Society's Hackathon for Social Good in 2015, and the Misk Hackathon for health applications. Briscoe and Mulligan categorize focus-centric hackathons further into socially-oriented, demographic specific, and company-oriented time-bounded events. Socially-oriented hackathons aim to contribute to issues of social concerns by exploring innovative solutions for challenges in providing public services or crisis management. Examples include the Techfugees hackathon in Jordan in 2016, in which Techfugees partnered with "Startup Weekend Amman" and UNICEF Jordan to organize a 52-hour hackathon to tackle refugee challenges; and the 2014 MyUNHCR 3-day hackathon in Jordan, organized by United Nations High Commissioner for Refugees (UNHCR) to develop applications in the context of the Syrian refugee crisis[2].

[1] https://webext.qatar.cmu.edu//news/view/1353.

[2] http://unhcr.github.io/hackathon/.

Demographic-specific hackathons are motivated by perceived or recognized disparity between specific demographic groups in society such as women, students or people with disabilities [1]. Hackathons are often open to people with diverse backgrounds and skill sets– not just people who know code [2, 13]. Some demographic-specific hackathons focus on bridging the gender gap in technology such as the "She Develops" hackathon Lebanon in 2015, The Meera Kaul Foundation's "Women in STEM Smart City Hackathon" in Dubai, UAE in 2016, the "Lady Problems" Hackathon (http://ladyproblemshackathon.com/) in Gaza in 2016, and the "Girls in Tech" hackathons in Kuwait. Student-focused hackathons include Elm hackathons for college students, held in Riyadh, Saudi Arabia; the student-led TechBench Hackathons organized by a tech community run by students at King Fahd University of Petroleum and Minerals (KFUPM) in Dhahran, Saudi Arabia and the Dubai Electricity and Water Authority (DEWA) Student Hackathon for UAE college students, sponsored by DEWA and SquareCircle Tech and held in Dubai in 2016. Notably, there is also a growing Space Apps community in the MENA region, emerging from the annual hackathons supported by NASA's Open Innovation Initiative. The Space Apps hackathons have been held in Jordan, Egypt, and Morocco in the 2015-2016 time frame; and is expanding to several cities in Saudi Arabia in 2017[3].

Some events have elements of more than one category, such as the 'Startup Weekends' in Badir technology incubators that were held in three cities in Saudi Arabia, and the startup weekend hackathons in Amman, Jordan[4]. Moreover, new configurations of time-bounded events in the MENA region may form in this rapidly evolving space.

4 MENA Hackathon Platform

One of the best ways to explore and try to understand the large datasets of hackathons is with visualization [14]. Motivated by the data-driven insights gained from researching time-bounded events in the MENA region, we developed an interactive platform to visualize the phenomenon of hackathons in the geographically scope of the MENA region. The platform embeds an information visualization that can be explored spatially by zooming in and out of regions and countries, and temporally by exploring the data sets across a dynamic timeline using a slider to move from one time-frame to another as shown in Fig. 3.

The data visualizations serve the purpose of facilitating access to scattered information of hackathons in the MENA region, fostering the recognition of structures in abstract data about the hackathons across different regions, and supporting information retrieval and exploratory analytics of these events and trends related to the emerging phenomenon of hackathon-led innovation programs, strategies and initiatives. The spatio-temporal visualization of time-bounded events in the MENA region facilitates closely coupled human and machine analysis. A screenshot of the platform's frontend prototype is depicted in Figs. 3 and 4. Dynamic chart visualizations overlaid on the

[3] https://spaceappschallenge.org.

[4] http://startupweekend.org/.

Fig. 3. The spatio-temporal visualization

spatial plots of events were designed to amplify viewers' cognitive capabilities by enhancing the recognition of patterns of when and where time-bounded events are held. When information on time-bounded events is organized in space by its time relationships, further analytics on the scale and scope of events can be explored. The use case scenario depicted in Fig. 4, and the interlinked dynamic charts, show how the visualizations support relatively easy perceptual inferences of relationships that are otherwise more difficult to induce. Zooming in the map provides a clear view of regional events when users click on a specific pin the map to visually explore spatial mapping of the related events along with detailed aggregate information about events as shown in Fig. 4.

Fig. 4. Layering event information with hover popup windows

Fig. 5. Filtering the data-driven visualizations by location, time, theme, and demographics

The platform data visualization can be filtered across time by location, format (e.g. gender participation if it is a male-only, or female-only or an event open to both genders), and theme (e.g. health, humanitarian aid, sport). Filters are applied to explore subsets of datasets, as shown in the scenario captured in Fig. 5. When the user chooses Saudi Arabia as the first filter; the map will zoom into all time-bounded events in Saudi Arabia and all other filters will show the related data only. In addition, the platform supports search feature where we can type search keywords, for instance if the user type "Misk" in the search field the platform will open the pop-up description about "Misk" event as shown in Fig. 6.

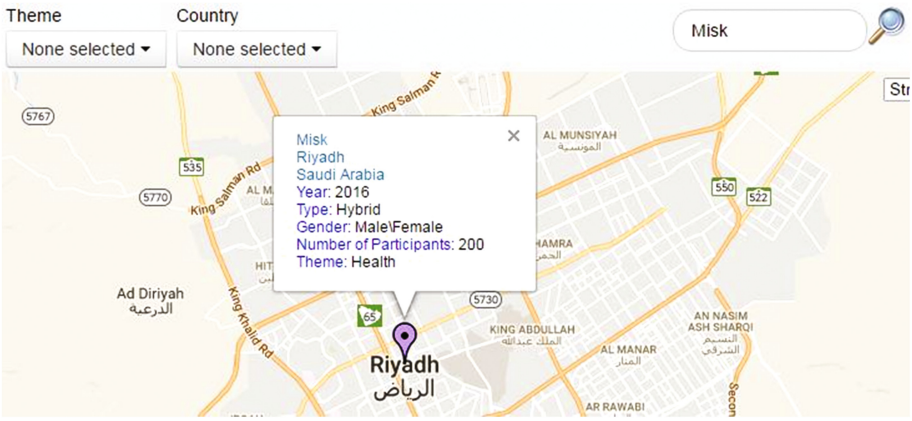

Fig. 6. Filtering the platform data by search keywords

While the volume of information is growing rapidly, opportunities to expand insights by combining data are accelerating. The spatial exploratory mode of interaction with the MENA Hackathon platform gives analysts and researchers more panoramic and more granular views of the typology of time-bounded events for selected regions. The platform encourages a more comprehensive look at time-bounded events' data by highlighting specific information about hackathon typologies, themes, and collocation as well as data on the scope and scale of the event. An example is depicted in Fig. 6. The platform also facilitates hypothesis-led modeling to generate insights and root models in practical data relationships that are more broadly understood by researchers interested in computer supported cooperative work (CSCW) and social dynamics that influence innovation eco-systems.

The visual representation of pins on the spatial map of the MENA region translates data gathered from the crowd into a visible form that highlights important features, including commonalities and anomalies for time-bounded events in time and space. These visual representations of time-bounded events make it easy for users to perceive salient aspects of regional distribution of events as well as the density of events across time. The visualizations augment the cognitive reasoning process with perceptual reasoning through color-coded visual representations of these time-bounded events.

The MENA Hackathon platform is an openly-editable website where users can contribute to the content of hackathon events in the MENA region. This content crowdsourcing approach was considered to facilitate a sustainable dynamic data set and to encourage users to contribute towards maintaining the accuracy and quality of data submitted through the platform's frontend, aligned with content crowdsourcing models such as Wikipedia [12]. In fact, the early motivation for users to participate in contributing to Wikipedia's content was reported to be mainly the desire to edit and/or correct articles posted by others, but with time, editors become Wikipedians and their motivation gradually shifted to participate in endeavors for improving the quality of the content and raising the level of awareness, participation and knowledge in the community [12]. The content crowdsourcing architecture of our hackathon platform, depicted in Fig. 7, is the bridge between the abstract goals of a crowdsourcing application and the final concrete resulting web platform. While the path from abstract to concrete can be complex, the block diagram in Fig. 7 embeds the set of structures needed to reason about the hackathon platform (i.e. software elements of location data and event-oriented data, the relations among them and the properties of both) and the flow of verification and validation of models for data-driven analytics.

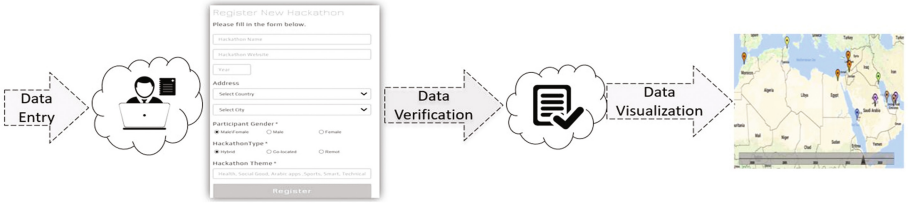

Fig. 7. Content crowdsourcing in the MENA Hackathon platform

Charts and graphs have evolved into not just tools to detect patterns but also as vehicles to communicate ideas. In our MENA Hackathon platform, data graphics are used to enhance exploratory search scenarios with a different lens on the same dataset, whereas other times the graphics tell the entire story by expanding on details for a specific geographic region. For example, motivation for participation in hackathons is an important element in the innovation eco-system. Data from respondents to surveys on motivation for participants have revealed trends across the region with learning and networking being the top responses, followed by the motivation to connect with like-minded people in the technology sector and seek opportunities for meaningful contributions to digital innovation. Analytics-driven recommendations derived from these insights can help analysts, researchers and strategic decision makers.

5 Conclusion

The increasingly digitized, distributed and disintermediated future of the technology industry in the MENA region is predicted to have hackathons, hackers and potentially agile models of development embedded as a core part of its growth strategy. Overall, time-bounded events in this region appear to interest communities because of the opportunities for rapid collocation and the allotted time and space for working intensively with teams in modes that are not often supported in their day-to-day environments of work, leisure or study.

The contribution of this paper outlines the trends and issues relevant to hackathons in the MENA region and focuses on how insights can be sought by dynamically exploring information visualizations that are crowd-sourced from the community. This paper has shed light on insights that can be drawn from collaborative development of digital systems in a concentrated time period. Themes from technology-centric and social-centric hackathons are often aligned with global trends. Data-driven analytics from our MENA Hackathon platform suggest that time-bounded events in the MENA region contribute beyond producing digital artifacts, with building capacity and technical expertise, building community and expanding social networks, exposing participants to different modes of design thinking, and shaping cross-domain identities for the human capital in these regions. Future directions for research include reporting insights from the typology of hackathons in the region and the trends in spatial and temporal dynamics of these time-bounded events.

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