Online Social Movements: Network Narratives & Knowledge Graphs

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ABSTRACT

This research covers topics of Human Computation, Machine learning and network visualization to identify narratives in fragmented image content. Social movements have been using social media to share their goals, values, and grievances with the world for the past decade. This information is spread throughout platforms usually in visual form, and from various perspectives, which can be seen as fragmented and not fully informative. To solve this problem, this research project uses mixed-method applications to identify a narrative from fragmented multi-modal content like image and text. The methods used will work in tangent to build a network visualization of a narrative and to build a knowledge graph. This research offers theoretical contributions to computer vision, human computation, and media frame theory. It holds practical implications for computational social scientists using artificial intelligence to understand social phenomena.

Index Terms: Human-centered computing—Network Visualization—Image Feature Extraction—Visualization design and evaluation methods

1 INTRODUCTION

Social movements have become popular content in digital media in the past decade (15) and each event representing a social movement appears to be independent of the one before (41). Specifically, when users consume information on social media about a social movement event, they get fragments of the whole narrative. Information regarding an event happening within a community or specific location will have different narrative frames at the local and global scale (37). Events represent content related to a movement, they include: Messaging campaigns, protests, solidarity posts,etc. Because social movements depend on society's collective action (6) and much of online collective action is influenced by online messaging, structural changes in the community's information circulation habits shift over time (18) – especially if bits of information reinforce only part of a narrative. This fragmentation can distort user perception, misinform the public, and impact collective action. With this problem in mind, the objective of this dissertation research will be to explore how narratives can provide context to fragmentation from social media image content representing a social movement.

With this problem in mind, the objective of this dissertation research will be to explore how narratives provide context for images. The project explores how a narrative provides context for the fragmentation of social media image content representing a specific social movement in Mexico (the anti-femicide movement). The supporting research questions explore how social media content fragmentation facilitates different narratives. Particularly, *how might a social media narrative provide context for the messaging a social movement is trying to convey?* Many narratives come out of social media platforms, especially if they are in image or multimodal form but, as described below, platform affordances, user activity and

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content quality can implement a fragmented narrative that might be difficult for users to follow.

1.1 Limitations In The Current Research

Visual frames in social movements have been a foundational methodology in the field of research that implements notions of knowledge generation and goal setting for movements and their members. Narrative framing as a device to convey knowledge through elements of association, composition, and social and technical components can create outlets for methods of visual interpretation. No research has been able to take a collection of images to identify an overall narrative for dynamic online data.

Identifying network narratives from image features have been explored by identifying how network structures can be used as storytelling devices through meaning and temporal event extraction. Methods include network visualization, natural language processing, computer vision, and graph data applications. (9; 17; 26; 29).

Narrative extraction using image content and metadata has been attempted to identify narratives solely from images data to identify narrative generation (20) others use images, metadata and social links (42). Human computation approaches use Multimodal image annotations for successful research in computer vision, some have even gone to lengths of building a narrative for each image in popular computer vision datasets through controlled image captioning (24; 33).

1.2 Motivation and Implications

Social media is not going anywhere and since its inception users have been interpreting and making sense of its fragmentation with great capacity for knowledge building (35; 38). The presentation of a narrative in new digital media such as online games, social media, blogs, and online forums can provide a non-traditional narrative structure that presents information from various perspectives. According to (36), new digital media introduces multimodality, polylinearity and user/creator interaction. These various affordances provided by new digital media affect user experience and lead to multiple aspects of a topic from various contributors that causes fragmentation. Fragmentation has been shown to provide a lack of control for the narrative but presents a reconstruction of the narrative that affects the human experience. The experience builds a collaboration between the content, device and viewer (36).

1.2.1 Implications

This project will have three types of contributions to industry and academic research.

- *Methodological:* The research builds a tool-set for how computational social science can be applied, specifically for interpreting topical image datasets.

- *Theory:* Identifies claims about the social movement phenomena with the tools and analysis proposed with an implication of more accurate results.

- *Data:* Contribution of a dataset with a novel structure and emergent use cases.

1.3 Research Questions and Hypotheses

The main question asks, how does a narrative provide context for the fragmentation of social media image content representing the anti-femicide social movement? To further explore this question, supporting questions and hypotheses are explored. The project reviews affordances of social media, identifies narrative patterns in fragmented social media content, implements human computation through a focus group with experts, and explores how an ontological structure can provide context for dynamic review of images. The supporting research questions are as follows:

RQ1: What aspects of social media enable narrative building from fragmented elements?

- Hypothesis 1 : The affordances of Instagram allow for different types of narrative sharing including linear, non-linear, and interactive structures.

- Hypothesis 1.2: Fragments of a narrative come about from various perspectives.These perspectives include geological locations and keyword topics.

RQ2: How might a social media narrative provide context for the messaging a social movement is trying to convey?

- Hypothesis 2: Interpreting social movement images into a narrative structure can provide context for the overall messaging of a social movement.

RQ3: How do these narratives act dynamically?

- *Hypothesis 3, H3:* Building an ontology/knowledge base for knowledge graph application will provide more contextual information for the viewer and enable them to identify a narrative in real time.

1.4 Helpful Information

Forms of visual interpretation used in this review come from Gilian Rose's (34) model that reviews methods of visual analysis which include the *site of production*, the *image itself*, and a split form of audiencing, into *circulation* and *audiencing*. These sites are described as forms of visual interpretation because they enable an aspect of knowledge generation through frames particular to each site. This project argues that each modality of Rose's visual interpretation framework encompasses an aspect of an image narrative and can be key in identifying frames.

Narratives are defined as a way of producing and communicating knowledge. A *Narrative Frame* surrounds a story and provides important context and key information on how to understand it (28). *Image Fragmentation* is defined as discontinuities, tensions and editing within a narrative (23) that can be implemented for events associated with a social movement. As a structural review of narratives, narratology can be used on narrative texts, images, spectacles, cultural events, and storytellnig artifacts it is also implemented into an ontology format for knowledge base dictionary (4) (3).

As a case study, the social movement used is the anti-femicide movement in Mexico. The anti-femicide movement in Mexico grew from years of femicide at the border of Mexico and Texas, with cases beginning to be documented around 1993 (32). Femicide can be defined as aggravated homicide due to gender, specifically females. Sexual violence, dehumanization through the image of discarded female remains, or other visual representation of ultraviolence against a woman leading to murder or death is how femicide came to be known in Mexico (1). A similar term, feminicide, provides an added distinction of putting responsibility not only on the perpetrator but also on the state and other judicial structures (11). Although these two words are constantly used interchangeably in much of the literature and official documentation,with femicide as the most familiar term used around the world, feminicide is mostly used in Latin-America (40).
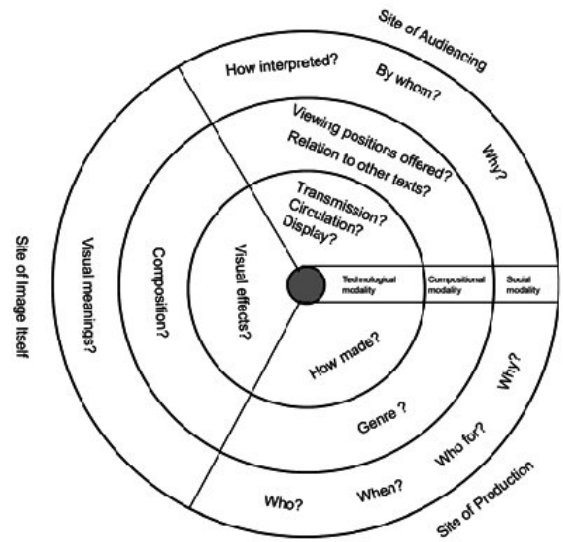

Figure 1: Gillian Rose's sites and modalities for interpreting visual materials (34)

2 PROPOSED WORK

This research intends to review methods that have the ability to work with visual framing concepts, social movements and be applied to the big data phenomenon. The intention is to build an interdisciplinary approach of social science research and data science for identifying visual frames in images online. A comprehensive understanding of the problem will be explored through methods of narrative network analysis and visualization with image data, visual interpretation of social movement frames, and knowledge graph (KG) application to identify contextual information.

The methods used will work in tangent by first using topic modeling, event extraction or image feature classification models on the data to identify narrative frames found in academic literature, non-governmental organizations, and government. The frames and the image metadata are then used in a network analysis methods (including group formation, positionality analysis and community structure) to find how the image frames are being shared. These frames are visualized in a network for experts in the social movement. These experts will form a focus group to implement Gillian Rose's visual interpretation modalities that will inform an ontology of image relations.Using protest ontology (5), narratology (narrative ontology) (4), scene graph ontologies, themes found from the network narrative and focus group, and semantic triple relation building with the data collected. NGOs, and citizen data scientists, I will create an ontology dictionary for the KG model. The KG method has academic implications that add to social movement analyses surrounding social media and theoretical concepts of framing and network analysis in the field. Similarly, this phase of the research adds to domain specific research using KGs and can be a generalizable approach to topical image datasets.

3 VISUALIZATION METHODS

The project will focus on a mixed methods approach that incorporates a pragmatic worldview with hints of transformative implications because of the data and community being studied (12). The pragmatic worldview enables a focus on how narrative structures support event fragmentation in the anti-femicide social movement in Mexico through images as graph data. A comprehensive understand-
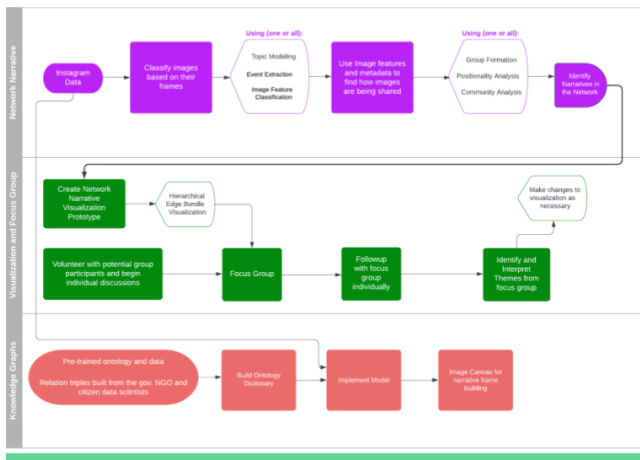
Figure 2: Dissertation Methods Process

ing of the problem will be explored through methods of narrative network analysis and visualization with image data, visual interpretation of social movement frames, and knowledge graph application to identify contextual information.

3.1 Network Narrative and Visualization

This method will be used to explore which aspects of social media enable narrative building from fragmented elements, use deep learning models to classify narrative frames based on themes from academic literature, non-governmental organizations, and government.These frames will be visualized in network form for visual interpretation by experts in the anti-femicide movement. Through Instagram's affordances of information circulation, feedback prompts, and account linking, this will contextualize the narrative to gain a better understanding of its interaction with the public.

To build the narrative network, the images and their metadata will first go through preprocessing which includes image correction, enhancement, integration, and transformation. These processes will enable better feature extraction to identify patterns and thematic elements in the image dataset. This process is considered image enrichment and linking, and will be used to build a story model from similar commonsense knowledge bases and graphs (26). There are many computational ways to model a story, for the purposes of this project, knowledge graphs which provide the topical data with relational concepts and events through image links, and include semantic metadata particularly created by subject matter experts will be explored (26). The data is semi-structured, which is data that does not have a predefined organization but does have some type of relation i.e. data residing in a fixed field (2). For this semi-structured data, popular summarization techniques will be explored, these include aggregation statistical techniques which helps approximate patterns in the data set, and machine learning techniques such as clustering where the goal is to find intrinsic groups within that data (2). Specifically, a combination of language and image models will be used to include the images and their metadata.

The resulting graph will provide narrative network examples from the data and will be visualized using hierarchical edge bundles which aggregate the adjacency relationships in graph data to show clear network flow of information (22). D3, a JavaScript library that is implemented in modern website browsers, will be used on the network narratives found in the previous graph evaluations to visualize the hierarchical bundles while still maintaining information about the data (8). This step is necessary to present the narrative information to social movement leaders in visual and textual form using interactive digital modes (21).

Domain image narratives are subjective to domain qualities and should be taken into account. While deciding on narratives and setting a story, the model, structure, time, purpose, and role of all participants should be considered to identify multiple detailed representations of a story. As this project continues, working with leaders in the field is ideal to bring about the social movement's domain knowledge. Contact has been made with Ivonne Ramirez from ellastienennombre.org and connections at conferences have begun with other leaders, but there is still more communication to be had with Ramirez and others. The goal is to create a sample narrative network from the models explored and work with domain experts as a focus group to identify the most relevant narratives. The feedback provided will help identify the best narratives, in relation to how this tool could be helpful in their work. Feedback will be considered in the form of visual interpretation.

3.2 Visual Interpretation and Focus Group

This small focus group will be used within the main study and an aid to interpret results, but will also be key elements for structuring the narratives of the knowledge base for the anti-gender violence social movement (7). This project will not exactly be a full community-based participatory research project where community members are involved in every phase of the project, but they will be key in deciding how the relational entities in a narrative network are structured (27). Essentially, the focus group will be used for decision making in the project and planning and goal setting for how this research can work for leaders in the movement (25). Narrative discourse will be situated in Nancy A. Naples's (30) relations of ruling which explores "how the dynamics of gender, race, ethnicity, culture, and sexuality are infused throughout the institutional sites in which survivor discourse is produced." This narrative discourse looks at when and where certain discourses are better implemented, and how to remain sensitive to the experiences of those involved in the narrative (30). Applying this narrative discourse analysis to social media images not only from those involved in the movement, but also from others who support and oppose the goals of the movement will be the underlying intention of the visual interpretation focus group.

This visual interpretation focus group will be used to explore how a social media narrative provides context for the messaging a social movement is trying to convey? To implement visual interpretation for narrative frames, Gillian Rose's visual interpretation modalities will be described and asked to be implemented in focus group considerations(34). The visual interpretation modalities are seen as sites of understanding, including the site of production based on the technologies used to make that image, the access to those technologies, and the affordances provided by technologies; the site of the image itself based on the composition and commodity based on its objective and emotional qualities; the site of circulation representing the the movement between the production site of an image and the viewer; and the site of audiencing based on when an interested viewer understands the meaning of an image and accepts or rejects them based on the circumstances of the viewing (34) Using these modalities to provide context for the messaging of a social movement can enable a deeper interpretation of what contributes to a social movement's narrative. The narrative will then create the base for the anti-femicide movement ontology that will be used in a knowledge graph model for application on dynamic data.

3.3 Knowledge Graph Building

Applying the ontology to a knowledge graph will be used to explore how these narratives act dynamically. To build the knowledge graph Tan et al's (39) narrative collage of image collections method will be followed. This is a four part method where first the narrative elements are selected to construct the dictionary (ontology) for objects within the narrative frames to be compared to newer images;

in the case of this project, the focus group outcomes will be the constructed dictionary (39). Second, there is a construction of layer graphs and scene graphs. Layer graphs describe the ordering of elements in a narrative as well as the spatial relationships of objects in the image, and scene graphs are used to describe the semantic relationship between elements in an image (39). Third, the narrative is generated by positioning elements in the images based on the constraints used in the dictionary input. Fourth the narrative is rendered into an image canvas to connect the narrative elements and identify the narrative frame (39). This method is shown to identify narrative elements from the image collection based on the set dictionary of element relations, and is able to illustrate the main theme of the narrative with better content consistency, scene transition, and visual understanding than other methods (39). Using this method to build a knowledge graph for the social movement image ontology can enable greater understanding of how the social movement is being portrayed in different circumstances and have better control over their messaging.

4 DATA

The data is collected from images, and governmental and organizational sources. A customized content-scraper script was developed using Python libraries and the Instaloader package which enables image and metadata collection of the Instagram social media platform. Records of gender violence from federal government databases and NGOs in Mexico will be used for narrative building.

Metadata collected from Instagram hashtags and accounts include: comments, likes, hashtags, URLs, account information, and automated descriptions from Instagram's API. So far, about 2,000 images have been collected within a year's time-frame between November 25, 2021 and November 25, 2023. The date November 25th was chosen because it is the international anti violence against women day, Dia Internacional contra la violencia hacia las mujeres. A second round of data collection will be done to include posts surrounding the topic on international women's day. The goal is to download over 5,000 images and their metadata. Structured image data for knowledge graph and feature extraction models include: ROCStories, VIST, Visual Genome, and FrameNet, to name a few. They will be used will be used as training data and templates for narrative and network structure.

5 EXPECTED RESULTS & IMPACT

Expected results will find that the analysis of images as fragments in narrative structure can be used to create a network encompassing groups of similar story frames within the overall narrative. Interpreting the narrative of a social movement on social media networks will provide context for better interpretation of an event. This context is expected to show a more holistic view of how a movemen'ts message is percived online. This structure is generalizeable and can be applied to a large-scale, domain-specific data set to identify stronger narratives in the movement's messaging. Based on the ablation studies, user study reviews, and comparison of the model against other models, the proposed model should similarly be able to identify a narrative from a collage of images(10; 16).

5.1 Ethical Implications

Some social and ethical implications for the project are of course the sensitive nature of the data and how privacy and safety are taken into account. With this being said, account information will be removed from the public facing materials as well as the names of the domain experts involved in the focus groups. In the social media data, the images and image comments will be included but nothing else. Similarly, the organization of the domain expert will be provided, not their individual names. An IRB application will be completed to include aspects of working with focus groups consisting of domain experts, sensitive data. Established ethical concepts particularly

tailored to gendered data will be included and used as guidelines throughout the project (13; 14; 19; 31).

6 PROGRESS TO DATE

I am all but dissertation (ABD) and passed my dissertation proposal this March. I am currently working on data collection and IRB forms. The IRB forms will be complete to work with human participants to collaborate and receive input on the data visualization. Once the forms are complete and the project is accepted I will begin working with focus groups to identify narrative frames brought up by the visualizations. I have been volunteering with a group in Mexico to work with their data and create maps of events around the city of Juarez, Chihuahua. Where I will also connect to other movement leaders to potentially be part of my focus group.

I am currently editing a python web scraping script to collect data from specific dates related to the Social Movement. For example, March 8th and November 25 are important dates that garner a lot of attention online. The multi-modal data of image and text content will be collected and stored in a personal usb device and a private github repository in the initial stages to align with privacy and ethical concerns. The data will be used in a network analysis to identify narrative frames and create a visual analysis for a general audience. The visual analysis consists of identifying group structures based on multi-modal (image and text) features within an overall network. The group structures will potentially identify narrative elements from the multi-modal content.

I hope to have begun the feature extraction for the network analysis, have the visualization mostly completed and have completed meeting schedules for the focus group by the time of the conference. The dissertation project is expected to be finished at the end of the 2023-2024 academic year.

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