

Thesis Project Portfolio

Data Pipeline for Digitizing Perioperative Flowsheets from Low-Middle Income Countries

(Technical Report)

The Sociotechnical Effects of Social Media, Telecommunication Technology, and the Egyptian Revolution

(STS Research Paper)

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Sociotechnical Synthesis

Modern day technological advancements have transitioned the world to allow for an increase in quality of life. From allowing distant family members to video-call, to performing surgery using precise robots, technological advancements have shaped the current society for the better. This portfolio documents the methodology and results of two independent research processes that are united under the common theme of advancing society through mobile applications. More specifically, the technical research topic focuses on improving the Rwandan health care system through the digitization of their medical flowsheets using a mobile application. The science, technology, and society (STS) research topic addresses the Egyptian revolution and how social media mobile applications allowed for the success of the revolution allowing for major improvement in the lives of Egyptians. Both projects place a heavy emphasis on the effect of adopting the mobile application. For the technical research topic, the final product is a mobile application allowing Rwandan health care workers to upload images of their surgical flowsheets and receive a risk notification for the patient in under 2 minutes. The final deliverable for STS is a paper discussing the answers related to the research question: How was social media and society affected by the Egyptian revolution and how did the revolution affect society. Overall, both sections of the portfolio discuss the impact and significance of mobile applications on the quality of life, with the Egyptian revolution focusing on social media and the technical research focusing on medical applications.

In Rwanda and many low-and-middle-income countries (LMIC), surgical flowsheets are manually filled by medical professionals due to lack of a wealth of infrastructure necessary to support expensive large-scale digitization efforts. In many LMIC, there is a lack of macro-level health data that can be utilized to quantify and improve existing healthcare outcomes. Literature

has championed POMR (post operative mortality rate) as a useful indicator of institutional and national surgical safety. Many surgical operations performed in LMIC that are deemed “low risk” by hospitals in high-income countries (HIC) have a surgical mortality rate more than ten times that of HIC. Furthermore, more than 94% of all maternal deaths occur in LMIC and in Rwanda, cesarean sections are deemed low-risk yet they have a high POMR (World Health Organization, 2019). Striving to lower POMR in LMIC, UVA has partnered with the University Teaching Hospital of Kigali in Rwanda (CHUK) to digitize paper surgical flowsheets. Over the past several years, UVA has aided in establishing a consistent and reliable system to scan and obtain the surgical flowsheets. The focus of the undergraduate systems engineering capstone team of 2021-2022 is to design and implement a data pipeline system that enables Rwandan medical professionals at CHUK to digitize paper surgical flowsheets via a mobile app and receive rapid patient risk-based notifications. The application enables medical professionals to quickly engage with pertinent operation data relevant for improving patient outcomes while also ensuring secure storage of the data, which in turn enables macro-level research into Rwanda’s healthcare system. The design includes the full-stack development of a mobile application, which is hosted on the AWS cloud computing platform to allow for scaling. Relevant literature is utilized to configure the logic necessary for a hypotension risk notification based on processed data points. A user interface and application is designed using user feedback to reduce the laborious nature of a pre-existing approach, allowing the user to scan, access, and receive risk notifications for perioperative sheets. A wooden physical contraption called SARA will be used by hospital staff in conjunction with a digital algorithm to ensure data quality. A relational database is designed and implemented to address data needs, ensuring that data collection omits sensitive personally identifiable information. This sensitive healthcare data is protected at-rest

and in-transit encryption, at the AES-256 standard. This mobile application is hosted in the cloud on the AWS cloud computing platform, with a suite of curated services and products. The application has undergone testing within the AWS ecosystem, user testing with the client, as well as students and faculty from the University of Virginia.

As for STS, the Arab Spring, more specifically the Egyptian revolution, signifies a monumental moment in which the Middle East saw a positive change in the oppression they were facing. The Egyptian revolution started in January 2011 through the organization of a protest through Facebook. By February 11th, the president of 29 years, Hosni Mubarak, stepped down which resulted in an outburst of joy and euphoria. Social media is thought to be a key part of the Egyptian revolution's success, and it was the first time in which social media was used to drastically change the political environment. Through using the concept of technological momentum, the research paper will determine the extent to which social media aided Egypt to organize multiple protests and in conjunction changed the way social media was being used. Through the research, it has been determined that social media was the key to the success of the Egyptian revolution and as a result companies, such as Twitter and Facebook, released new versions of their software allowing for a more political platform and adapting to the Middle Eastern market. In addition, social media became more heavily adopted and used in the Middle East, specifically in Egypt, and the United Nations released a regulation regarding the usage of social media and the internet to prevent the misuse of the internet by governments. The extent to which social media affected and was affected by the Egyptian revolution is a topic of interest as it sheds light on how technology and mobile applications can be used in politics to fight against injustice and change governments, ultimately improving the lives of the citizens.

At the surface level, a mobile application can seem like a technological development for entertainment. However, as evident through both research parts, certain mobile applications have proven to become a necessity to improving the quality of life. Working on both projects simultaneously has allowed for the full cycle of the mobile application integration to be seen while developing the mobile application for Rwanda. Working on the STS research highlighted the unexpected usages of mobile applications which has allowed the Capstone research team to take unexpected usages under consideration while developing the mobile application. Careful consideration of the design, use cases, and security of the mobile application were considered to prevent unwanted usages. In addition, a roll-out plan was developed to ensure the practitioners in the Rwandan hospital are well-equipped to use the application efficiently. Seeing a full life-cycle of a mobile application for social media has provided tangible evidence of the integration of mobile applications into our society which acts as an example of the mobile application being developed in the technical portion of the portfolio.