INTERACTIVE SURGICAL DEPICTION FOR THE ELECTRONIC MEDICAL RECORD

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JOHNS HOPKINS MEDICINE

ART as applied to medicine

ABSTRACT

With the transition to electronic medical record (EMR) technology, traditional paper charts are seldom used and less accessible to clinicians. In the past, written documentation of operations were frequently supplemented by a sketch by the surgeon. This thesis explores the design of a digital interactive tool to enable surgeons to quickly and accurately document the patient's post-procedural anatomy in an image. This tool is unique in that it presets a preexisting 3D model which the user may split, remove, and reconnect to represent changes to the patient's gastrointestinal (GI) tract. Through an intuitive interface, the surgeon will manipulate a 3D model of normal GI anatomy to depict resections and reconnections of bowel at appropriate distances and configurations and include elements such as drains, measurements, and annotations. The surgeon can then save the image with the post-operative note to follow the patient. As a part of the EMR, the image is available for viewing by practitioners responsible for post-operative care and subsequent diagnoses and procedures, contributing to overall patient safety.

INTRODUCTION

Problem Statement

In 2009, use of EMR technology was mandated and widely implemented. Surgeons who routinely included drawings with paper charts can no longer do so **(fig. 1)**. This loss is particularly significant in complex and reoperative surgical cases.

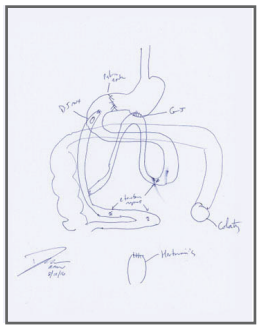


Fig. 1 Drawing of complex reconstructive GI operation by JHH surgeon

Solution

The author set out to design a digital interactive tool enabling surgeons to create a 3D visual depiction of post-operative anatomy. This documentation tool will enhance communication among the entire care team.

Audience

- Image creators (GI surgeons)
- Image readers (surgeons, nurses, endoscopists, diagnostic and interventional radiologists, student and trainees, patients)

Objectives and Scope

- Research: competitors, user interviews, customer discovery
- Design minimum viable product (GI surgery)
- Implement the tool and integrate with EMR
- Pilot study at Johns Hopkins Hospital (JHH)

"A bad drawing on a napkin is better than reading the post-op note"

- JHH Interventional Radiologist

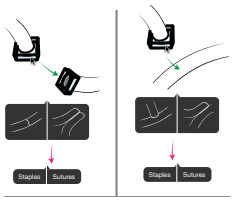
MATERIALS AND METHODS

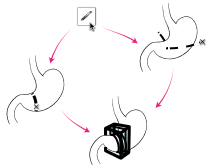
1 Research

In 2016, the author pitched the concept at the Johns Hopkins Medicine Technology Innovation Center's (TIC) Shark Tank Event. We won a top prize, admission into the their entrepreneurial pre-accelerator course. Throughout Fall 2016, this course guided us through forming our team, 30 user interviews, competitor research, customer discovery, and other research geared toward forming a startup business.

2 Design minimum viable product (GI surgery)

Throghout this thesis project, I focused on designing and defining the minimum viable product (MVP). The concept of the MVP allowed us to define the scope of the initial program with only the features necessary to be introduced into a clinical setting.





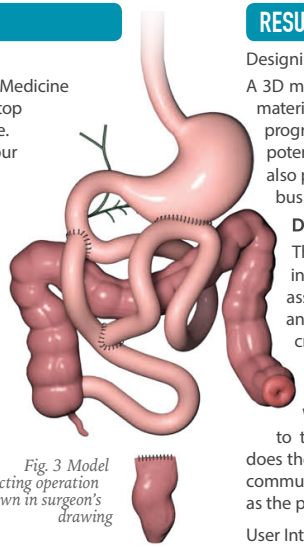


Fig. 3 Model depicting operation shown in surgeon's drawing

Fig. 2 Wireframes showing workflows for reconnecting bowel and splitting the stomach

3 Implement the tool and integrate with EMR

Since March 2017, the team has focused on securing grant funding. In June, we were awarded $100K from the Thalheimer Fund for Translational Research. These funds have allowed us to begin development of our MVP in July 2017.

4 Pilot study at JHH

The MVP will undergo a pilot study at Johns Hopkins Hospital, where GI surgeons will incorporate the tool into their practice to offer feedback and generate data to facilitate the program's improvement.

5 Future directions

Beyond initial testing and commercialization, the program will be expanded to allow surgeons to document vascular and transplant surgery as well as several niche surgical sub-specialties. It also has significant implications in personalized medicine as well as potential military applications.

RESULTS AND DISCUSSION

Designing the Anatomic Model

A 3D model **(fig. 3)** was created for the purposes of planning, testing materials and textures, and communicating requirements to programmers. Although this model is static, it was useful to discover potential challenges in implementing a manipulatable model. It also provided a means to demonstrate the program's capabilities in business pitches and grant applications.

Defining In-Program Functions

The functions of the tool, determined with stakeholder feedback in mind, fall into four categories: manipulation of the model, adding assets and annotation to the model, camera control and navigation, and completion of the image. Comprehensive feature lists were created and shared with programmers as the main guidelines for development.

Wireframes **(fig. 2)** were created to plan each potential alteration to the model. They helped to answer questions such as "How does the user reconnect loose ends of the small bowel?" and then to communicate each solution to developers. These have proven valuable as the project moves into the implementation phase.

User Interface Design (UI) and User Experience Considerations

Function wireframes guided design of the UI **(fig. 4)** with the aim of keeping it as minimal as possible. The interface includes a toolbar with all tools to alter the model and camera view and an accordion menu which can be expanded to see details about the case and annotations added to the model.

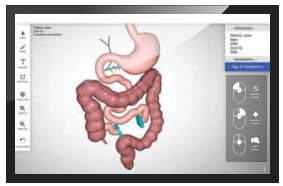


Fig. 4 Mockup interface

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Lukas Manka, MBA, Business consultant

MAR 2017

Apply for Funding
Submit Maryland Innovation Initiative and Thalheimer Fund grant applications

JUL 2017

Develop Pilot Version for JHH Surgical Department
Include features of the Minimum Viable Product

AUG 2017

Integration with Epic
Accomplish seamless integration with top EMR system at academic hospitals

OCT 2017

Pilot at JHH
Test with 40 JHM GI surgeons and gather feedback; concurrently develop vascular anatomy

DEC 2017

Distribute Product
Introduce program at 6 JHHS hospitals. Focus on promotion and attendance at conferences and regional meetings.

JAN 2018

Expansion into Niche Sub-Specialties
Develop anatomy for pediatric cardiac & urology, ENT, plastics, etc.