

Project Title

Artificial Intelligence to Read Abdominal X-Rays as Part of a Bowel Management Program for Children with Constipation and Fecal Incontinence

Team Members

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Abstract

Many children suffer from bowel complications such as constipation and fecal incontinence. These children are enrolled in a week-long bowel management program during which they undergo daily abdominal radiographs. Radiographs need to be analyzed by colorectal surgeons or radiologists to determine the appropriate treatment for the patient; however, many clinical facilities around the world do not have access to these experts. To address this problem, we developed IntelliStool, a software application that harnesses artificial intelligence to analyze the abdominal X-rays of patients enrolled in bowel management programs. Our process uses three different models of convoluted neural networks (CNN) to detect the colon, isolate its anatomical segments, and score their stool quantities. Our algorithm works by submitting the original image through a U-Net algorithm for image segmentation, which results in a mask that isolates the colon's contour. Then, the image is analyzed by YOLO, an object detection algorithm, that improves specificity in the identification of the colon's anatomical segments. Finally, a score prediction model analyzes the stool content of the individual segments on a scale from 0 to 2 using a CNN. Providers can upload X-ray images and receive scoring results through a graphical user interface (GUI). Ultimately, we were able to develop an algorithm capable of identifying the colon in an X-ray, isolating the colon segments, and then extracting them for stool quantity scoring. Our accuracies for the respective code segments were 65% for colon identification, 69% for segment extraction, and 53-70% for scoring depending on the colon segment being evaluated. A graphical user interface was also successfully implemented to walk users through the use of the software. One of the biggest ethical issues present in the field of medicine is the struggle for many individuals to have access to essential medical care. In fact, according to the US Census Bureau, "27.5 million Americans" had no access to health insurance in 2018("Uninsured Americans Stats and Facts 2021: Policy Advice."). This problem is even more evident globally according to the World Health Organization, with more than 400 million people around the globe not having access to basic health care ("New Report Shows That 400 Million Do Not Have Access to Essential Health Services."). Bowel Management Programs contribute to this ethical issue posed by medicine. Prior to the implementation of the treatment program, radiologists are needed for X-ray interpretation of patient colons. Around "67% of the world does not have access to radiology services", resulting in a large portion of individuals unable to have access to proper Bowel Management Programs ("The Global Radiology Gap"). Intellistool tackles this ethical problem and as a result, access to proper Bowel Management Programs can become globalized to regions without radiologists.

1. "The Global Radiology Gap." *HealthManagement*, 18 July 2019, healthmanagement.org/c/imaging/news/the-global-radiology-gap#:~:text=According%20to%20the%20World%20Health,a%20threat%20to%20public%20health.
2. "New Report Shows That 400 Million Do Not Have Access to Essential Health Services." *World Health Organization*, World Health Organization, 12 June 2015, www.who.int/mediacentre/news/releases/2015/uhc-report/en/.
3. "Uninsured Americans Stats and Facts 2021: Policy Advice." *PolicyAdvice*, 14 Feb. 2021, policyadvice.net/insurance/insights/how-many-uninsured-americans/.