Executive Summary

Dr. Pushpak Bhattacharyya

Professor,

Department of Computer Science and Engineering,

IIT Bombay

1. Title of the Project:

"Shushrut"- a System for Increasing Efficiency and Diagnosis- Accuracy in Clinical Workflow in Indian Radiology Using Automatic Speech Recognition and Natural Language Processing

2. **Date of Start of the Project:** 1 February 2020

3. Aims and Objectives:

3.1 Context:

Radiology is an integral part of medical care. Radiological imaging-based evidence (X-ray, MRI, CT, USG, *etc.*) is crucial in determining the nature of treatment in most hospitals. Once patients get themselves scanned, the radiologists have to prepare a report which clinicians then use for determining the correct treatment. Conventionally, radiologists prepare the diagnosis notes by either dictating to a voice recording device or writing it on paper. These notes are then handed over to a transcriptionist/secretary. The transcriptionist opens a scan-specific standardised template corresponding to all normal findings (henceforth referred to as the normal template) and edits it based on the measurements and findings reported by the radiologist.

India is a country with 1.3 Billion people and one radiologist per 100,000 population, a severely imbalanced ratio (the corresponding ratio in the US is 1:10,000 and for China it is 1:14,772). It results in very high patient inflows which make radiologists incredibly busy and stressed out.

3.2 Challenges:

The workflow mentioned above mainly consists of multiple humans in the loop - radiologists, transcriptionists, clinicians, *etc.* This leads to the following shortcomings:

1. Frequent delays: Different time schedules of different human participants can lead to delay in report generation, often by multiple days.
2. Erroneous report generation: Typographical and grammatical errors made by either radiologist during note taking, or by transcriptionists during report generation can lead to erroneous diagnosis. This indirectly burdens the radiologists as they have to verify the reports prepared by transcriptionists.

These challenges are further amplified considering the fact that in a densely populated country like India, the radiologists are already handling several patients every day.

3.3 Problem Statement:

Using NLP we want to automate the report generation process from radiology (XRAY, MRI, CT, UltraSound) plates with high accuracy and speed, so that the radiologist can concentrate only on the diagnostics. It will improve the productivity of radiologists. Improving productivity of radiologist is equivalent to reach US like ratio of 1 radiologist per 10000 people, up from the prevalent Indian condition of 1 radiologist per 100000.

• The input to the system are
1. Input text (Spoken form)
2. Generic radiology report with all normal findings (henceforth referred to as normal report)

• The output of the system is
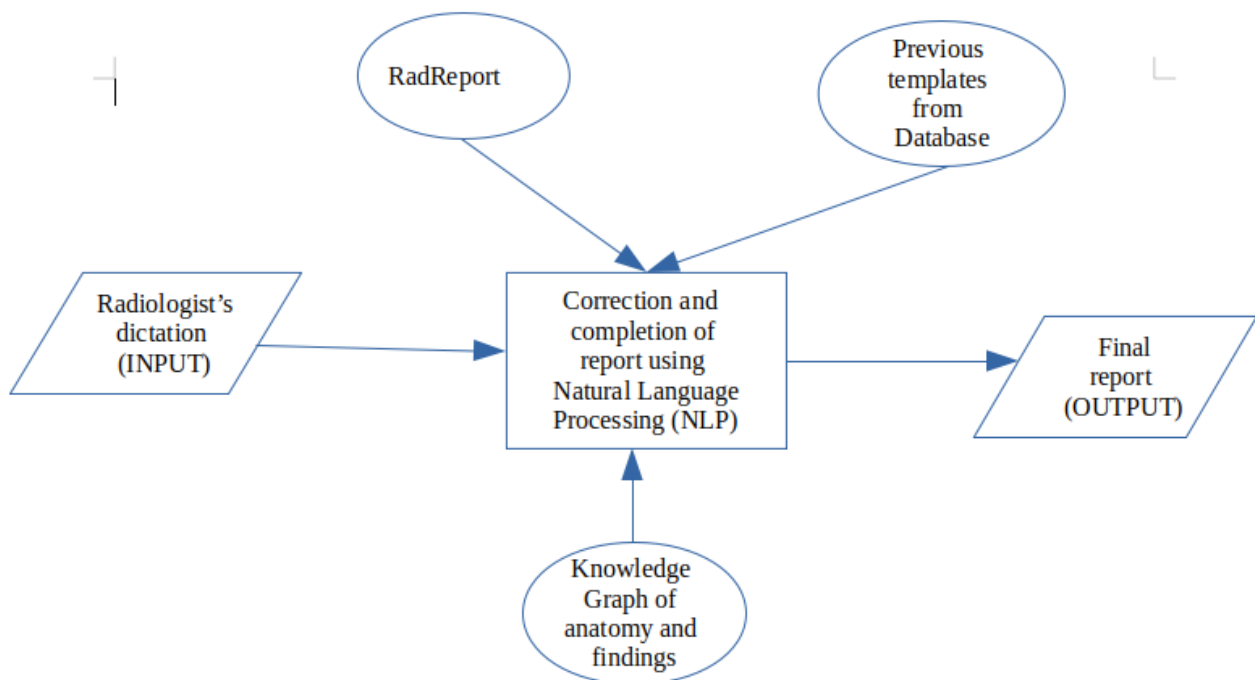1. Radiology report with patient specific findings

Figure-1: Workflow of Sushrut; Knowledge Graph (KG) is at the Center Stage

4. Significant achievements (not more than 500 words to include List of patents, publications, prototype, deployment etc)

1. Sapan Shah, Sreedhar Reddy and Pushpak Bhattacharyya, A Retrofitting Model for Incorporating Semantic Relations into Word Embedding, 28th Int'l Conf on Computational Linguistics (COLING20), Online Conference, December 8-13, 2020.
2. Deepak Gupta, Hardik Chauhan, Ravi Tej Akella, Asif Ekbal and Pushpak Bhattacharyya, Reinforced Multi-task Approach for Multi-hop Question Generation, 28th Int'l Conf on Computational Linguistics (COLING20), Online Conference, December 8-13, 2020.

In addition to the above publications various modules are also being developed. The figure below shows those modules and the colours give the current status as per the caption below.
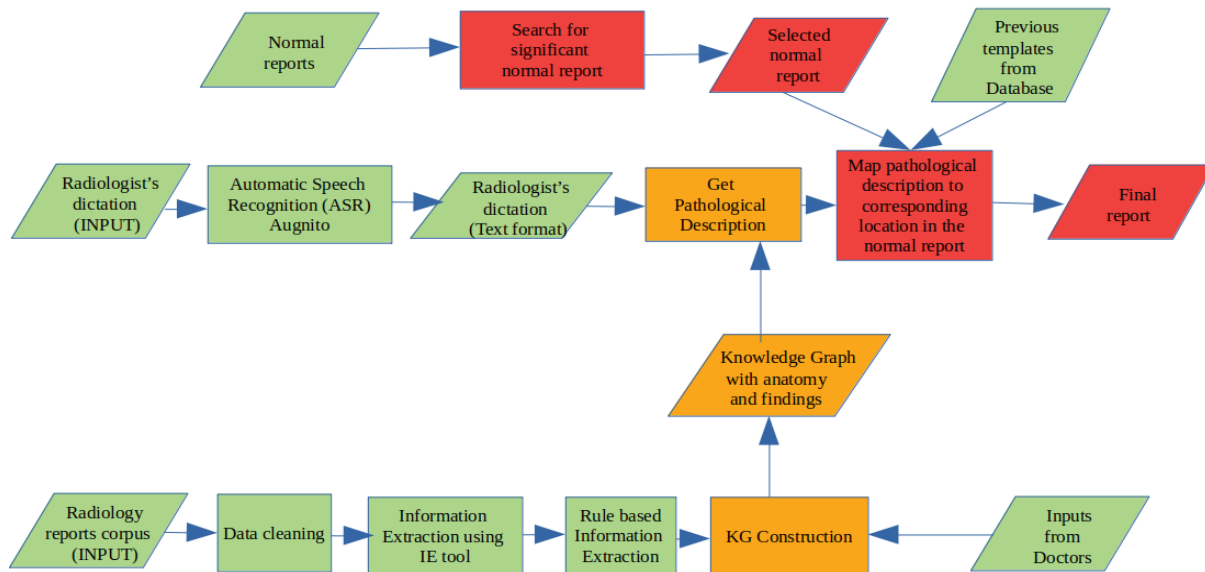

Figure 2: Status of development of Shushrut. *Green*- components/processes completed; *Orange*- in progress; *Red*- to start.

5. Concluding remarks

Currently, we focused on building an AI system for Indian radiology which can augment radiologist's capabilities in order to enhance clinical workflows. We are exploring different NLP techniques like ASR, NLP, KG to proceed with the problem. With the help of Doctors we are creating KGs for the radiology domain.