Cybermedia Center

Osaka University, Japan

SC16 BOOTH 1437

Towards a Smart Healthcare System for Orthodontic and Dental Treatment

Motivation

- ***Increasing demand and costs for healthcare***, exacerbated by ageing populations, are serious concerns worldwide.
- ***A relative shortage of doctors or clinical manpower*** is also a problem that leads to increase their workload.
- ***Large amounts of heterogeneous medical data*** have become available in various healthcare organizations.
  - Electronic Healthcare Records (EHR) are the fundamental resource to support medical practices or help derive healthcare insights.
  - Most of the medical practices are completed by medical professionals backed by their experiences.
  - Clinical researches are conducted by researchers via painstaking designed and costly experiments.

Aim

- This project aims to ***enhance the medical operation efficiency*** and ***improve the quality of healthcare services*** leveraging high performance computing resources and advanced machine learning technologies.
- It is overburdened for doctors to properly manage a sequence of operations including hearing, diagnosis, surgery, progress checkup, counselling, treatment, etc. for all patients.
  Especially, doctors spend a lot of time and effort to manually
  - diagnose by looking at massive number of oral and face photo images and x-rays.
  - extract morphological features of face from CT scan and MRI.
  - make plans of orthodontic procedure or treatment for patients.

Smart Healthcare System

- Smart Healthcare System operates ***Data Curation*** and ***Data Analytics***, supported by ***High Performance Computing Resources***.
- Figure 2 illustrates the pipeline for Big healthcare data analysis.
  - Obtained raw EMR data is probably heterogeneous composed of structured data, free-text data (such as doctors' notes), image data (such as MRI images) and sensor data. Hence, data extraction is of great concern for further analysis.
  - Data cleansing is necessary to remove inconsistencies and
  - errors.
    Data annotation with medical experts' assistance contributes to effectiveness and efficiency of this whole process from
  - acquisition to extraction and cleansing.
    Data integration is employed to combine various sources of data,
  - such as different hospitals' data for the same patient.
    Finally, statistical, descriptive and predictive analysis of different
  - types will be performed on processed EMR data.
    The analysis results are interpreted and visualized, and are used to construct medical knowledge and ontology for better and more accurate analysis.

Example Applications

The specific objectives are to develop a system that automatically

- computes Index of Orthodontic Treatment Priority (IOTN), one of the severity measures for malocclusion and jaw abnormality, which determines whether orthodontic treatment is necessary;
- extracts facial morphological features (e.g., points and measure);
- generates medical certificates or checkup lists;
- provides a set of necessary procedure/treatment recommendations;

from oral and face photo images and x-rays or cephalogram.

Challenges

- A great amount of interests and motivation in providing effective healthcare services through ***Smarter Healthcare Systems***.
- Doctors are required to provide ***immediate and accurate diagnoses*** and ***proper treatments for patients***.
- The rapidly increasing availability of Big and Complex EHR data is becoming the driving force for the adoption of data-driven approaches to ***automate healthcare related tasks***.
- It is also a challenge to achieve ***earlier disease detection, more accurate prognosis, faster clinical research advance*** and ***the best fit for patient management.***

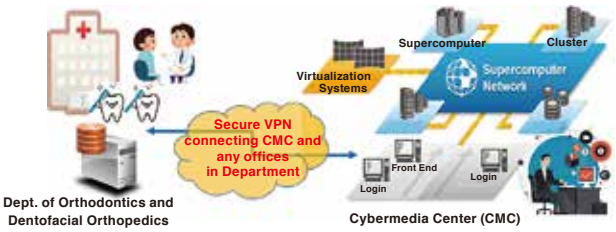

Figure 1. Secure and high performance smart healthcare systems

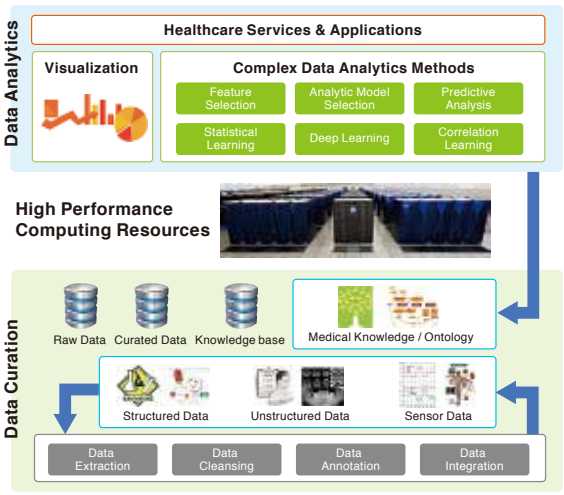

Figure 2. An overview of system architecture

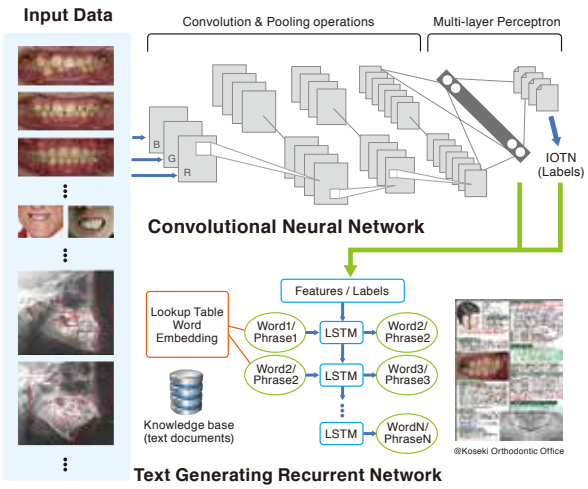

Figure 3. An illustration of example applications