Cybermedia Center

Osaka University, Japan

SC16 BOOTH 1437

About Us : Cybermedia Center, Osaka University

As a resource provider of knowledge and technology derived from advanced researches conducted in Osaka University, the Cybermedia Center (CMC) offers support in the areas of large-scale computation, information communication, multimedia content and education. The center also works closely with educational and research organizations within Osaka University, as well as with industries and institutes outside the University. By sharing its resources and encouraging local communities to use its facilities for public lectures and other events, CMC has helped to create a more internationally-oriented IT society for the region.

Location Map

Location

University-Wide Services

Large-Scale Computer System, we provide a high-performance computing environment, consisting of the NEC SX-ACE supercomputer and PC clusters, to both the academic and industrial communities. Part of the overall computer system is provided, as a computational resource, to the national High-Performance Computing Infrastructure(HPCI).

Information Media Education Multimedia Language Education, we have implemented a consistent curriculum, from the basics of computer utilization to advanced subject matter, while the Computer Assisted Language Learning System supports foreign language learning and cross-cultural understanding in accordance with each individual's language-proficiency level.

Cybermedia Commons is an active learning space for students, exploiting a wide variety of the Cybermedia Center's information technology, to support student's active learning and research activities.

Cybermedia Commons

Digital Library provides academic information databases and remote access to electronic journals. It is equipped with multimedia terminals and public network jacks with an authentication system.

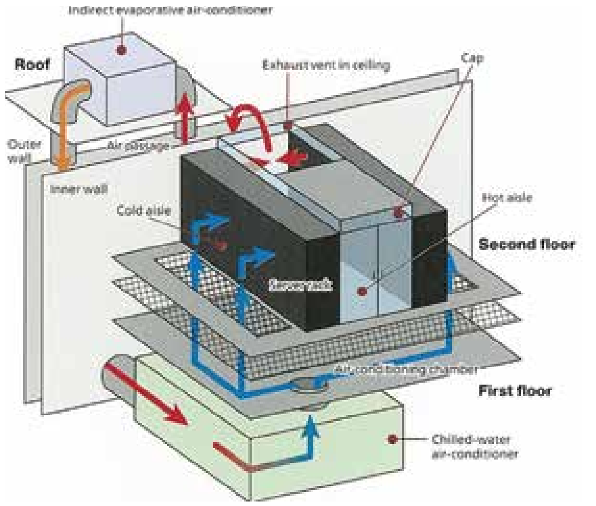
Repair and Maintenance of the Information Network, a high-speed, stable and reliable campus-wide network environment, as well as wireless access networks, as information infrastructure for supporting the educational, research, and social contribution activities of Osaka University.

Visualization Services, we maintain two types of high-resolution stereo visualization systems, as primary visualization facilities. The systems can be used for scientific visualization, information visualization, visual analytics, and other research activities.

Visualization Services

Academic Cloud improves the integration of computing resources scattered across the university. The objectives of the system are to optimize administrative operations, enhance security, and reduce costs.

IT Core Annex is a two-story steel-frame data center housing large-scale computers. The perimeter wall is designed with gently curving surface and light-permeable metal panels, to harmonize with the surrounding environment.



Air-conditioning mechanism in IT Core Annex

Cybermedia Center

Cybermedia Center
Osaka University

Osaka University, Japan

SC16 BOOTH 1437

Large-scale Computing and Visualization Systems at the Cybermedia Center

Overview of high-performance computing environment at the CMC

Large-scale computing systems (SX-ACE, VCC, and HCC), and large-scale visualization systems are deployed on CMC-Supercomputer network, a.k.a CMC-SCinet, a low-latency and wide-bandwidth network. This architectural design allows users to access to large-scale storage systems, perform large-scale high-performance computation and analysis on our large-scale computing systems, and then visualize its computation and analysis results without loosing any important information on our large-scale visualization system.

Large-scale Computing System

The large-scale computing systems at the CMC are classified into (1) Vector-typed Supercomputer and (2) Scalar-typed Supercomputer.

SX-ACE

Type: Vector
OS: Super UX
# of nodes: 1536
# of cores: 6144
Total memory: 96 TB
Peak performance: 423 TFlops

SX-ACE is a “clusterized” vector-typed supercomputer, composed of 3 cluster, each of which is composed of 512 nodes. Each node equips 4-core multi-core CPU and a 64 GB main memory. These 512 nodes are interconnected on a dedicated and specialized network switch, called IXS (Internode Crossbar Switch) and forms a cluster. Note that IXS interconnects 512 nodes with a single lane of 2-layer fat-tree structure and as a result exhibits 4 GB/s for each direction of input and output between nodes.

Library

MathKeisan(BLAS, LAPACK, etc)
ASL, ASLSTAT, ASLQUAD
MPI/SX
HPF/SX
XMP

VCC (PC Cluster for large-scale visualization)

Type: Scalar
OS: Linux
# of nodes: 65
# of cores: 1300
Total memory: 4.160 TB
Peak performance: 26.0 TFlops
Accelerator: NVIDIA Tesla K20x59

PC cluster for large-scale visualization (VCC) is a cluster system composed of 65 nodes. Each node has 2 Intel Xeon E5-2670v2 processors and a 64 GB main memory. These 65 nodes are interconnected on InfiniBand FDR and forms a cluster. Also, this system has introduced ExpEther, a system hardware virtualization technology. Each node can be connected with extension I/O nodes with which GPU resource, and SSD on 20Gbps ExpEther network. A major characteristic is that this cluster system is reconfigured based on user’s usage and purpose by changing the combination of node and extension I/O node.

Library

Intel MKL(BLAS, LAPACK, etc)
Intel MPI, Open MPI

HCC (General-Purpose PC Cluster)

Type: Scalar (VM)
OS: Linux
# of nodes: 575
# of cores: 1150
Total memory: 2.6 TB
Peak performance: 16.6 TFlops

IPC-C (Image Processing PC Cluster on Campus)

Type: Scalar
OS: Windows/Linux
# of nodes: 7
# of cores: 84
Total memory: 448 GB
Peak performance: 1.68 TFlops
Accelerator: NVIDIA Quadro K5000×7

IPC-U (Image Processing PC Cluster on Umekita)

Type: Scalar
OS: Windows/Linux
# of nodes: 6
# of cores: 72
Total memory: 384 GB
Peak performance: 1.44 TFlops
Accelerator: NVIDIA Quadro K5000×6

Application

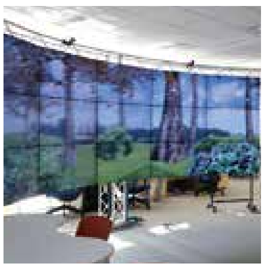
GROMACS	Gaussian09	Marc / Mentat	Nastran
GROMACS for GPU	IDL	Dytran	AVS/Express (DEV/PCE/MPE)
LAMMPS	NEC Remote Debugger	Patran	
OpenFOAM	NEC Ftrace viewer	Adams	

Large-scale Visualization System

The large-scale visualization systems at the CMC are set up on Campus and on CMC’s Umekita Office. Large-scale and interactive visualization processing becomes possible through the dedicated use of PC cluster for large-scale visualization (VCC) on these systems.

24-screen Flat Stereo Visualization System

The visualization system is composed of 24 50-inch Full HD (1920x1080) stereo projection module (Barco OLS-521), Image-Processing PC cluster (IPC-C) driving visualization processing on 24 screens. A notable feature of this visualization system is that it enables approximately 50 million high-definition stereo display with horizontal 150 degree view angle.



15-screen Cylindrical Stereo Visualization System

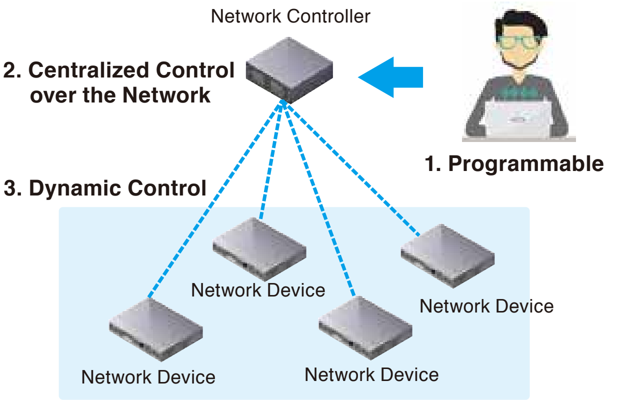
This visualization system is composed of 15 46-inch WXGA (1366x768) LCD, and Image-Processing PC Cluster (IPC-U) driving visualization processing on 15 screens. A notable characteristic of this visualization system is that it enables approximately 16-million-pixel very high-definition stereo display.

Contact : system@cmc.osaka-u.ac.jp　Visit us at www.cmc.osaka-u.ac.jp

SDN-enhanced MPI: Towards Dynamic and Application-aware Interconnect Architecture

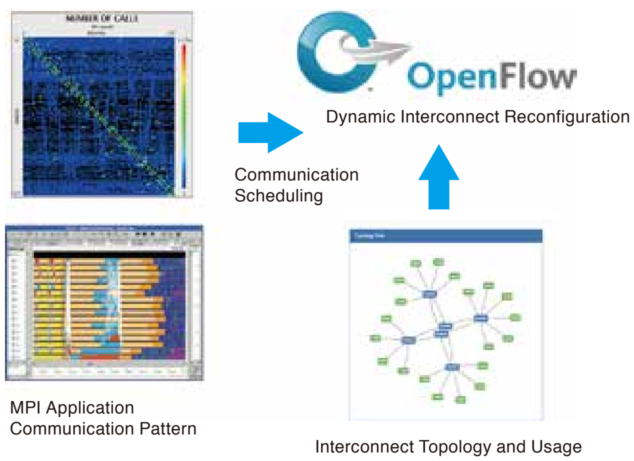
1. Software-Defined Networking (SDN)

Software-Defined Networking (SDN) is a new concept of network architecture that decouples conventional networking function into a programmable control plane (responsible for deciding how to control the packets) and a data plane (responsible for the actual packet delivery). Currently, OpenFlow is the most common implementation of SDN, which enables to dynamically control the forwarding functionality of network from a centralized controller.

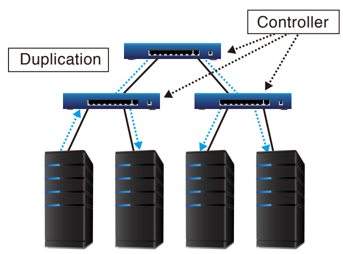


2. Aim of SDN-enhanced MPI

We have been developing SDN-enhanced MPI based on the idea that a mechanism that configures and controls the network of a cluster system depending on the requirement of each application is essential. The key concept of SDN-enhanced MPI is to utilize the underlying network of a computer cluster to its maximum capacity by leveraging the flexible network controllability of SDN.

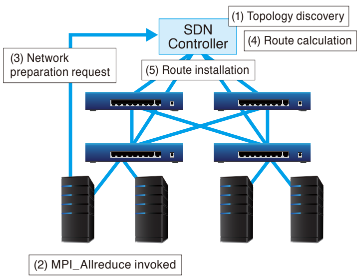


3. SDN-enhanced MPI Communication Primitives



A. SDN_MPI_Bcast [1]

SDN_MPI_Bcast is an SDN-enhanced version of MPI_Bcast, which is the broadcasting function in MPI. SDN_MPI_Bcast offloads packet duplication operations during the broadcast onto SDN switches. As a result, SDN_MPI_Bcast has successfully decreased the number of communications and communication latency of MPI_Bcast.

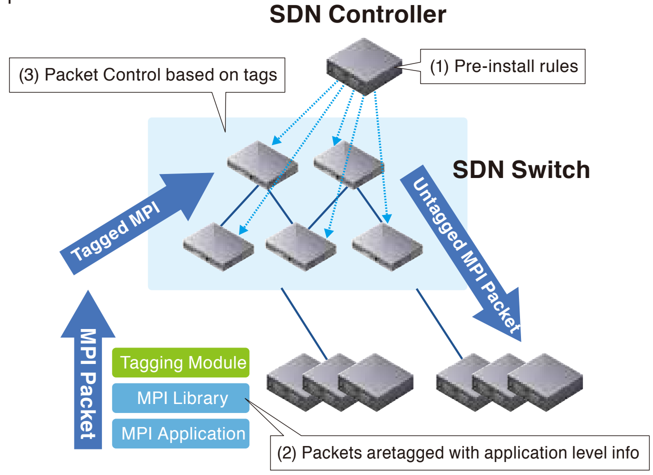


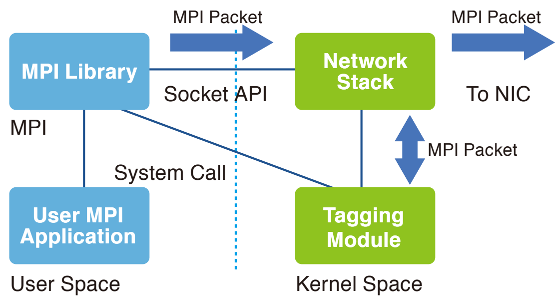
B. SDN_MPI_Allreduce [2]

SDN_MPI_Allreduce is an SDN-enhanced version of MPI_Allreduce. Since it requires multiple simultaneous communication between nodes, congestion may happen on an oversubscribed interconnect. We employ a real-time traffic load balancing method to solve this problem.

4. Coordination Mechanism of Communication and Computation

We propose an integrated framework [3] to combine SDN-MPI components that we have developed in our previous works. In this framework, MPI packets are tagged with MPI-layer information which are used by the SDN switches to determine how to control the packets.





Publications

[1] K. Dashdavaa et al., Architecture of a High-Speed MPI_Bcast Leveraging Software-Defined Network, in: UCHPC2013 6th Work. Unconv. High Perform. Comput., 2014: pp. 885–894.
[2] K. Takahashi et al., Performance Evaluation of SDN-enhanced MPI_Allreduce on a Cluster System with Fat-tree Interconnect, in: Proc. Int. Conf. High Perform. Comput. Simul. - HPCS 2014, 2014: pp. 784–792.
[3] K. Takahashi et al., Concept and Design of SDN-Enhanced MPI Framework, in: Proc. Fourth Eur. Work. Softw. Defin. Networks - EWSDN 2015, 2015: pp. 109–110.

Contact
Keichi Takahashi : takahashi.keichi@ais.cmc.osaka-u.ac.jp
Khureltulga Dashdavaa : huchka@ais.cmc.osaka-u.ac.jp

Cybermedia Center
Osaka University, Japan

SC16 BOOTH 1437

A Proposal of Access Control Mechanism Towards IoT Era

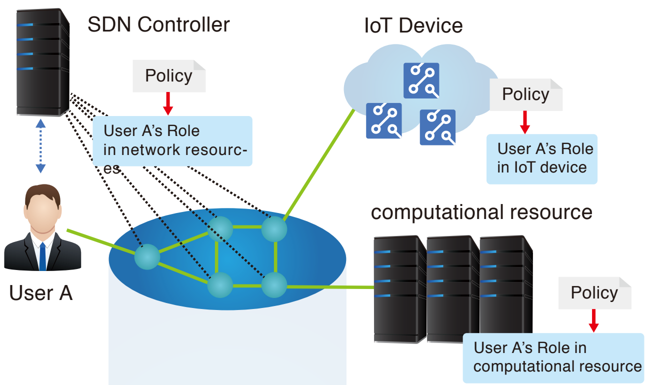
1. Introduction: Network of IoT Era

In the IoT (Internet of Things) era, there is ***a large number of IoT devices*** distributed widely throughout world.Many groups of users share such devices.In the network that connects such IoT devices, ***access control becomes an important problem for assuring security.***

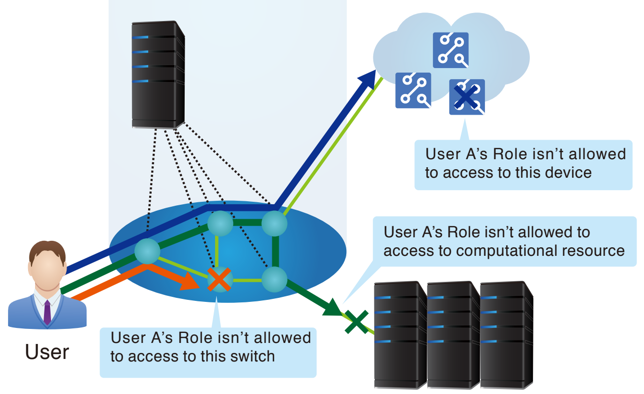
2. Access control mechanism

To date, various security technologies have been proposed and implemented. However, these technologies have targeted only computational resources. We propose an access control mechanism that ***targets network resources as access-controlled resources.*** We have adopted ***RBAC*** (Role Based Access Control) and ***SDN*** to develop the mechanism. The mechanism works as shown below, and ***provides user-dedicated infrastructure.***

1. SDN controller authenticates every user connected to the network.



2. Each resource has its own security policy, and assigns a role to each user depending on the policy.



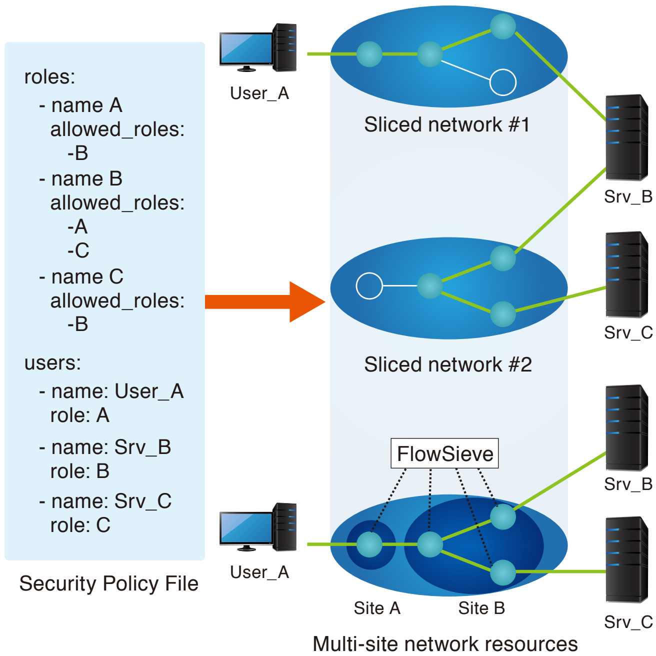
3. User's access to any resource is controlled based on user's role.

3. Previous work: FlowSieve

FlowSieve is a preliminary implementation of the access control mechanism.FlowSieve is implemented as an OpenFlow controller, and ***controls access to network resources***.

FlowSieve works as follows.

1. FlowSieve works as IEEE 802.1X authentication server, and authenticates every user connected to the network.
2. When a device sends a packet to an OpenFlow switch, the switch handles the packet based on the rules installed in it.
3. If the switch cannot find any rule for handling the packet, the switch sends the packet to FlowSieve.
4. FlowSieve determine how the packet should be treated by the controller, and installs rules for handling the packet to the switch.



4. Future works

Under the current version of FlowSieve, all devices and network resources are controlled under one security policy file.
In the next plan, we extend FlowSieve so that ***each device and network resource can have its own security policy*** towards multi-site network.

Source Code of FlowSieve: https://github.com/shimojo-lab/flowsieve

Contact: Takuya Yamada yamada.takuya@ais.cmc.osaka-u.ac.jp Visit us at www.cmc.osaka-u.ac.jp

Cybermedia Center

Osaka University, Japan

SC16 BOOTH 1437

Hi-IaaS : High Performance Computing Infrastructure as a Service

Hi-IaaS

Software defined HPC platform covering applications of IoT/BigData and Science

Providing diversity of HPC Platform dynamically

Hardware (GPU/FPGA, Cluster) Software (SPARK, MPI)

Back Ground

HPC computing platform going into cloud. however HPC computing platform needs application specific configuration

Ex. #GPU, #FPGA, InfiniBand, FatTree

Features

Job-resource cross management system

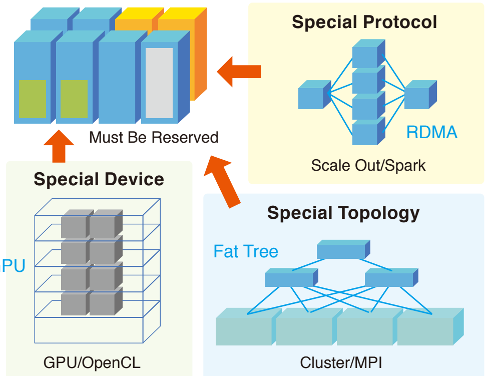
Job management over Accelerators(GPU/FPGA)

Shared NVM+PCIe fabric based scalable High-speed storage

PCIe device level reconfiguration

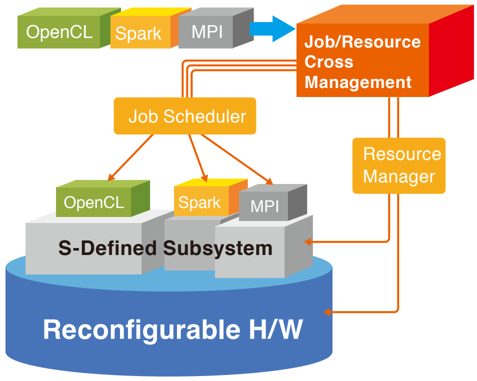
Today : Special/Static

Expensive, not fit, low utility

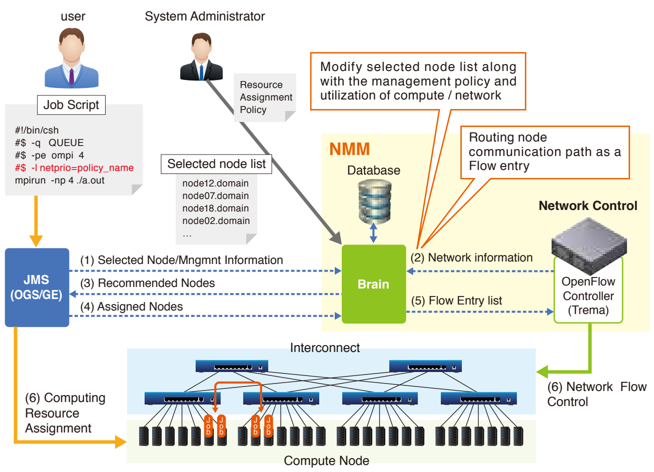


Proposal : Open/Dynamic

Reasonable, scale up, high utility



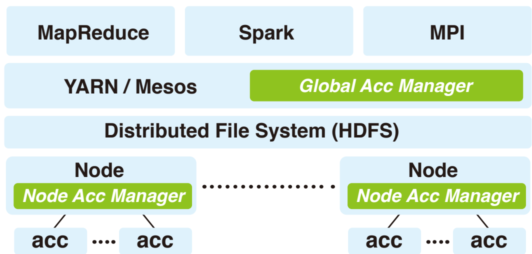
SDN-Enhanced Job Management System with Nara Institute of Science and Technology (NAIST)



Job / Accelerator Management with UCLA and Falcon Computing Solutions

Global Accelerator Manager : Global resource allocation within a cluster to optimize system throughput and accelerator utilization

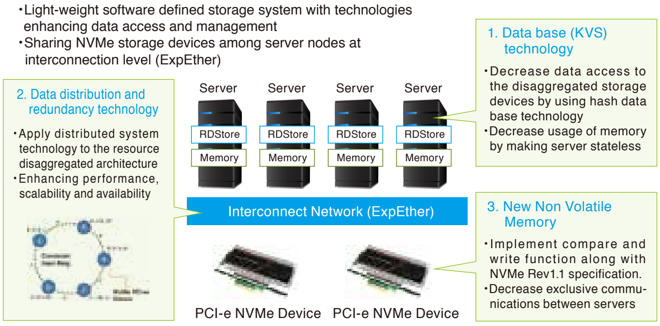
Node Accelerator Manager : Accelerator sharing/isolation across applications using accelerator-as-a-service



Resource Disaggregated data Store (RDStore) with NEC

Scalable Key-Value store (NOSQL) on Resource Disaggregated Architecture

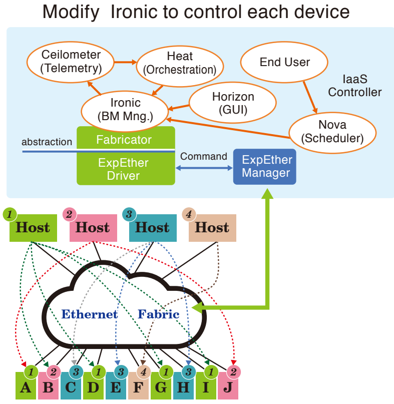
- Communication among servers degrades performance such as storage capsyty and access latency.
- Proposal:
  - Light-weight software defined storage system with technologies enhancing data access and management
  - Sharing NVMe storage devices among server nodes at interconnection level (ExpEther)



OpenStack based Resource Management of Disaggregated Platform

Modify Ironic (Bare metal control) to device level.

Modify Ironic to control each device



GUI on modified Horizon

Contact : system@cmc.osaka-u.ac.jp Visit us at www.cmc.osaka-u.ac.jp

Cybermedia Center

Cybermedia Center
Osaka University

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.***

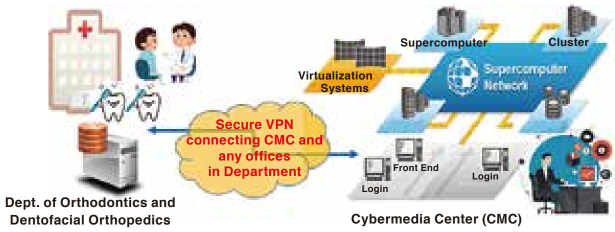


Figure 1. Secure and high performance smart healthcare systems

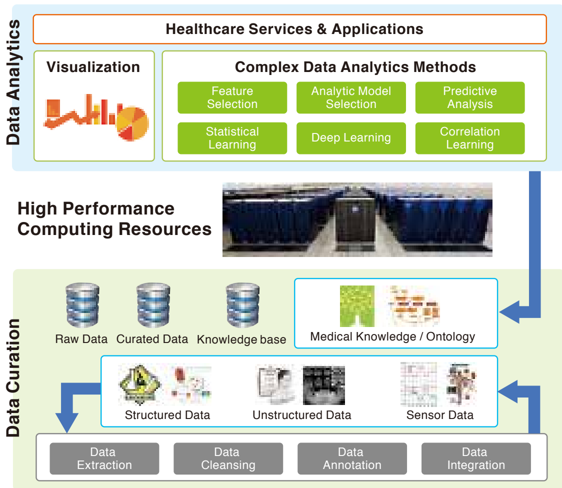


Figure 2. An overview of system architecture

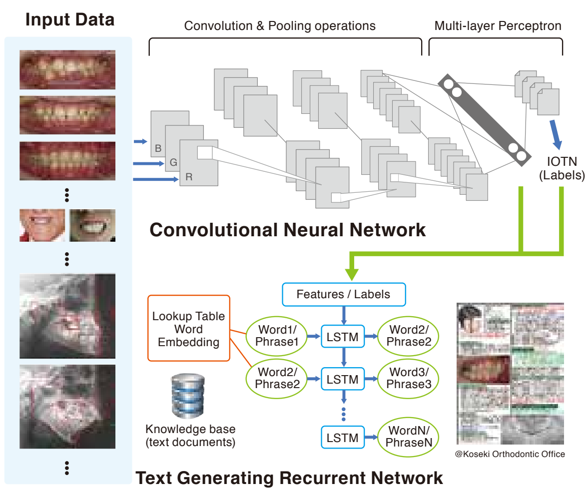


Figure 3. An illustration of example applications