

KNOWLEDGE
RESEARCH
INDUSTRY
IMPACT



Faculty of Computer Science &
Engineering
Ghulam Ishaq Khan Institute of
Engineering Sciences and Technology

RESEARCH AT FCSE, GIKI

The Faculty of Computer Science & Engineering (FCSE) at Ghulam Ishaq Khan Institute of Engineering Sciences & Technology has set high standards in providing its students with a strong platform to develop their skills for meeting the software and hardware requirements of the industry. This is evident from the positions, which the alumni of FCSE has gained over the years in several multinational software giants like Microsoft, Google etc. The faculty of FCSE along with providing its students with valuable knowledge has itself spend a great deal of time carrying different funded research projects that were of great benefit both to industry as well as to the students and faculty at GIKI. This brochure lists some of the research projects that were successfully carried out by our faculty in recent past.



Research Projects @ FCSE



Prof. Dr. Mushtaq Ahmed
*Professor at Faculty of Computer
 Science & Engineering, Ghulam Ishaq
 Khan Institute of Engineering
 Sciences & Technology*

HPC CLUSTER HARDWARE SPECIFICATIONS

- Total RAM: 256-512 GB
 - 16-24 GB RAM per node
- Processors: 128-256 Cores
 - A multiprocessor System
- Hard disk: 4 TB in master node
 - And 1-2 TB in slave node with raid option
- External memory: 8-16 TB
- Network: Hybrid hierarchical version of infiniband/10GB Ethernet for high performance communication
- Electric surge devices/UPS to protect the hardware from the high voltage hazards



SE LAB at FCSE, GIKI

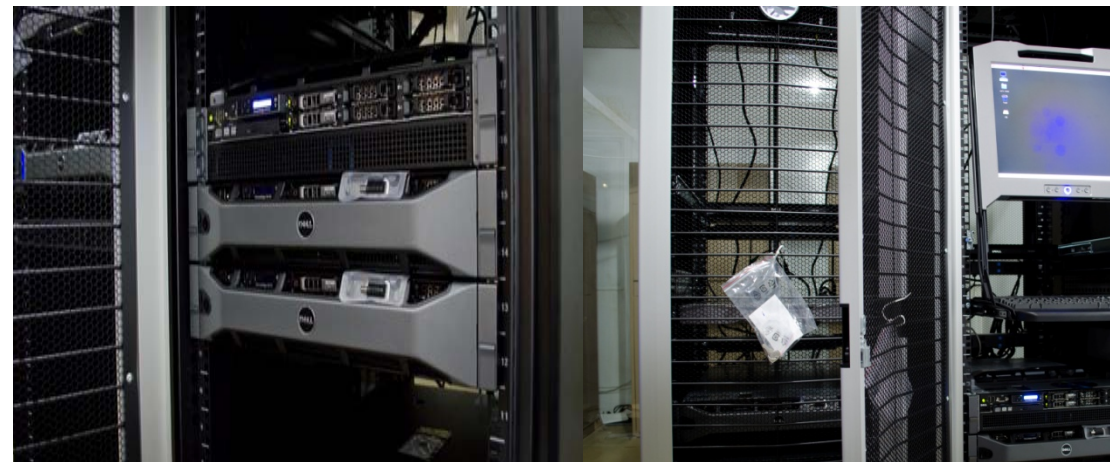
Development of Super Computer

The aim of this project was to develop an advanced super computing infrastructure at K.P.K with a state of the art High Performance Computing (HPC) cluster system. The facility is now installed and in working at GIKI, Topi. The HPC cluster is being used to carry out research work in data mining, computational biology, computational mechanics, etc. It provides a huge storage capacity in Tera bytes, fast processing power, reliability, efficient and accurate resource for the problems involving millions of elements and thousands of time steps including the data over several miles. These computational requirements need an advanced

state of the art computing infrastructure to solve and store the data structures for current massively parallel architectures. This project is being utilized for the training of undergraduate/graduate students and industry on Super Computer and its usage via workshops/seminars/sources. It is also facilitating the faculty, graduate and Phd students for publication of research papers international conferences and journals. The facility is available for providing high performance supercomputing 24/7 to all over Pakistan for both academia and industry. . The project aims to train graduate students and professionals from the industry.

HPC CLUSTER SOFTWARE SPECIFICATIONS

- Rocks-Cluster distribution
- Parallel programming languages: c/c++, Fortran
- Parmetis: A parallel mesh partitioning library
- Abaqus: A finite element analysis software
- ANSYS: A finite element analysis software
- MATLAB: Mathematical and statistical tool box
- Mahoot: Scalable machine learning and data mining library
- Plus many others arranged through the courtesy of research groups in Pakistan

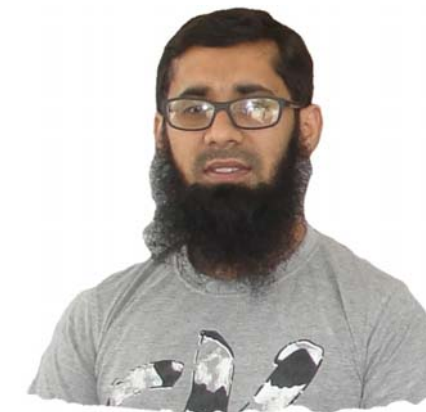


HPC Cluster at GIKI

Up-gradation of Software Engineering Lab

The Software Engineering Lab at Faculty of Computer Science and Engineering (FCSE), Ghulam Ishaq Khan Institute of Engineering Sciences and Technology (GIKI) is equipped with high speed computers, multi-feature HP colour laser jet 2820 printer. In 2007, Dr. Muhstaq Ahmed supervised the project for upgrading the equipment in Software Engineering lab. The aim of the project was to facilitate the students during their research.

Three laptops were bought along with an HP laser jet printer 2820 equipped with the capability of both colored and black and white printing, scanning and copying. Since then the MS and Phd students have been using this facility for their research work such as research papers, thesis, presentations and printing colored posters for their projects exhibition. Along with this additional equipment for upgrading the Software Engineering lab was also bought.



Dr. Masroor Hussain
(Principal Investigator)
*Assistant Professor at Faculty of
 Computer Science & Engineering,
 Ghulam Ishaq Khan Institute of
 Engineering Sciences & Technology*

FUNDING AGENCY AND COST

The project for the Development of Super Computer was funded by Directorate Of Science And Technology (DOST) Government Of Khyber Pakhtunkhwa. The total funding obtained from DOST was 10 Million PKR. All operational and maintenance expenses are beard by GIKI.

PROJECT TIMELINE

The project started on 27th January, 2012 and was completed in June, 2013.

CORE TEAM MEMBERS AT GIKI

Dr. Masroor Hussain, Principle Investigator (PI)
 Prof. Dr. Mushtaq Ahmed, Adviser
 Dr. Muhammad Abid, Member
 Prof. Dr. Ashfaq Khokhar, Honorary Consultant

FUNDING AGENCY & COST

The project for upgrading the Software Engineering lab at FCSE was funded entirely by Higher Education Commission (HEC) of Pakistan. The total funding obtained from HEC to execute this project was 1 Million PKR.



Range of Indus River dolphins
The range of dolphins in Indus Basin is shown in light blue

BISMIL AT GIKI

The Bio-inspired Simulation and Modeling of intelligent Life Laboratory of Ghulam Ishaq Khan Institute of Engineering Sciences and Technology focuses on application of bio-inspired modeling and machine learning algorithms of everyday problems, structured in signal processing framework. BiSMIL Lab is actively engaged in developing sensors related to environmental monitoring and disaster risk deduction.



An Indus River Dolphin,
(Courtesy: WWF)

Designing and Developing GPS Collars

A STUDY ON UNDERSTANDING TEMPORAL PATTERNS OF TRANSHUMANCE GRAZING IN THE UPPER INDUS BASIN THROUGH GEO-SPATIAL TOOLS

Changes in agricultural practices, climatic changes and seasonal forage in grazing fields of upper Indus basin are affecting nomadic pastoralist (transhumance) system in the upper Indus basin region. These land ranges, mostly found at high altitude and in dry areas, are one of the most fragile and critical ecosystems in the context of the changing climate. In sensitive eco-regions such as glacial areas, are more likely to be governed by local dynamics than by regional or global trends. In Upper Indus Basin, high climate variability across the area is supposing

quite different characteristics of climate change on a relatively small scale. In this context of changing anthropogenic practices and climate conditions in Upper Indus Basin, it is important to analyze how rangelands (pastoral communities) respond as a function of climate variability and human management. Thus, availability of accurate information about grazing resources and animal movements is crucial. In this context this project is going to be launched for developing GPS based tracking devices (GPS Collars) to provide technical assistance for the project.

Pastoral Monitoring

Smart data-loggers provide range of information about pastoral practices in important rangelands and ecological corridors

PROPOSED DEVICE DESCRIPTION

For reasonable coverage and long term monitoring, a GPS and GSM module along with some basic computing and storage equipment with light-weight and good battery life support can be used. A similar system is proposed for this project. The proposed system will include long term and light weight battery powered GPS+GSM device with cellular connectivity. In order to keep the battery budget minimum and ensure long term monitoring (8 months or above), cellular connectivity would only be used for once in a day, data relay or query based data transmission back to server. Moreover, GPS logging intervals will be followed by sleep intervals to minimize the battery usage. The developed GPS collar would consist of rechargeable batteries.

SOFTWARE REQUIREMENTS

A software system will be developed to support the hardware. The record of all the devices will be kept by a website, thus real time monitoring of grazing patterns of the animals fitted with GPS collars can be observed. Also, an interface would be provided to observe the device's health data, indicating battery levels, memory usage and many sensor errors. By using this method, a user can acquire prompt notification of grazing itineraries and could rely on automated data storage system based on web-portal and GSM-based GPS collar, without any field-based manual involvement on long term basis to collect summaries of animal activity data.



Dr. Suleman Mazhar
(Principal Investigator)
Assistant Professor at Faculty of Computer Science & Engineering, Ghulam Ishaq Khan Institute of Engineering Sciences & Technology

BISMIL PROJECTS

1. Mobile phone based epilepsy patient's fall detection
2. Wireless sensor nodes for agricultural applications

PROJECT TIMELINE

The initial study of the project started on July 30th, 2013 and the project is expected to be completed by January 2015

FUNDING AGENCY AND COST

The project is funded entirely by International Centre for Integrated Mountain Development (ICIMOD). The total fund amounts to 13,500 USD.

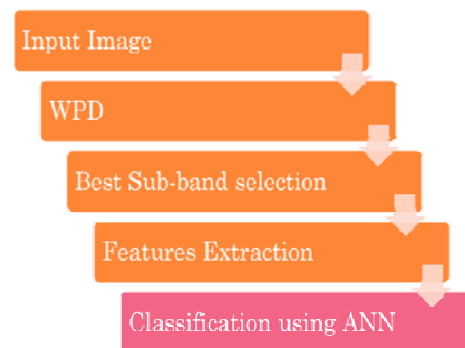
SPECIFIC REQUIREMENTS

In order to develop an application that automates the Gleason grading system for Histological images, the following requirements are necessary.

- Accept input image/s in various formats
- Classify tissues captured in the input images on the basis of severity
- Grade the image using Gleason grading system
- No extra expertise should one need to operate the application
- Easy to use
- Quality and well organized interface
- Platform independent
- Precise

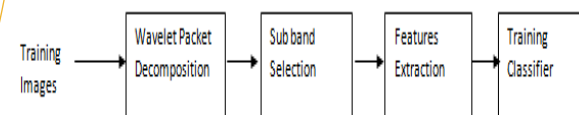
METHODOLOGY

Digital image processing was a key area in this project. The automation process is evolved from the actual manual systems, below given steps are the headings of the steps involved in the approach towards the final results. After feeding the input histological image to the final software application, following steps were carried out



TRAINING PHASE

Already graded images were obtained from the doctors for training the system with each type of Cancer



Automation of Gleason Grading System For Cancerous Tissues Using Wavelet Transformation

Cancer is one of the most life taking diseases. Serious care is needed at the time of treatment planning and prognosis. The existing systems for Cancer prognosis are highly time consuming, complex and costly. The project was aimed at speeding up all these processes and thereby eliminating the chances of errors caused from observer variations. The Cancer prognosis and treatment planning is done on the basis of data derived through manual techniques.

For example If infection of cancer disease was not detected by non-invasive diagnostic techniques like MRI, CT scan, and ultrasound, then a biopsy specimen of the tissue is tested. For prostate, the tissue is usually stained by H&E (Hematoxyline and Eosine) technique. Gleason grading system is used to grade the specimens on the basis of Cancer severity i.e. less effected specimens are assigned lower grades, while highly effected specimens are assigned higher grades, ranging from Grade 1 to Grade 5

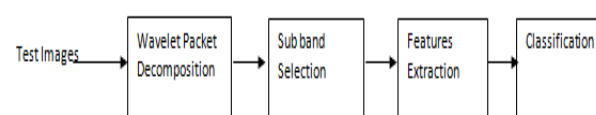
Platform independent and portable Only requires a PC for implementation

OUR SOLUTION

Now a days the incidence of cancer infected tissue is detected and analyzed by a Radiologist and Oncologist by just looking at an X-Ray or an MRI scan which is not very reliable and often results in false diagnosis. Our software will take a histological image of any tissue as input, analyze it and based on different patterns recognized in the image, it will deduce whether the tissue is infected or not and if it is infected, it will further classify which grade cancer it is. Gleason grading system was used to grade the Cancer infected tissues

CLASSIFICATION PHASE

After training the system, it was ready to grade new cancer tissue in the classification phase



SOFTWARE INTERFACE

MATLAB (2009a) from "MathWorks Inc" was used as the main software for analyzing and grading the image of the tissue and for image classification

PROJECT TIMELINE

The project spanned just over a year, starting from 6th June, 2011 and ending on 15th June, 2012

FUNCTIONAL REQUIREMENTS

A software application that

- Takes a histological image to analyze the inner structure of the tissues.
- Validate the input measures.
- Grade the whole image using the Gleason grading image.
- Precise results.
- Exceptions handling.
- Input errors prompting.



Mr. Shahabuddin Ansari
(Project Supervisor)
Research Associate at Faculty of Computer Science & Engineering, Ghulam Ishaq Khan Institute of Engineering Sciences & Technology

For image data, IRNUM, Peshawar was soliticized.

FUNDING AGENCY AND COST

The project was funded entirely by Directorate Of Science And Technology (DOST) Government Of Khyber Pakhtunkhwa. The total funding obtained from DOST was 0.48 Million PKR

NON-FUNCTIONAL REQUIREMENTS

- No extra expertise should one need to operate the application.
- Easy to use.
- Quality and well organized interface.
- Platform independent.
- Less time consuming.
- User-help prompting at each input.
- Drop down menus for bounded input variables.

PERFORMANCE REQUIREMENTS

- This application can process a single set of data at a time.
- It can be used by a single user at a time.
- For higher accurate results the input data should be more exact and accurate.