Planetary Exploration Activities at R&D Center, D.D.University



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About R&D Center,DDU

- R&D centre of DDU started from 1998 and its main objective is to carry out research activity in the area of Information Technology, Computer Science, Computer Application and Electronics & Communication with the respective faculty members.
- It has taken up national level projects from pioneer institutes like National Crime Record Bureau(NCRB), Institute of Plasma Research, Physical Research Laboratory(PRL), Oil and Natural Gas Corporation Limited(ONGC),Gujarat Samachar, Muljibhai Patel Urology Hospital(MPUH), Forensic Laboratory and many others.
- It has the distinction of developing a Color Portrait Building System which is successfully used at every District Police Head Quarters in the Country to arrest criminals.
- R & D centre has guided several projects of under-graduate, post-graduate and Ph.D. students in very diverse areas. For further details please visit www.ddu.ac.in.

List of Activities

1. Designing a Reflecting Light Microscope for 3D Imaging of Thick and Irregular Surface (On Going)
2. Development of Embedded and FPGA Application Modules for Space Payloads (On Going)
3. Planetary Exploration Technology Research
   a) Astro-material Analysis
   b) Crater Simulation Modelling and Analysis
   c) Radiation Counting Efficiency Improvement Using Noise Signature Anti-coincidence
4. Algorithm for Image De-Blurring (on going PhD)
5. Algorithm for Forecasting Rainfall (PhD)
6. Utilities for Large Biological Databases (PhD)
7. Motor Control Using Space Vector Modulation (IEDC)

List of Activities

8. A Novel Hybrid Wireless Sensor Network Development System For Smart City (IEDC)
9. Solar Powered Sensor Networking for Drip Irrigation(IEDC)
10. Smart Predicting Thermometer (IEDC)
11. DDU Robot with Gripper and Path Finder
12. Color Portrait Building System (NCRB)
13. Portrait Building System (NCRB)
14. Coupled Oscillators Simulation and PC Based Data Acquisition System (IPR)
15. Hand Written Text Recognition With Speech Output (PhD Work)
16. Indian Classical Music Trainer with 200 Ragas Database (DDU)
17. Medical Information Management using Internet with On-Line ECG Machine (DDU)

List of Activities

18. Skull Image to Face Identification System (FSL)
19. Neural Network Tool Box using C++ (PhD Work)
20. Email Bulletin Board for Villages using POCSAG code (Gujarat Samachar News Paper)
21. Pattern Recognition Tool Box using Neural Network (PhD Work)
22. Simulation of Two Legged AI Based Walking Robot using Neural Network (PhD Work)
23. Time Series Data Prediction using Time Delay Neural Network (PhD Work)
24. Image Band Compression using Vector Quantization (PhD Work)
25. Continuous Tubular Reactor Simulator(GUI) (PhD Work)
26. Mobile Multi Tasking Gripper Robot (DDU ROBO) (DDU)

Project List:

Project Title	Sponsoring Agency	Status
Designing a Reflecting Light Microscope for 3D Imaging of Thick and Irregular Surface	Department of Science & Technology	On-Going
Development of Embedded and FPGA Application Modules for Space Payloads	Physical Research Laboratory	On-Going
Crater Simulation Modeling and Analysis under Planetary Exploration Technology Research	Physical Research Laboratory	Completed
Astro-Material Analysis under Planetary Exploration Technology Research	Physical Research Laboratory	Completed
Radiation Counting Efficiency Improvement Using Noise Signature Anti-coincidence under Planetary Exploration Technology Research	Physical Research Laboratory	Completed
Measurement and Control of Temperature Using Neural Network based Prediction Algorithm for Industrial and Space Application	IEDC - DST	Completed
Color Portrait Building System	National Crime Record Bureau	Completed
Portrait Building System	National Crime Record Bureau	Completed

Project List:

Project Title	Sponsoring Agency	Status
A Low Cost Low Maintenance Solar-Powered Drip Irrigation System Design	IEDC - DST	Completed
Microcontroller Based Implementation of Space Vector Modulation Direct Torque Controller for Industrial Permanent Magnet Type Motor Control (SVM-DTC)	IEDC - DST	Completed
Coupled Oscillators Simulation and PC Based Data Acquisition System	Institute of Plasma Research	Completed
Hand Written Text Recognition With Speech Output	DDU PhD work	Completed
Indian Classical Music Trainer with 200 Ragas Database	DDU	Completed
Medical Information Management using Internet with On-Line ECG Machine	DDU	Completed
Skull Image to Face Identification System	Forensic Science Laboratory, Gujarat	Completed
Neural Network Tool Box using C++	DDU PhD work	Completed
Email Bulletin Board for Villages using POCSAG code	Gujarat Samachar News Paper	Completed

Project List:

Project Title	Sponsoring Agency	Status
Pattern Recognition Tool Box using Neural Network	DDU PhD work HSM	Completed
Simulation of Two Legged AI Based Walking Robot using Neural Network	DDU PhD work HSM	Completed
Time Series Data Prediction using Time Delay Neural Network	DDU PhD work HSM	Completed
Image Band Compression using Vector Quantization	DDU PhD work	Completed
Continuous Tubular Reactor Simulator(GUI)	DDU PhD work	Completed
Mobile Multi Tasking Gripper Robot (DDU ROBO)	DDU	Completed

Designing a Reflecting Light Microscope for 3D Imaging of Thick and Irregular Surface

- Objective is to enhance the performance for observing thick samples or irregular surfaces to extend the scope of microscope applications without using physical point scan, point sensor or laser illumination methods like con-focal microscopy.
- To demonstrate the proposed method for focus correction an experimental setup shown in next slides. In this first we take series of digital images at different focal plane. We use a neural network to identify the defocused area and combine all the focused patches from all images to compose a fully focused surface of target object. A neural net is trained using fully focused or fully defocused image segments.
- Preliminary experimental result shows that such neural networks are capable of distinguishing or classifying focused segment from defocused segment.
- Identifying components at different focal plane will provide depth information on 2D surface. This will lead to the capability of projection of 3D image using optical microscope.

Image Stacking using Digital Microscope



Figure-A shows the front view of experimental setup for proof of concept of the proposed method. A stepper motor is used to move the object relative to the low cost USB digital microscope. In every steps of this 400 step motor, rock moves 1/500 mm (2u).

Image Stacking using Digital Microscope

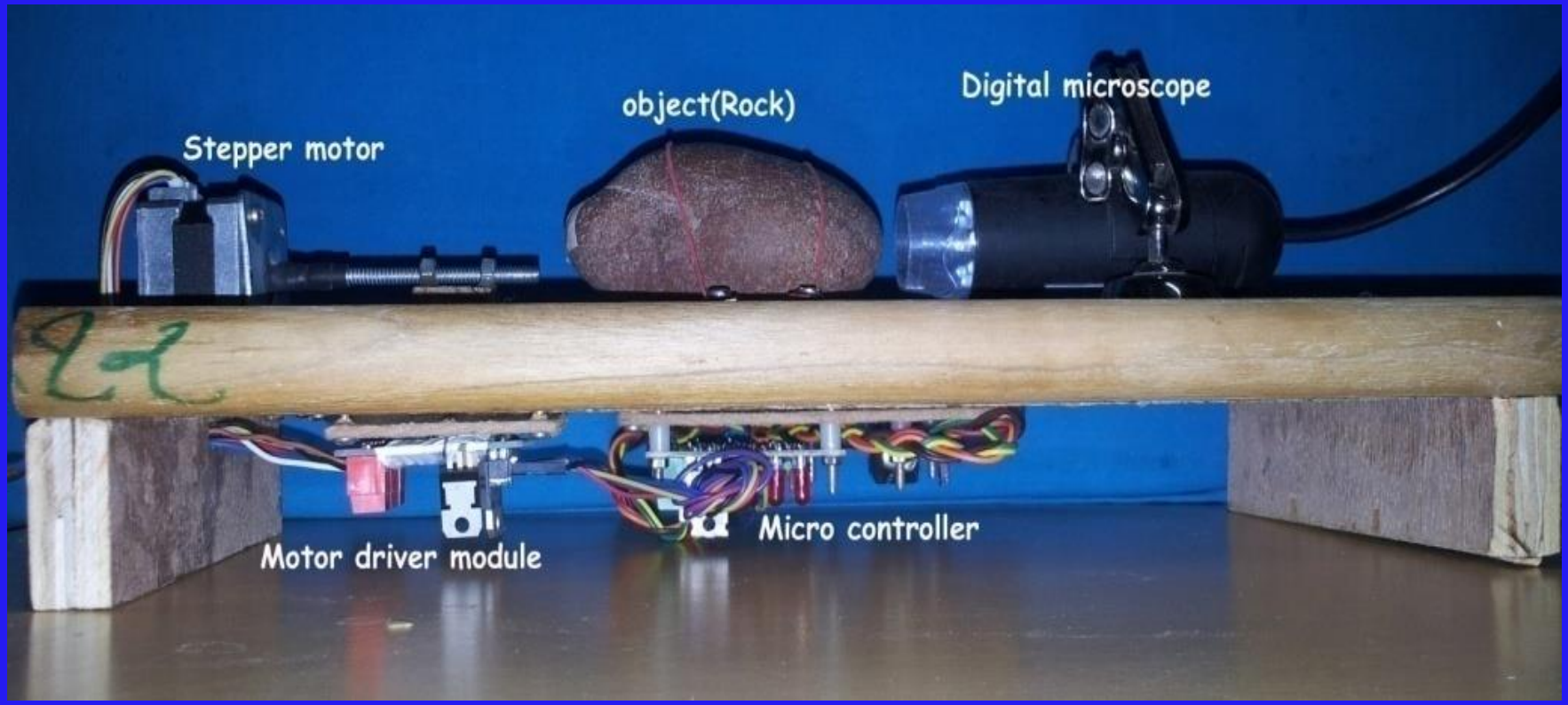


Figure-B shows the side view of experimental setup of figure-A with motor driver module and microcontroller

Schematic Diagram of Proposed system

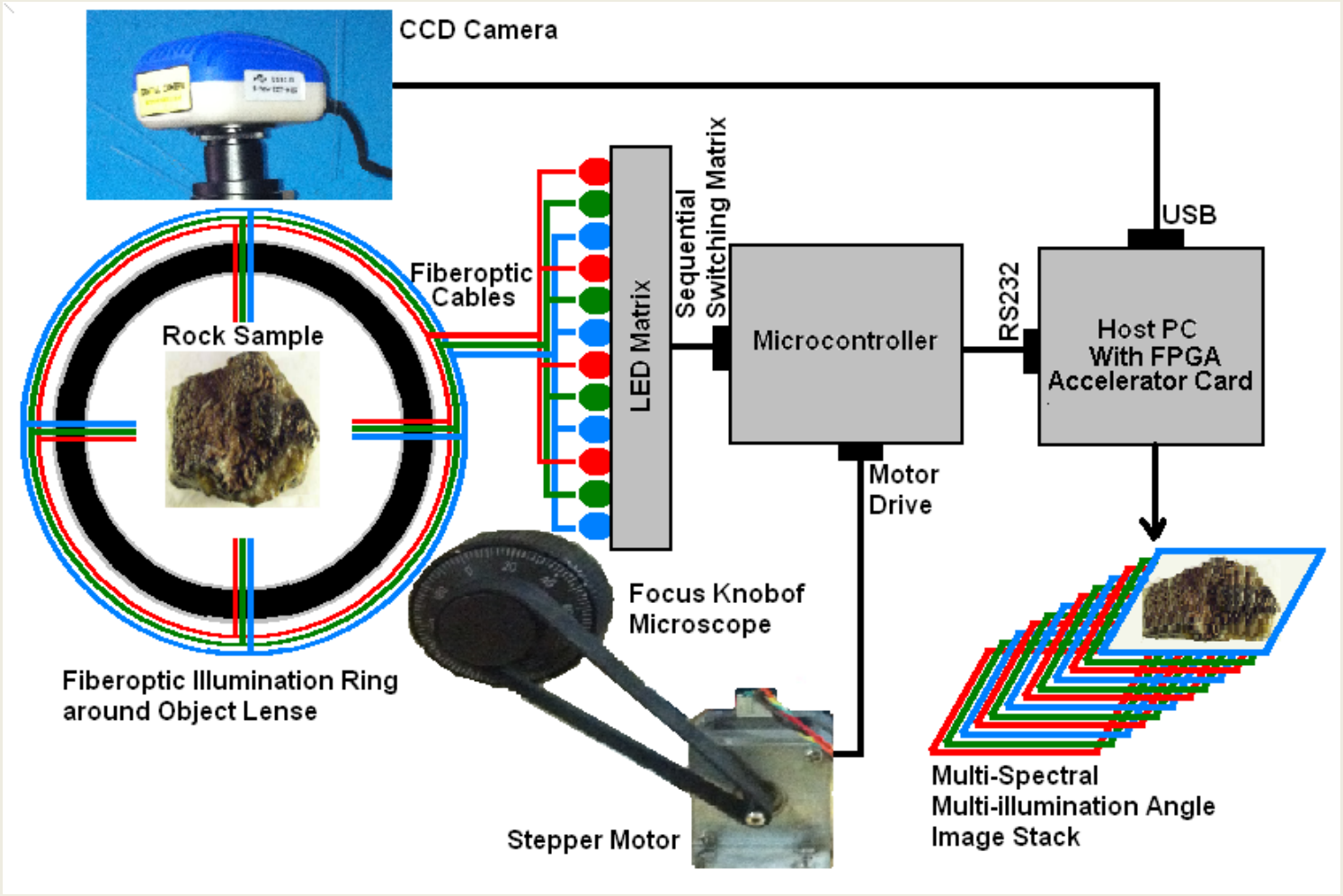


Figure-9 shows the conceptual block diagram of 3D imaging add-ons for standard compound light microscope.

Auto Focusing using Stepper Motor

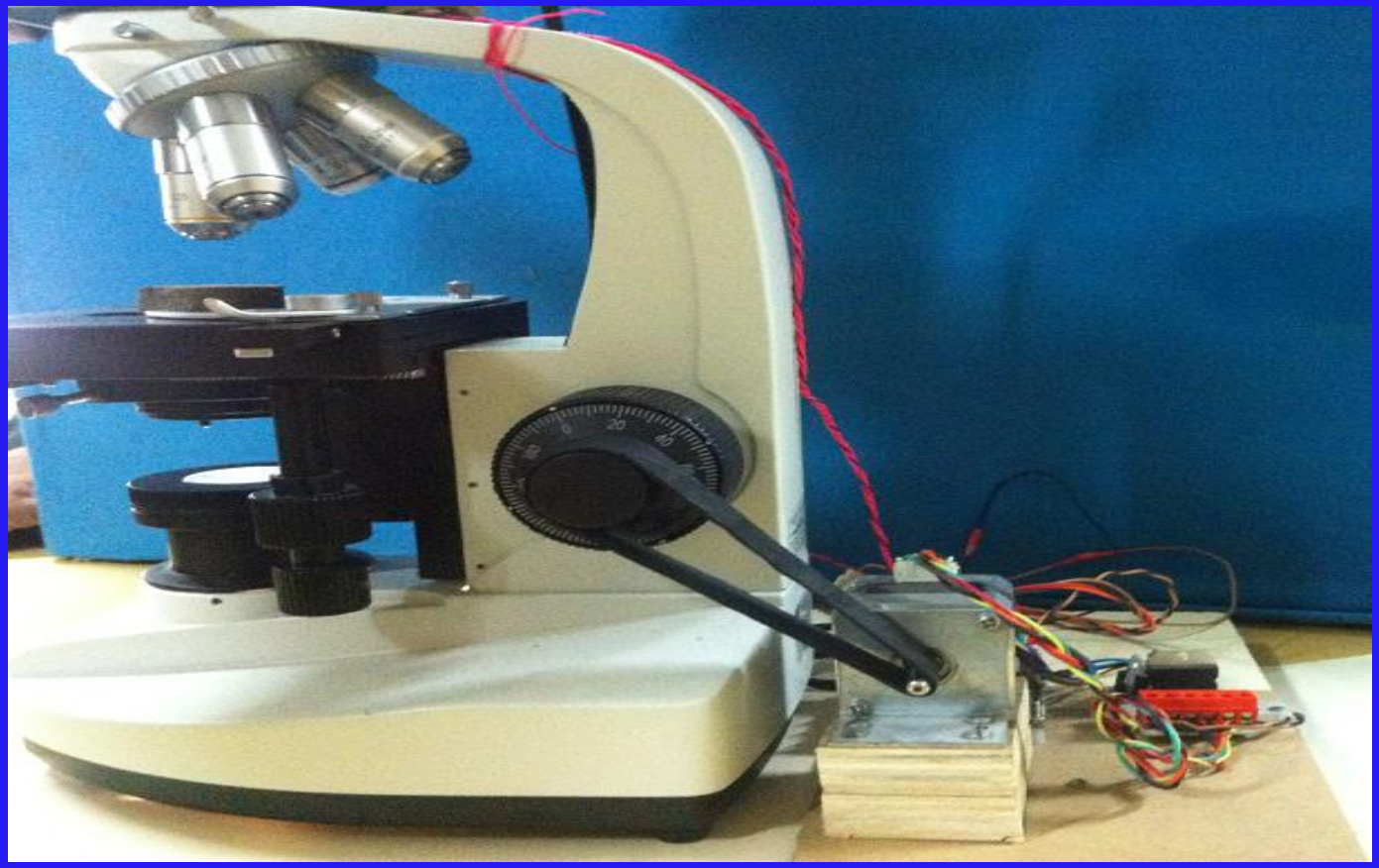


Figure-C Shows proof of concept focus scanning experimental setup with standard compound light microscope. The focus knob is driven using a stepper motor drive interfaced to the host PC.

Block Diagram- proposed algorithm

- It is strongly felt that an affordable microscope system with set of related advanced Image Processing and Pattern Recognition tools for the researchers working on automatic identification and analysis of samples uses microscopic studies will be very useful.

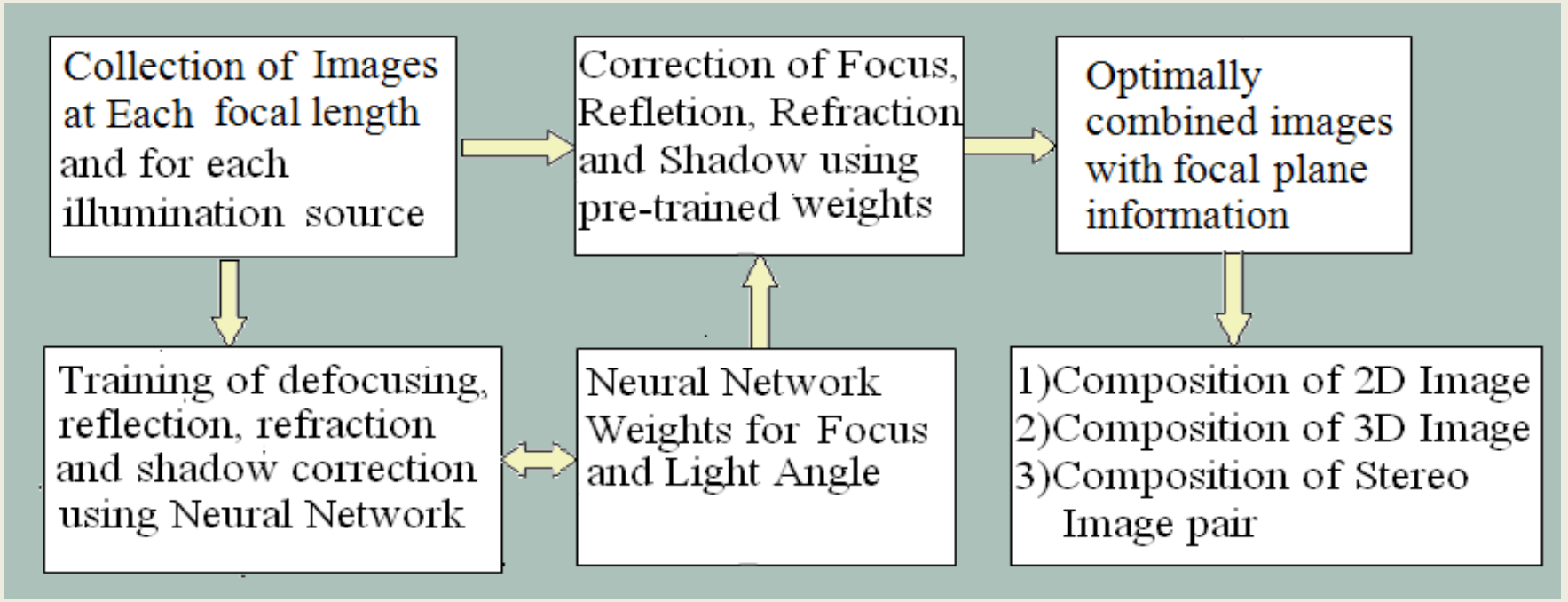
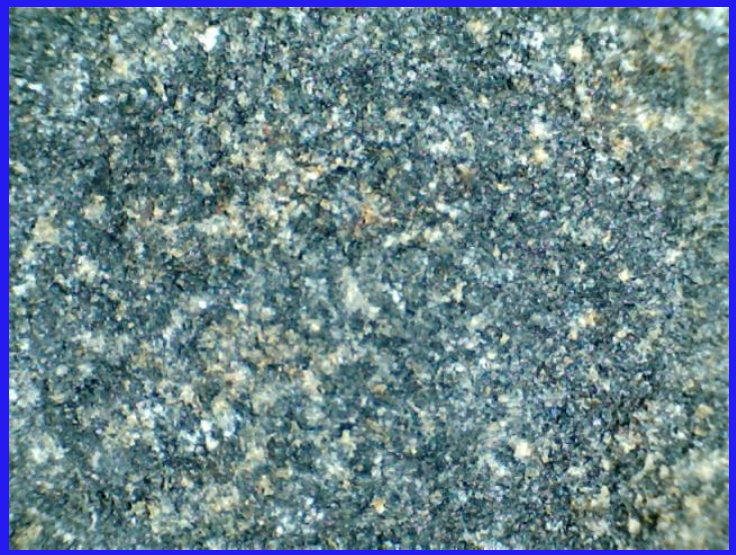


Figure- shows the schematic diagram of the proposed image correction add-ons for standard compound light microscope.

Focused and De-focused image for training NN



(a)



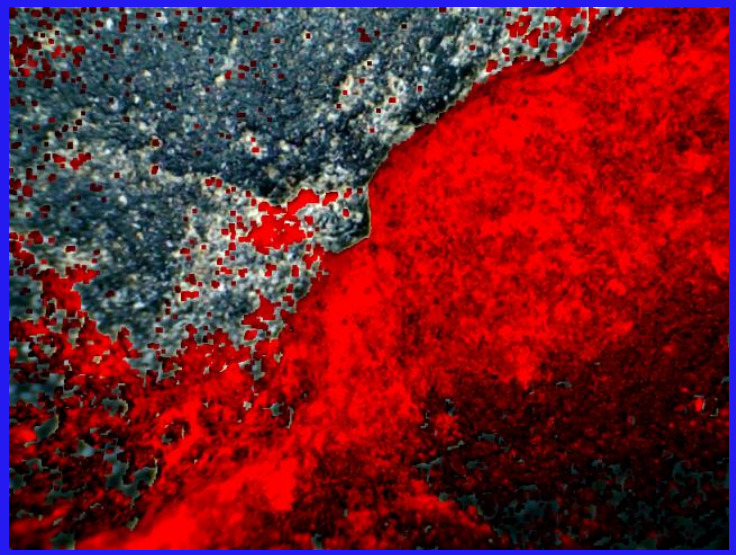
(b)

Figure1(a) shows focused digital microscope image of rock grain and 1(b) shows de-focused image of 1(a) obtained from the setup shown in figure-A. Both images are used for training a Neural Net to distinguish focused from de-focused patches.

Identifying de-focused area



(a)



(b)

Figure-2(a) shows one of the partially focused rock grain image taken using a digital microscope for testing a Neural Net trained using samples of Figure A. Figure-2(b) shows the trained neural net output identifying the defocused patches in red color.

Identifying de-focused area

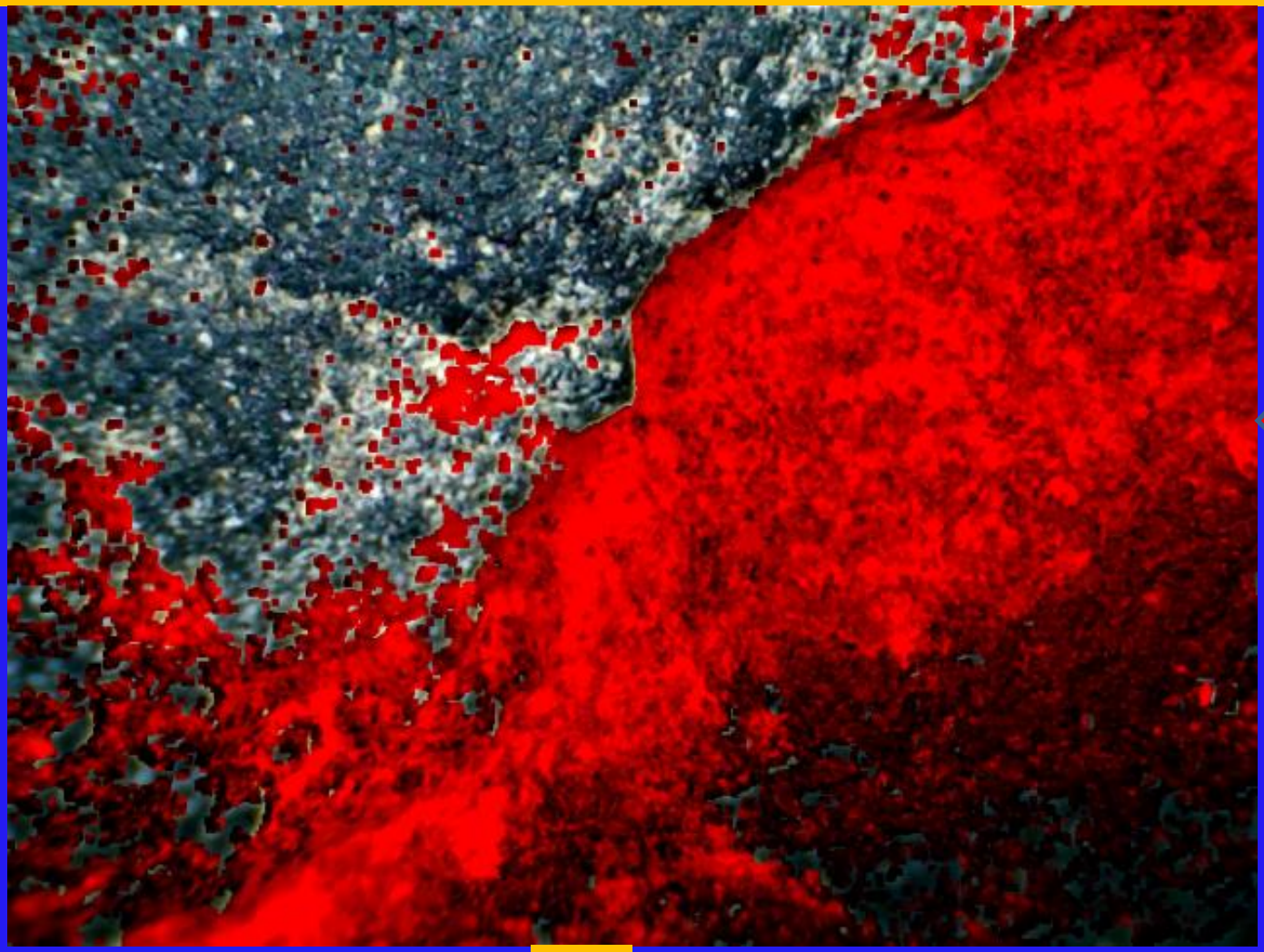


(a)

Figure-2(a) shows one of the partially focused rock grain image taken using a digital microscope for testing a Neural Net

Next

Identifying de-focused area

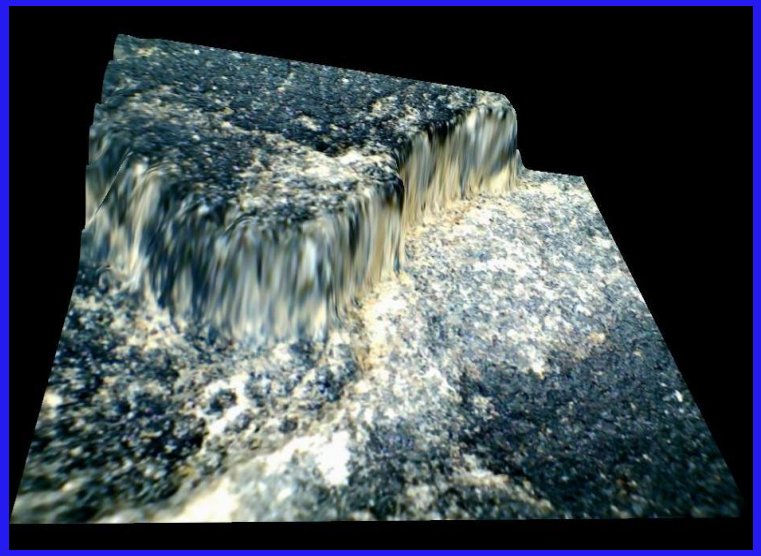


Previous

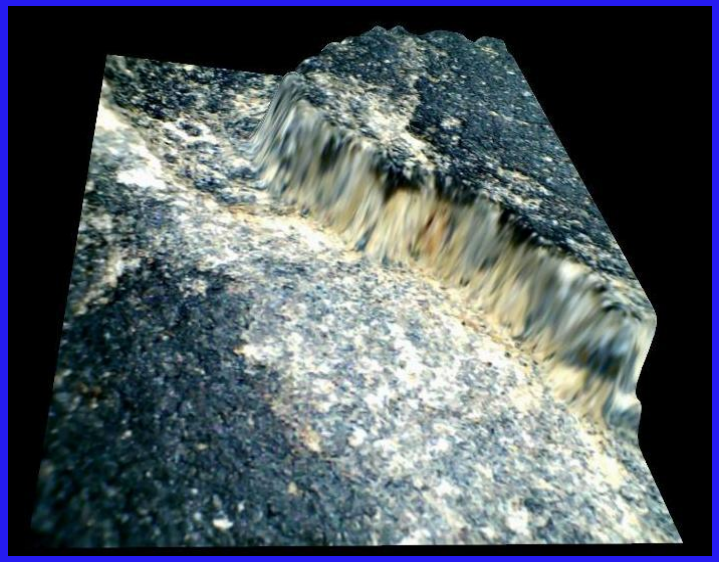
(b)

Figure-2(b) shows the trained neural net output identifying the defocused patches in red color.

3D projection of image stack



(a)



(b)

Figure-3(a) and 3(b) shows the 3D Projection of image shown in previous slide figure2(a) using height information derived from defocused plane.

Application areas

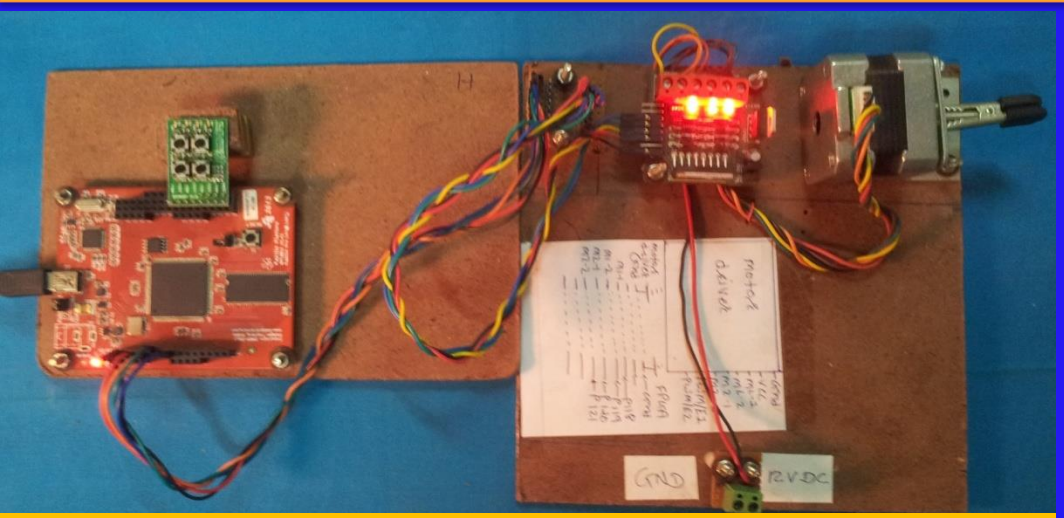
Proposed technology will have application in following areas

- Biological samples
- Handheld microscopy for geological/mineralogical survey
- Metallurgical application for measuring thin films, electroplating coatings, grain size, surface inclusions and defects.
- In-situ analysis of rock sample in space missions
- Surface roughness measurement
- 3D Stereo vision
- Rock identification of oil exploration
- Facilitate Nano- based enhance oil-recovery

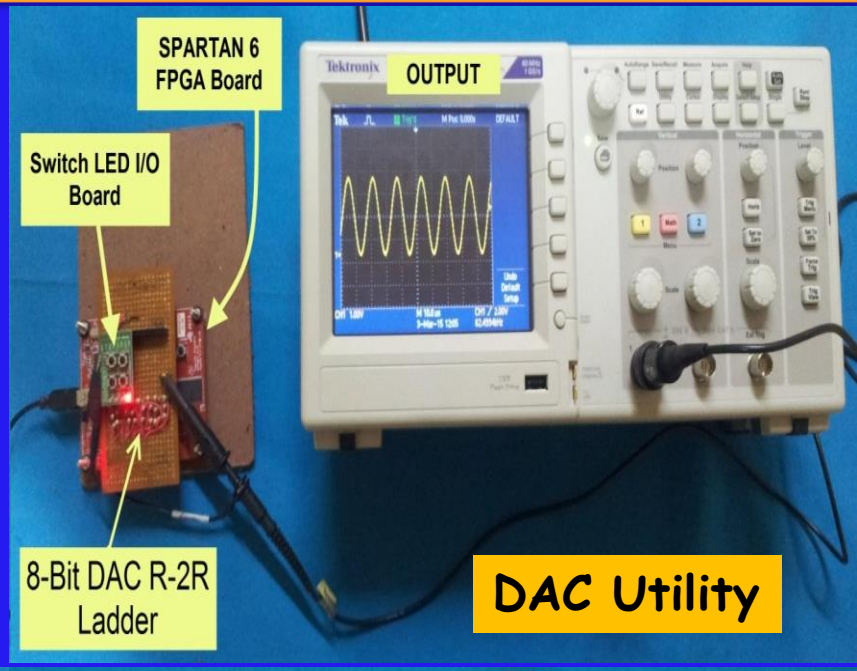
Impact areas in applications

- Observation of opaque object using front illumination by optimizing the effect of reflection, refraction and shadow.
- Observation of thick sample microscopy will increase the quality of imaging with increased throughput.
- Real time 3D stereo viewing will give clarity in structural analysis.
- This technology is low cost and affordable for optical compound microscope to extend the scope of microscope applications and similar technology may be extended to electron microscope and the various types of scanning probe microscope.

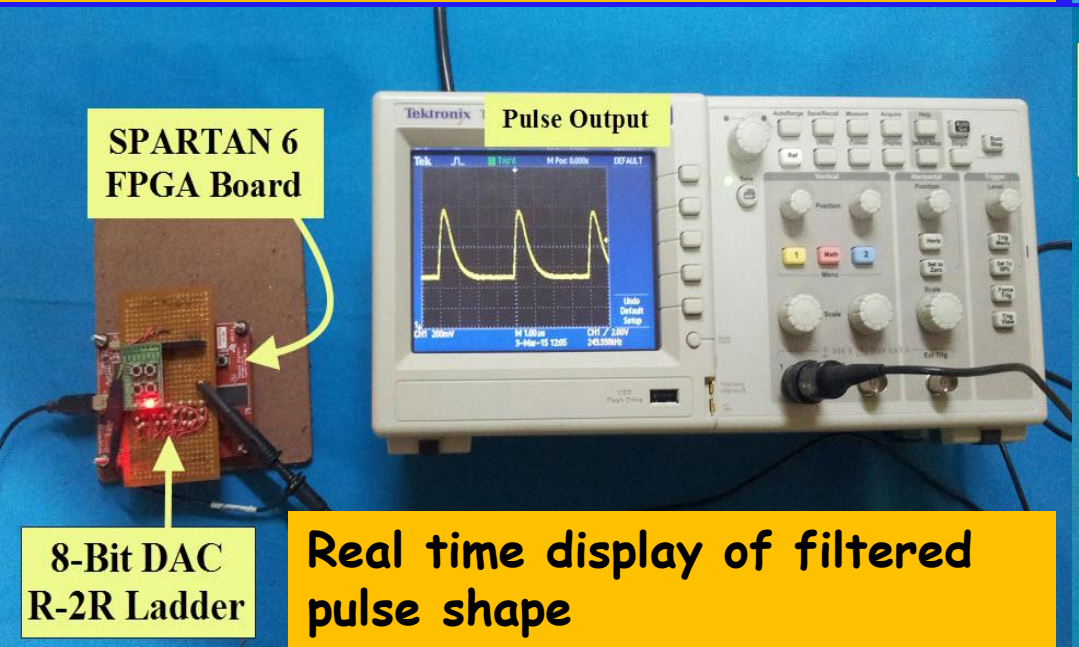
Experiments with FPGA



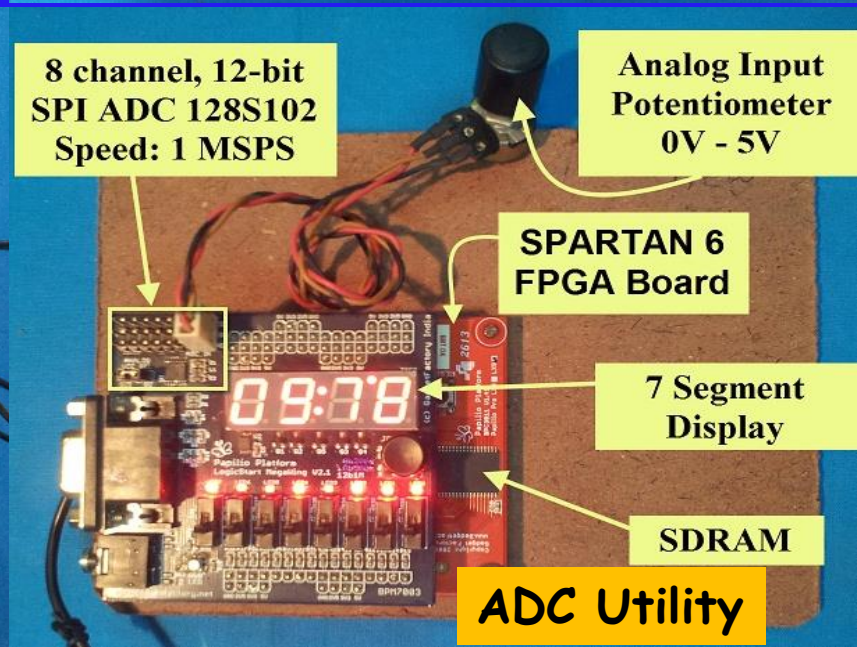
Simple stepper motor interface to SPARTAN6 FPGA



DAC Utility

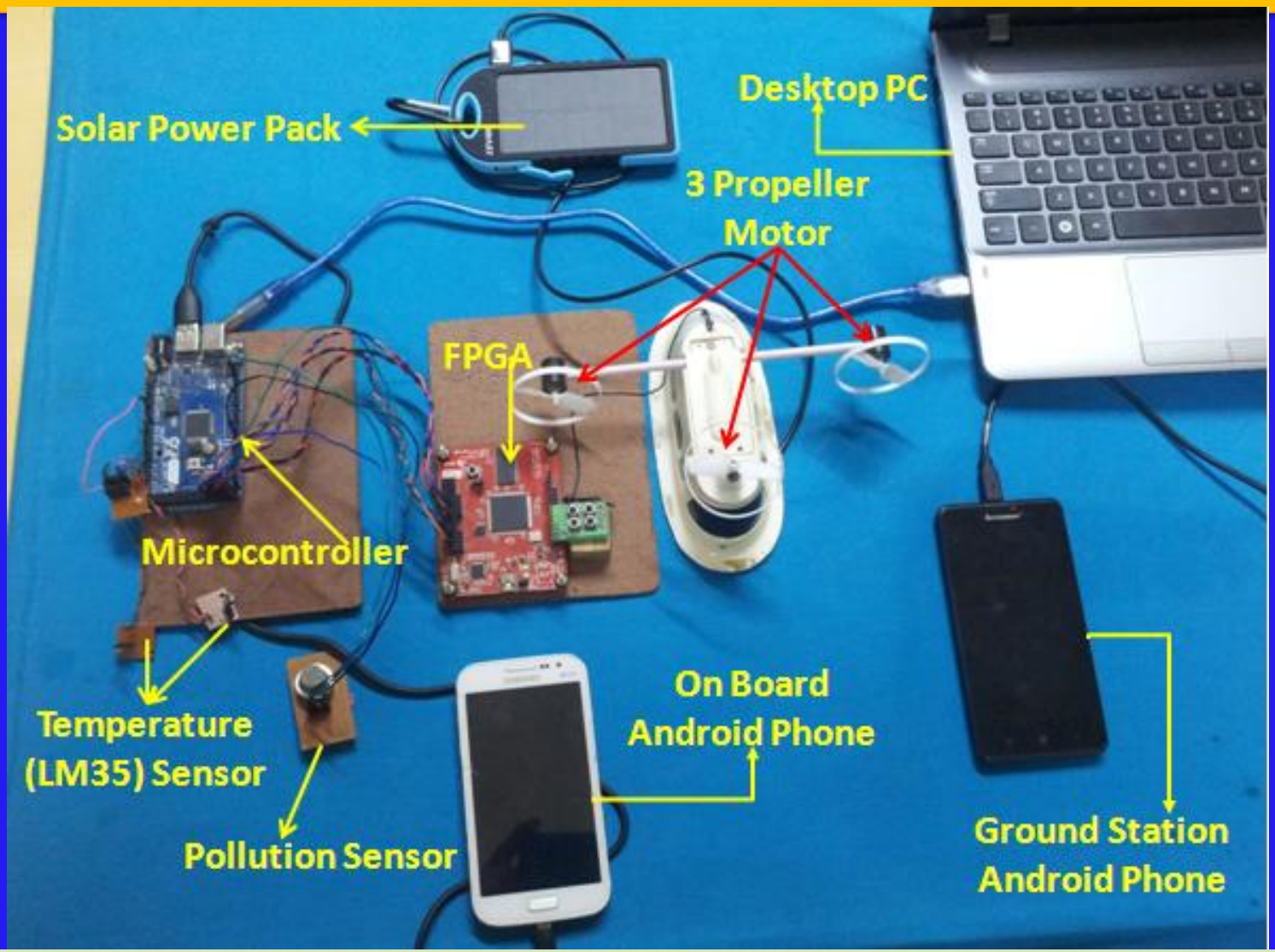


Real time display of filtered pulse shape



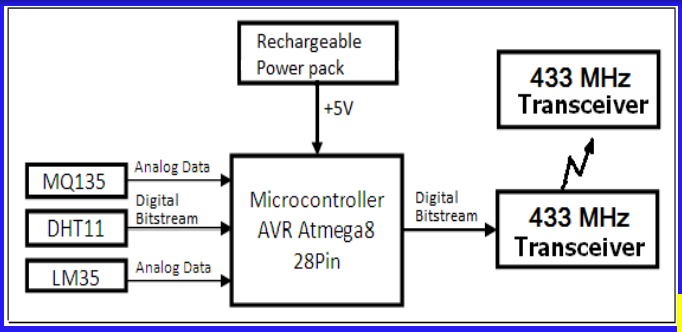
ADC Utility

Balloon Payload Pilot Project



Photograph of different subsystems of DDU balloon payload with Laptop based Ground Monitoring Station. High performance low cost COTS components are used for implementation of payload.

Balloon Payload Pilot Project Contd...

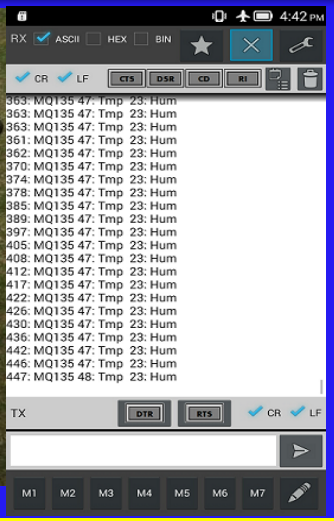




Solar Power Panel







Mobile Ground Station

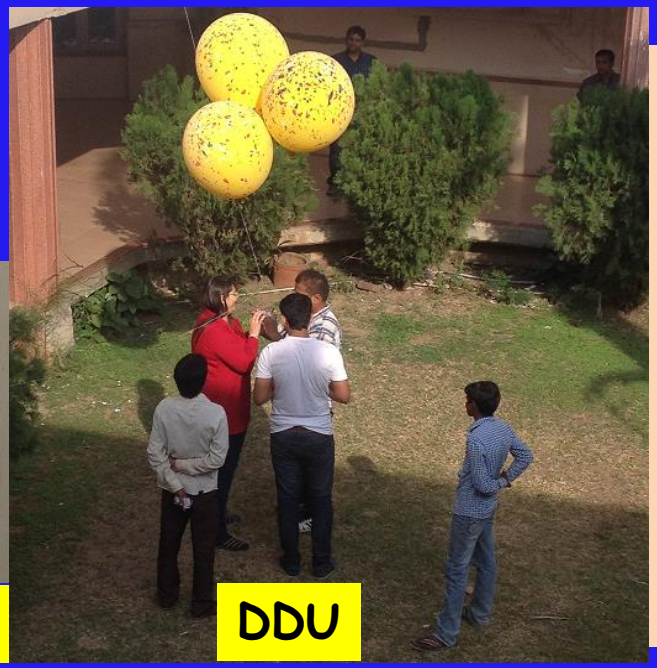


LM35: Temperature
MQ135: Air Quality
DHT11: Humidity + Temp





Balloon Payload

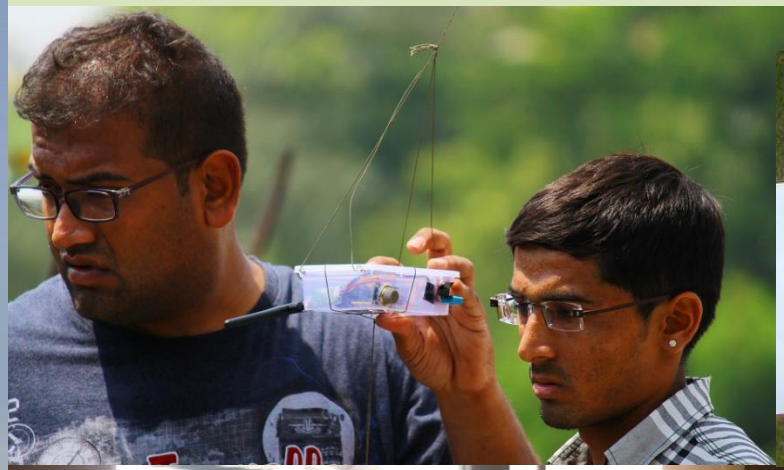


DDU

R&D Center initiated a balloon project as prototype to microsatellite to monitor Pollution, Humidity, Temperature. Experimental balloon flight successfully conducted.



DDU Balloon payload is demonstrated to Registrar and Vice chancellor of D.D.University by PI. On left three hydrogen balloons are carrying the instrumentation payload. The signals are telemetered at 433MHz in vice chancellor's office.







Astro-Material Analysis

Objective

- The grain, color and texture analysis of astro-material is an important method for classification. Objective of this study is to characterize rock samples using above visual properties as a signature of its composition.
- A multi parameter based algorithm to compute rock signature needs to be developed. This may consist of preprocessing using wavelet function and feature extraction using neural network. The model needs to be validated with actual rock samples of different types.
- Basic idea here is to develop a portable instrument to identify any rock object by visual and touch inspection in real time.

Block Diagram

- In original proposal we had proposed to measure five parameters – Color, Texture, Grain, Scratch and Vibration – of rock sample for measurement. First three parameters – Color, Texture and Grain – were successfully measured, analyzed and reported for successful characterization.

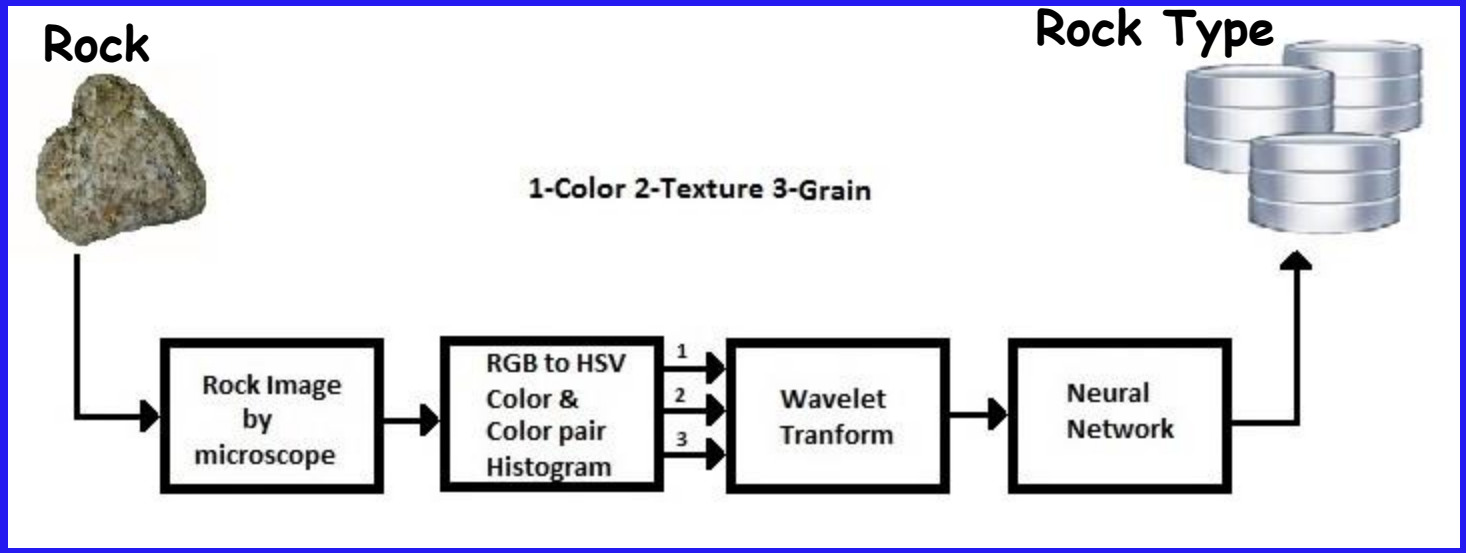


Figure shows the block diagram of the proposed system to measure and analyze color, texture and grain parameter of rock samples

Geological Rock Types

Three major groups of rocks are defined: igneous, Sedimentary, and metamorphic. In geology, a rock is a naturally occurring solid aggregate of one or more minerals or mineraloids. For example, the common rock granite is a combination of the quartz and feldspar minerals.
Some of the geological rock listed below consists rock forming minerals like calcite, quartz, biotite, gypsum, fluorite, magnetite, mica-white and mica-schist.

- Agate
- Basalt
- Calcite
- Corundum
- Limestone
- Dolomite
- Marble
- Diatomite
- Granite
- Quartz
- Biotite
- Gypsum
- Fluorite
- Magnetite
- Bituminous coal
- Mica white
- Mica Schist
- Pegmatite
- Quartzite
- Pumice White
- Sand stone
- Serpentine
- Slate

Details

Mineral Rock and Rock-Grain Images



Twenty five geological mineral rock samples

Corresponding grain images of geological mineral rock samples

Rock Analyzer

(Demo)



Image above shows the tool for identification of rock based on three parameters color, texture and grain.

Smart Handheld Miniature Microscope

- This year we have also ported the algorithm in a handheld miniature microscope based on smart phone.
- The rock image pattern recognition algorithm developed earlier is ported as a java applet to mobile phone. This can be used as handheld rock screening device for in-situ measurement.



(a)



(b)

Figure (a) shows a handheld miniature microscope attached to a smart-phone camera. (b) Shows the test set-up for rock imaging

❖ **Some of the application areas:**

- ✓ Geology
- ✓ Biological
- ✓ Printed circuit boards testing
- ✓ Medical
- ✓ Textile
- ✓ Precision parts
- ✓ Horticulture



(c)

Figure (c) shows a magnified rock image of test setup shown in figure (b).

Crater Simulation Modeling and Analysis

Objective

- The planetary images from public domain database is to be used to **develop the tools** to study formation of the planet surface, and associative history.

- Objective of this study is to develop essential image processing and data analysis tools for planet surface images acquired from planetary missions and to extend this development for public access as anaglyph 3D image browsing website of selected planet surface with crater database.

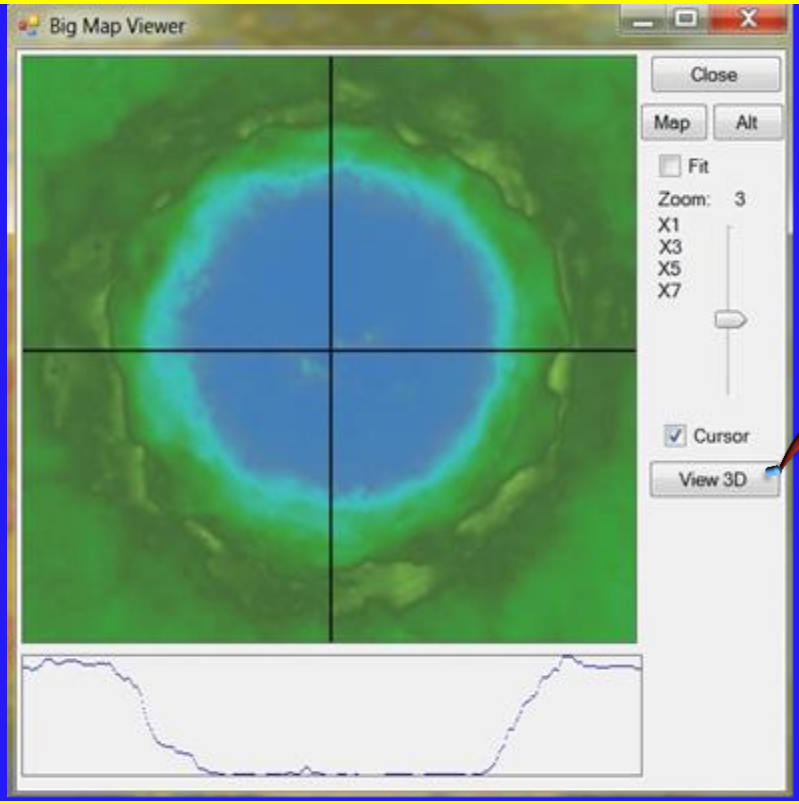
Crater Simulation Modeling and Analysis

- Based on the Image processing algorithms developed last year, this year we developed 3D terrain map of Mars surface using public databases of Mars Global Surveyor's **MOC and MOLA payloads.**
- This will enable researchers to develop the tools to study formation of the planet surface, and associative history. The data extracted from craters can be used to classify and associate with other parameters like location, time of event, mineralogical composition etc. A similar exercise was conducted during STP-2013 workshop to map lunar craters with ejecta.

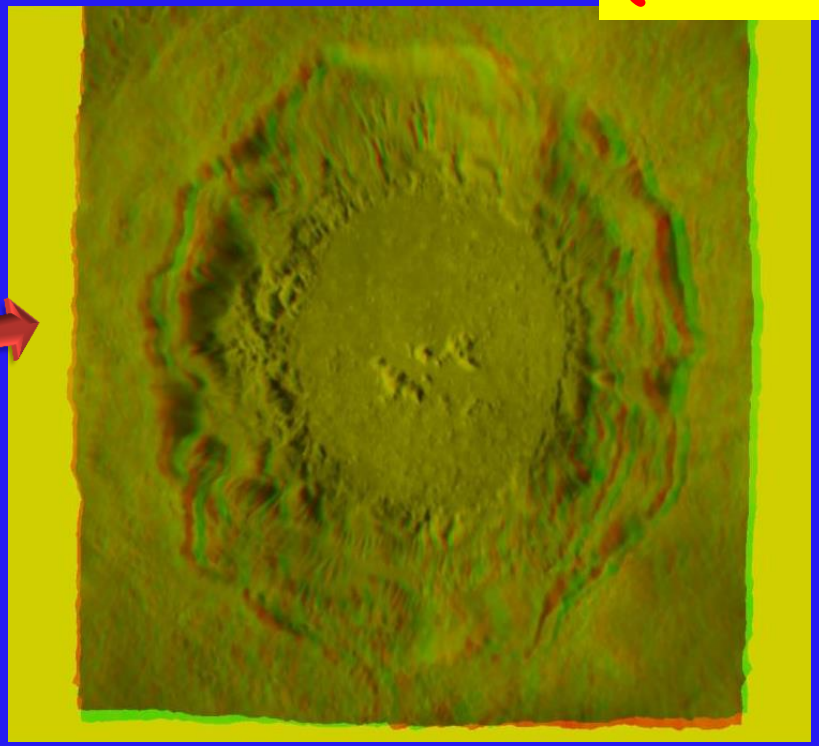
Development of Stereoscopic Viewer Application for Lunar Surface

- The 3D viewing **anaglyph** is constructed using two images with an adequate look-angle, displayed in two colors (red and blue, or cyan).
- As long as the stereo separation is within limit of human viewing angle, the brain can perceive depth in the image.
- Anaglyph provides a valuable tool for visualizing the morphology of the lunar surface.

(Demo)



Zoom view of crater and crater cross section



A composite anaglyph 3D image of the selected crater

Neural Net Based Lunar Crater Classification feature (Demo)

- A **neural net based application** is developed for lunar crater feature extraction and database creation for crater type classification.
- An algorithm is developed to extract six different parameters from selected craters as shown in figure . These parameters are used for training the classification algorithm of the selected craters.
- The extracted crater parameters are **diameter, depth, roundness, center peak, rim height and rim width**.

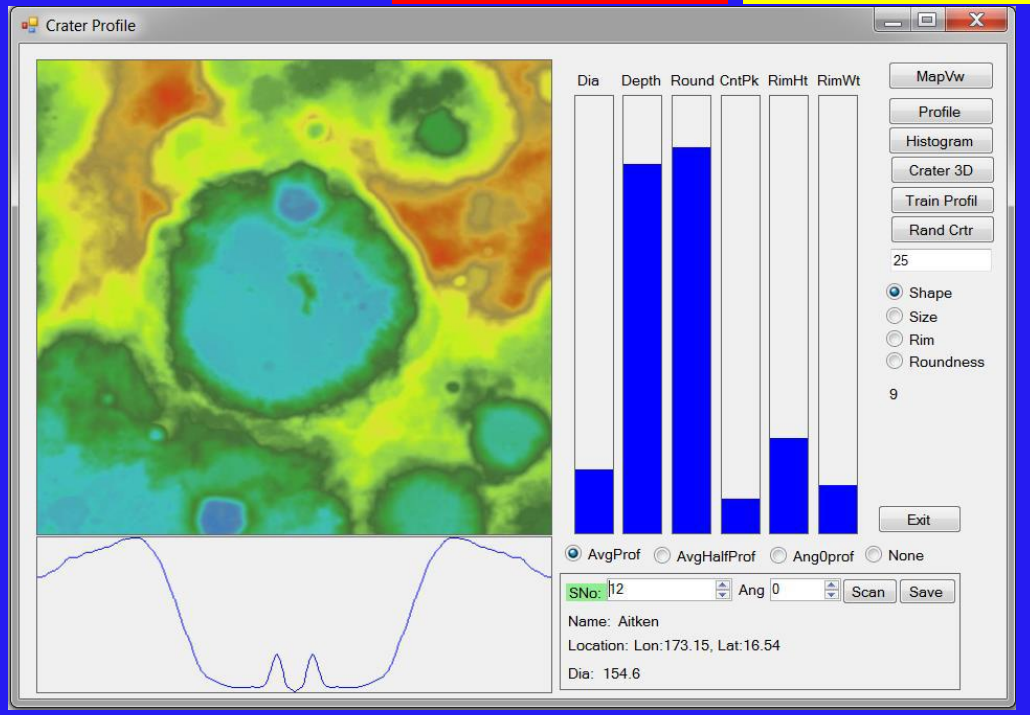


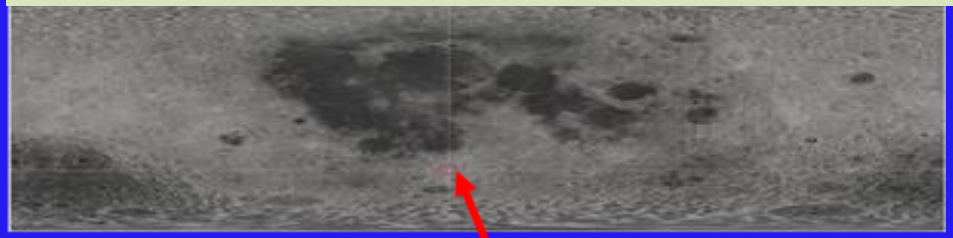
Figure shows Crater Profile for neural net based Crater Classification Application

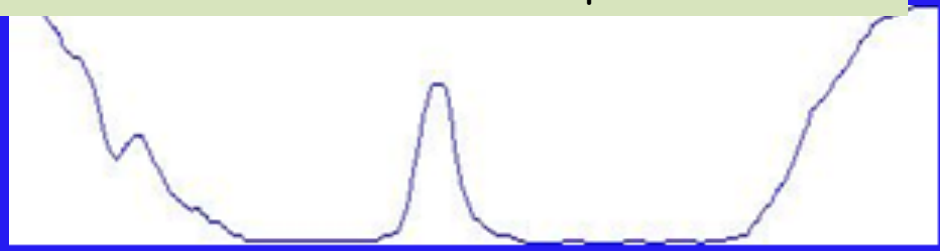
The application contains **map view, altitude view, cross-section, histogram, crater 3D, training for classification and browsing normal, random, classified modes.**

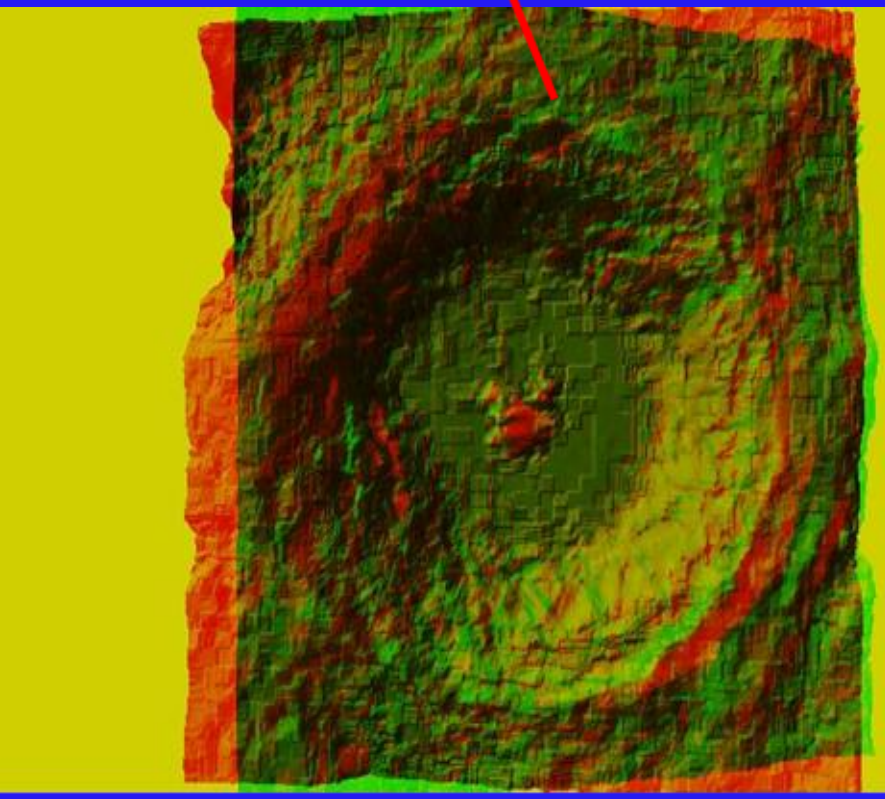
Crater Viewer

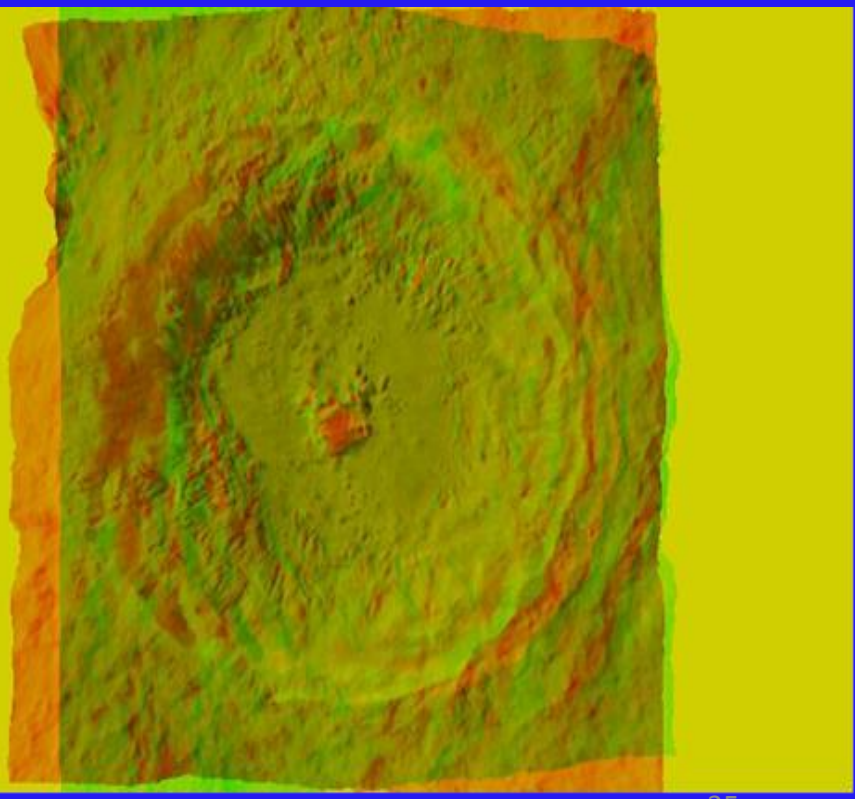
Name	Lat.	Long.	Dia.
Tycho	43.4S	11.1W	102

Crater vertical cross section profile









Neural Net Based Lunar Crater Classification

Following display functionalities are developed-

Screen Shot

- Classify using shape, size, rim and roundness.
- Shows the crater with crater parameters like diameter, depth, roundness, center pick, rim height, rim width as bar graphs.
- Display the crater cross section view.
- Profile control is used to display selected type of crater profile at any angle.
- Histogram control is used to calculate histogram for altitude color coded image for analysis.
- Crater 3D control displays the stereo 3D of selected crater in separate window.
- Train Profile control is used to start the Neural Network training for crater classification.
- Different types of profile like average profile, average half profile and angle profile can be selected using the respective radio control selection.
- Scan control is used to get continues scan of all craters.
- Craters are **classified into groups based on similar parameters using self organizing map**, this is performed using Kohonen`s Neural Network **with different crater parameters like shape, size, rim, and roundness as input**.

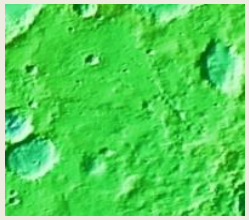
Creation of Mars surface and elevation database

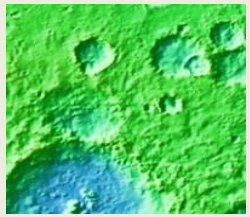
Surface and elevation map data of planet mars is downloaded from following open source websites.

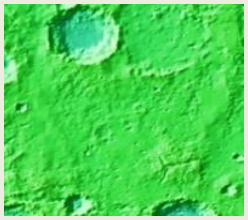
- Mars Altitude Data source:
  URL:http://www.mars.asu.edu/data/mola_color/
  Number of images: 72
  Resolution: 7680 x 7680
- Mars Map Data source:
  URL: http://www.celestiamotherlode.net/catalog/mars.php
  Number of images: 2048
  Resolution: 512 x 512
- Elevation and surface maps are processed to optimum resolution using interpolation algorithm to match existing data structure. The interpolated elevation and surface maps are tiled of size 512x512 in 8192 segments

Creation of Mars surface and elevation database

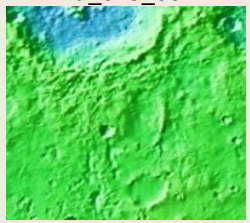
8192 segments of 512x512 size

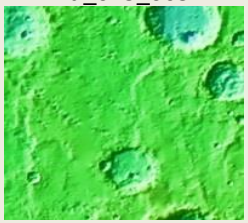

Alti_025_061


Alti_025_062


Alti_025_063

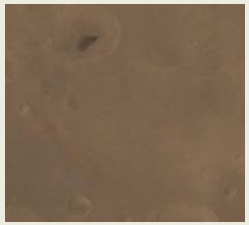

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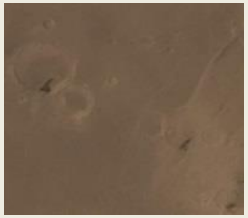

Alti_026_062


Alti_026_063

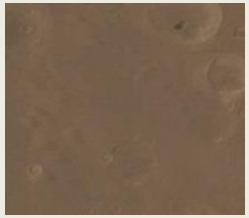

Map_025_061


Map_025_062


Map_025_063

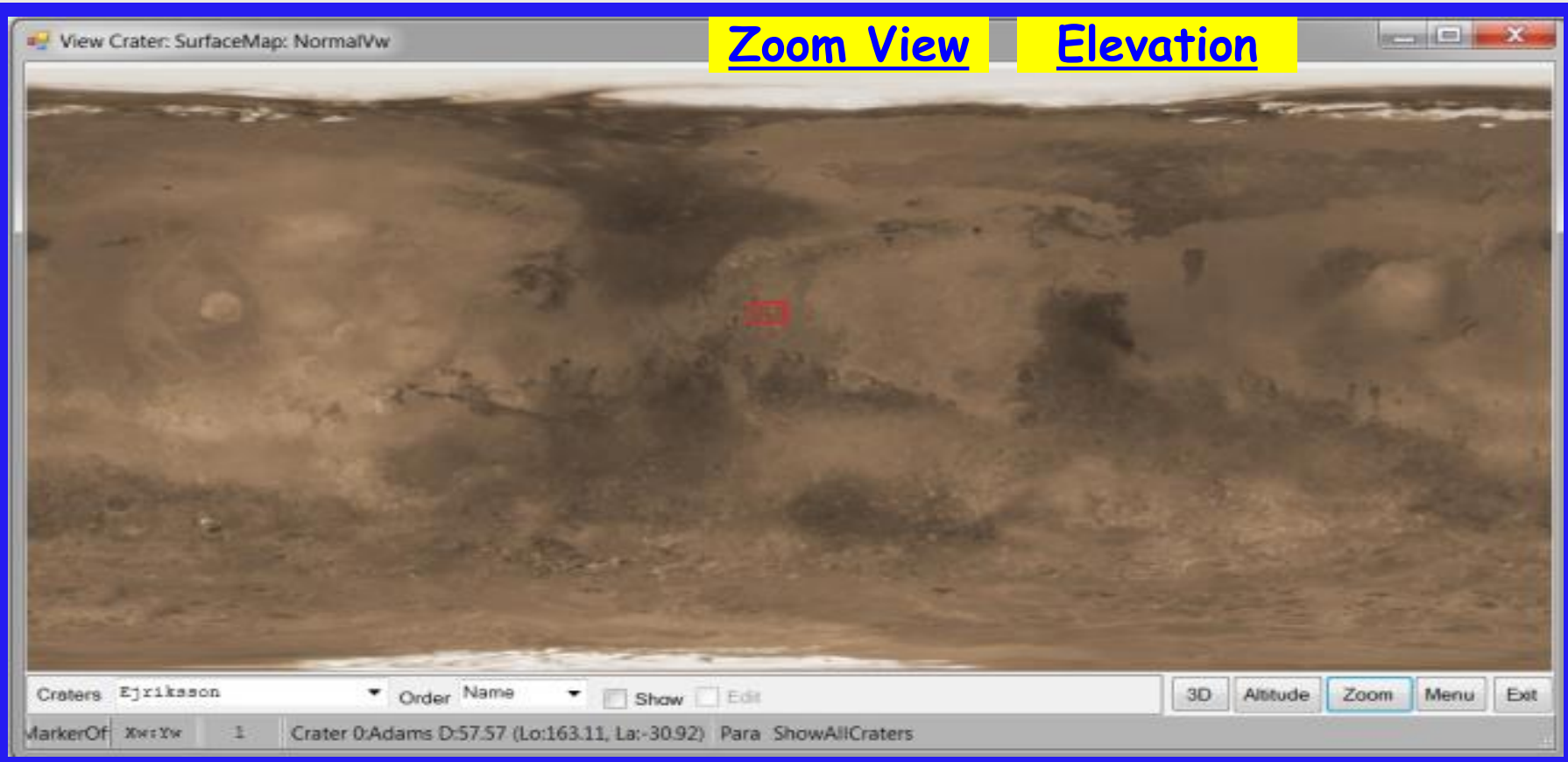

Map_026_061


Map_026_062


Map_026_063

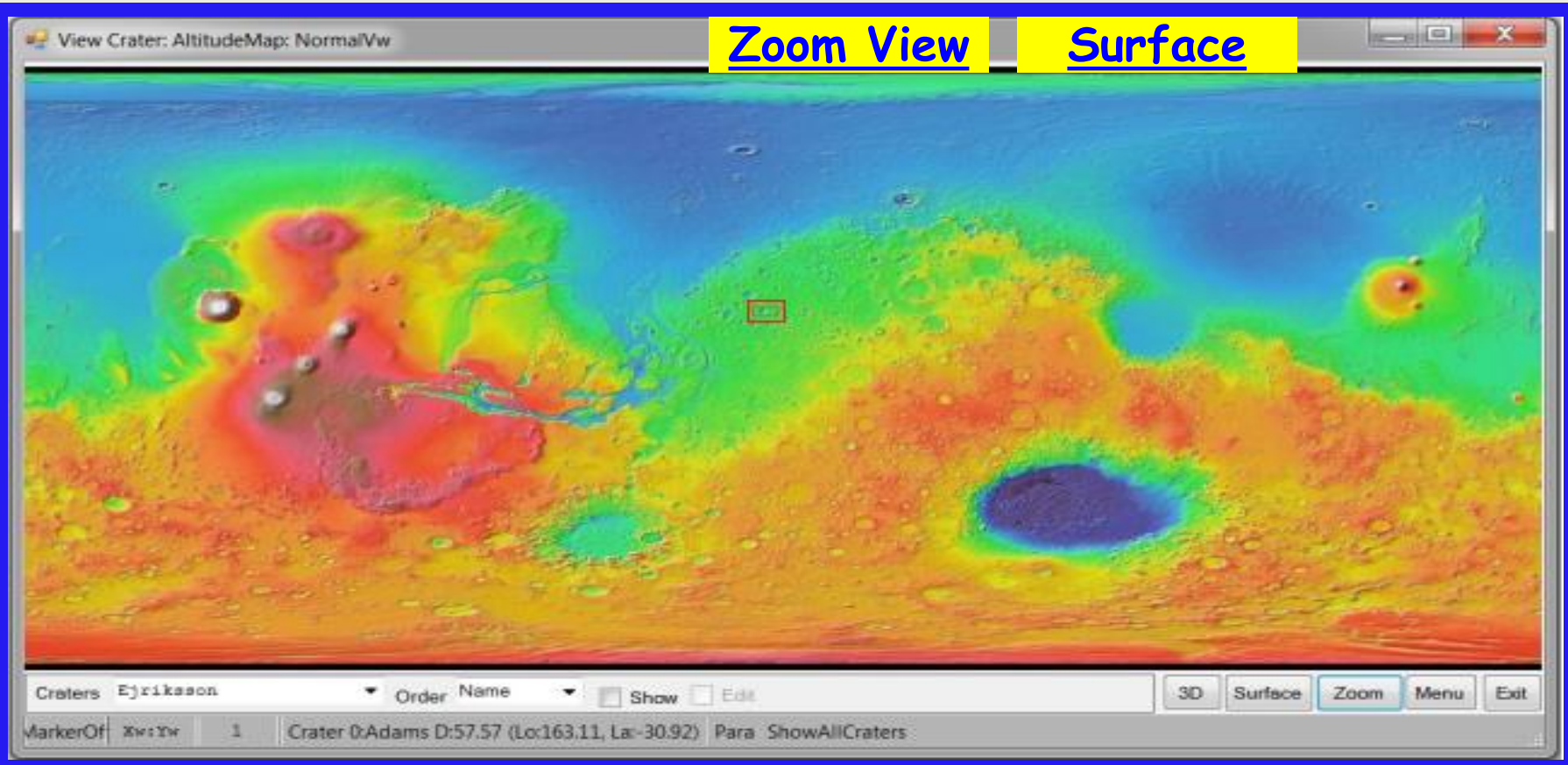
Mars 3D Terrain Browser Using Surface and Elevation Map

- The tool developed last year for lunar surface browsing and analysis is **upgraded to accommodate multiple planet viewing capabilities with improved 3D viewing features**
- **The red mark shown in figure represents an interactively selected area of study**



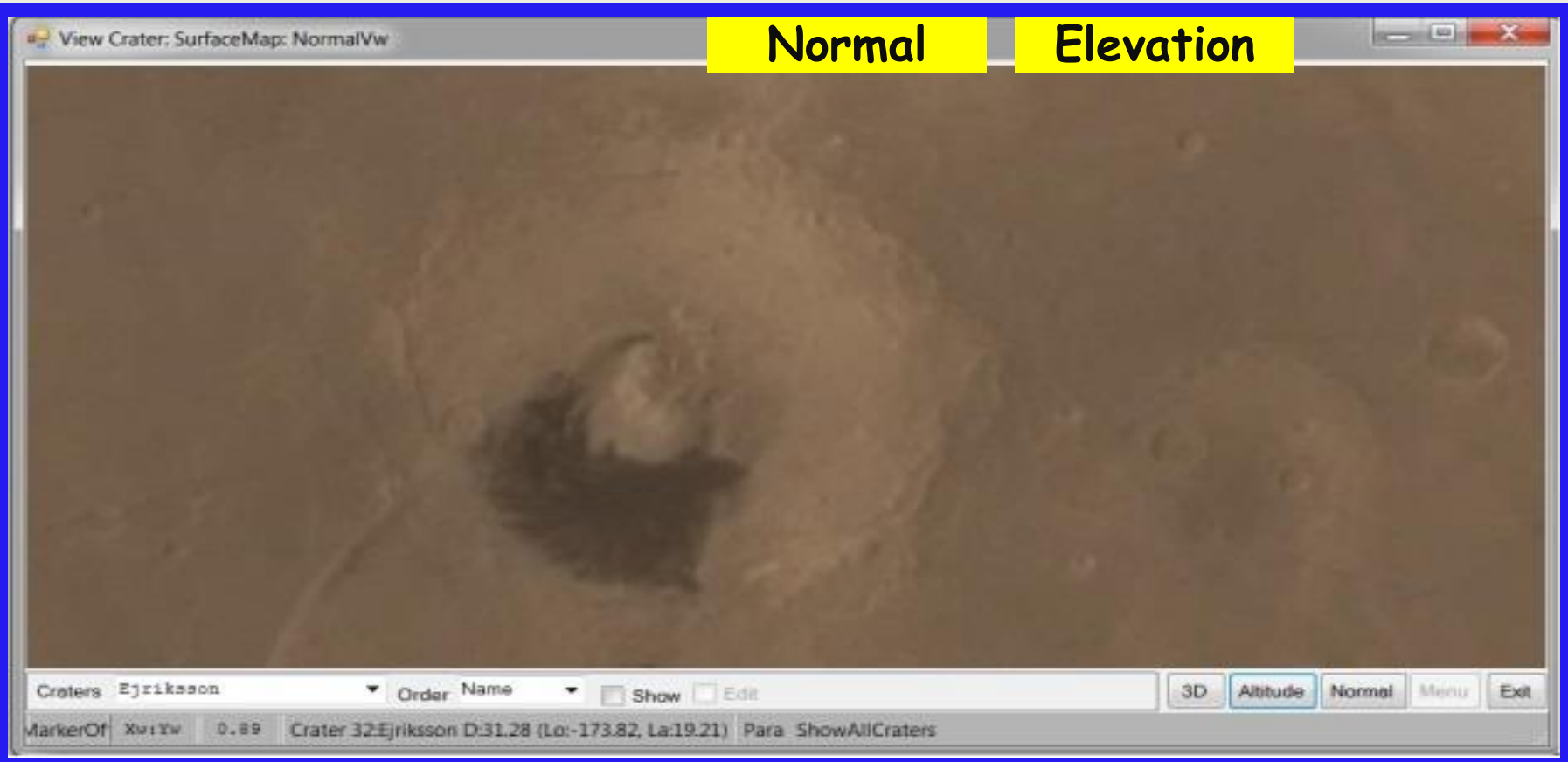
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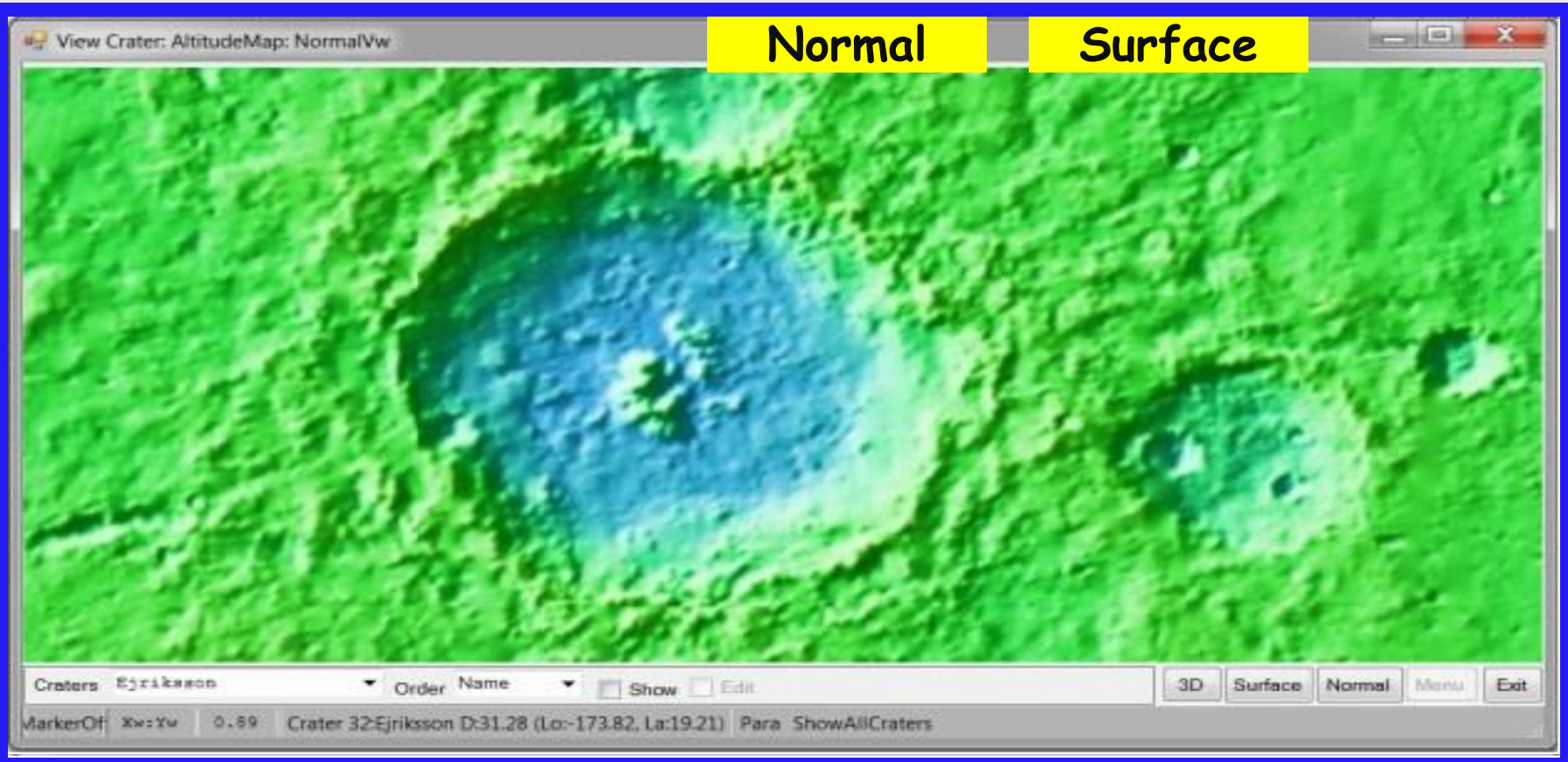
Mars 3D Terrain Browser Using Surface and Elevation Map

- The selected areas are brown up in figure as shown below of a Martian impact crater`s surface map. These magnified maps can be used with pan and zoom controls to continuously navigate on entire surface using user friendly operations.



Mars 3D Terrain Browser Using Surface and Elevation Map

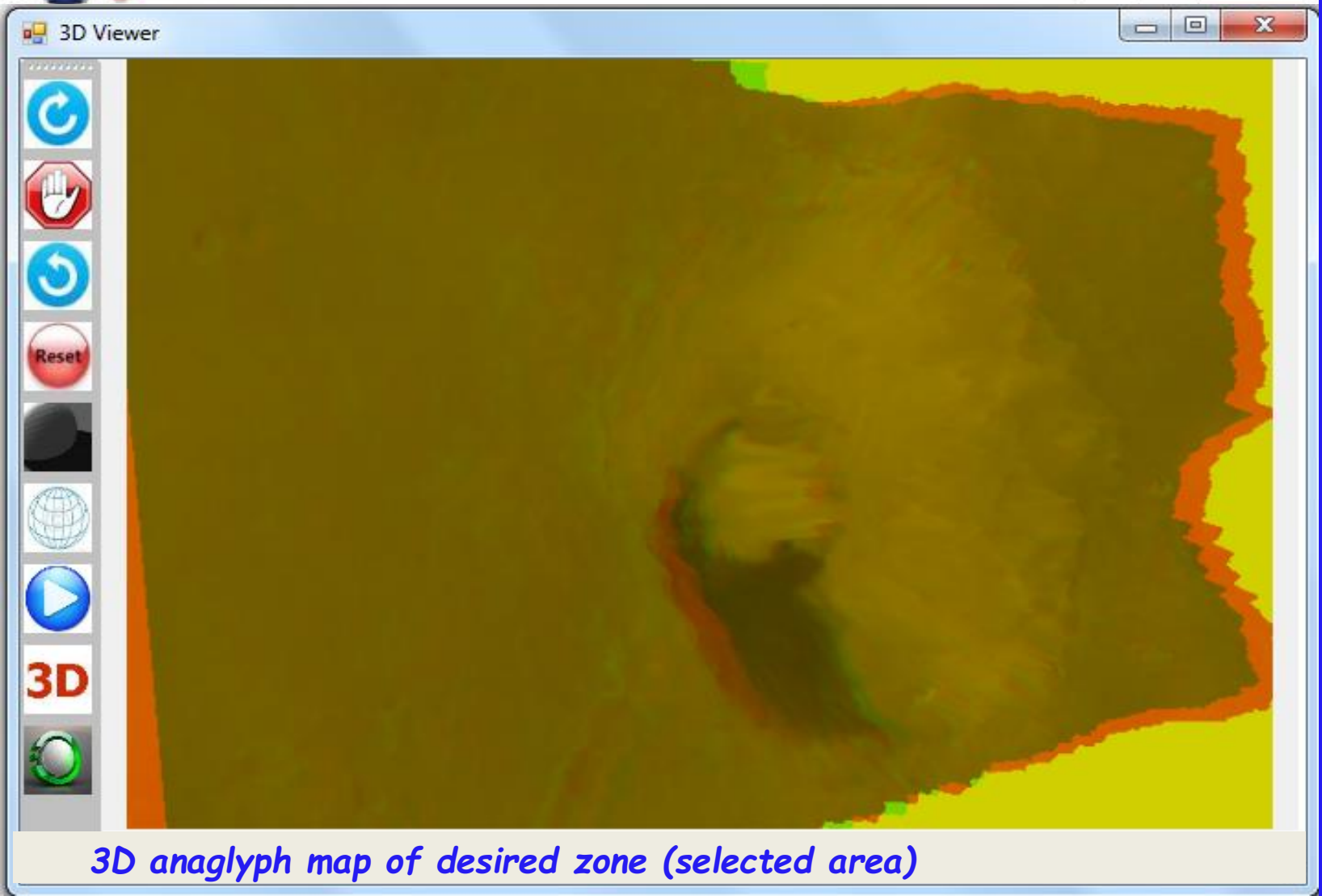
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Mars 3D Terrain Browser Using Surface and Elevation Map

(Demo)





3D anaglyph map of desired zone (selected area)

features

The zoom view of previous figure could be further processed using Microsoft DirectX technology for high speed 3D viewing capability as shown in the screenshots of figure

Mars 3D Terrain Browser Using Surface and Elevation Map

Functional description of this 3D viewer application is given below

Screen Shot

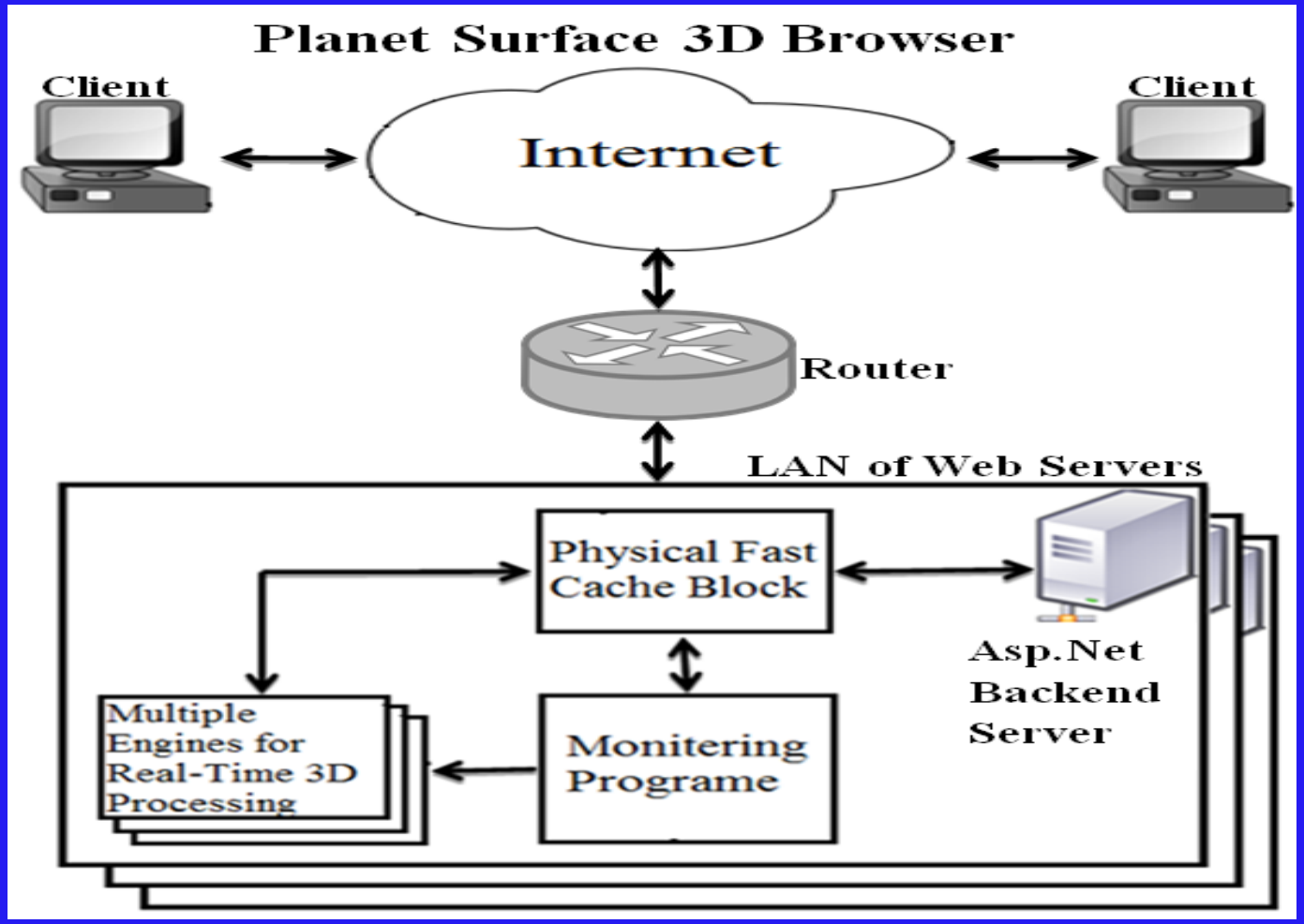
- Manual and automatic rotation in clockwise and anti-clockwise direction of 3D projection of selected surface.
- Multi-mode viewing capability of 3D projection of selected area. These modes are **wireframe, planet surface texture with artificial shadow to improve contrast and super impositions of two perspective view corresponding to left and right eye** .
- Interactive browsing using mouse drag operation in any direction for single step of continues mode of scrolling.
- Viewing of 3D stereo anaglyph of projected surface, is possible using a red blue viewing glass.

Lunar surface Web Browser

Objective

- The planetary images from public domain database is to be used to develop the tools to study formation of the planet surface, and associative history.
- One of the objectives of this project is to document and study the entire lunar surface. Study will need development using advance image processing algorithms and tools to identify and extract crater details.
- Other objective of the web based lunar surface is it is openly available on internet and any end user is able to render or analyze the selected surface of the planet.

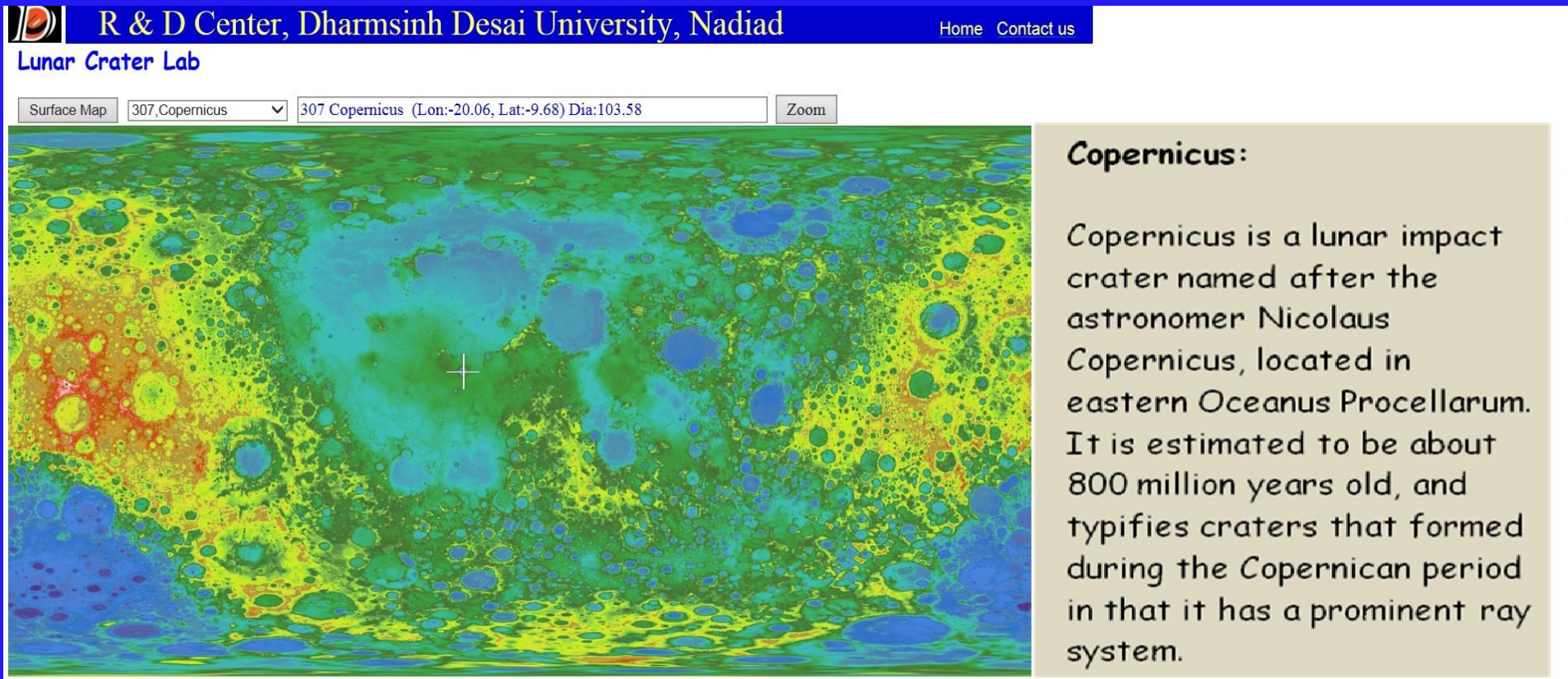
Lunar surface Web Browser



An **innovative parallel architecture** is used to display planet surface 3D anaglyph with **light client architecture** as shown in block diagram of figure

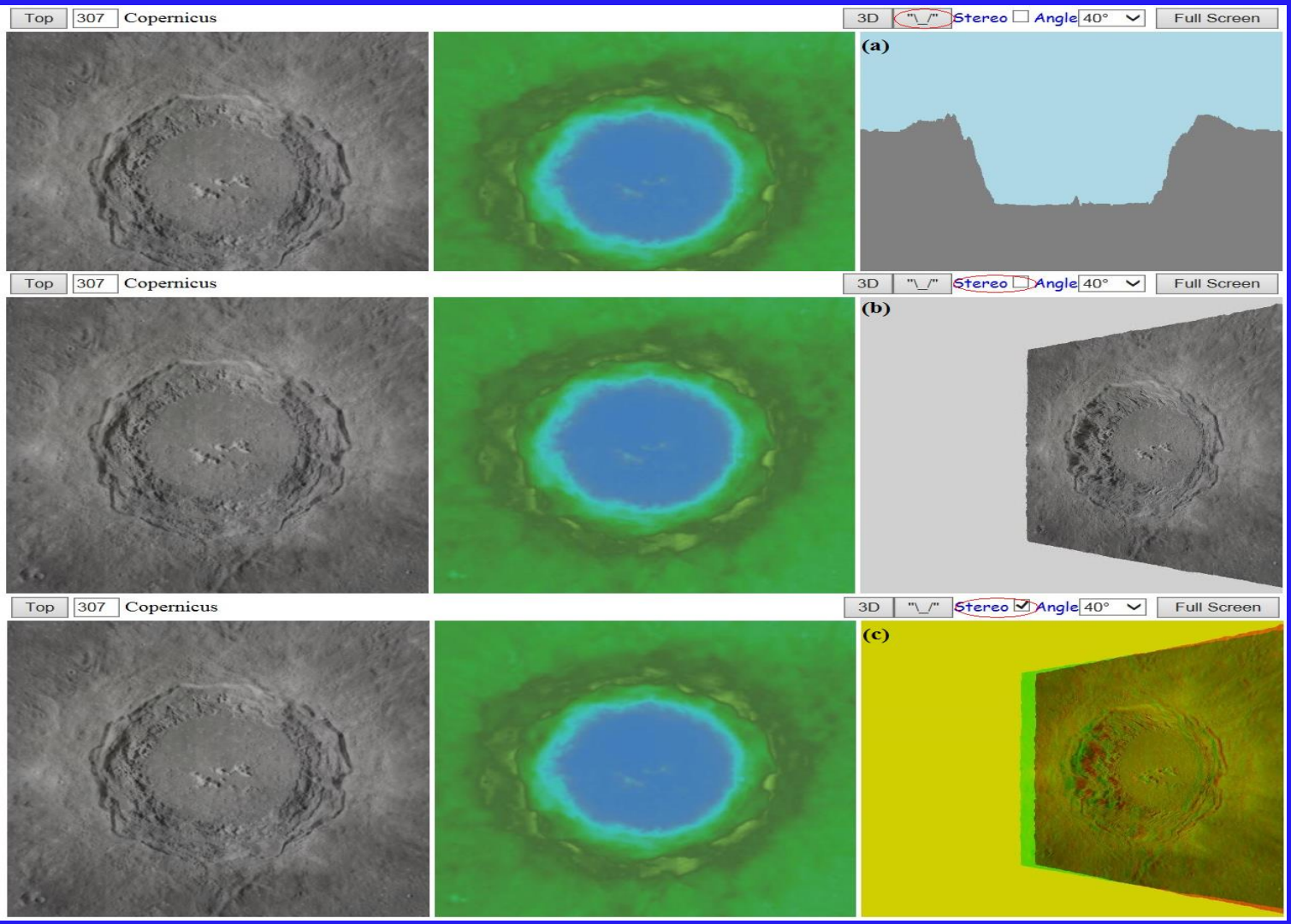
Planetary optical remote sensing data from public domain database is used in this application to create a 3D anaglyph terrain display website for study and research of formation of planet / lunar surface

Lunar surface Web Browser



The website **provides each known crater's short information** as shown in figure. Figure shows the lunar browser with Copernicus crater details like Longitude, Latitude and Description

Lunar surface Web Browser



"Copernicus" crater`s surface map and altitude map along with its

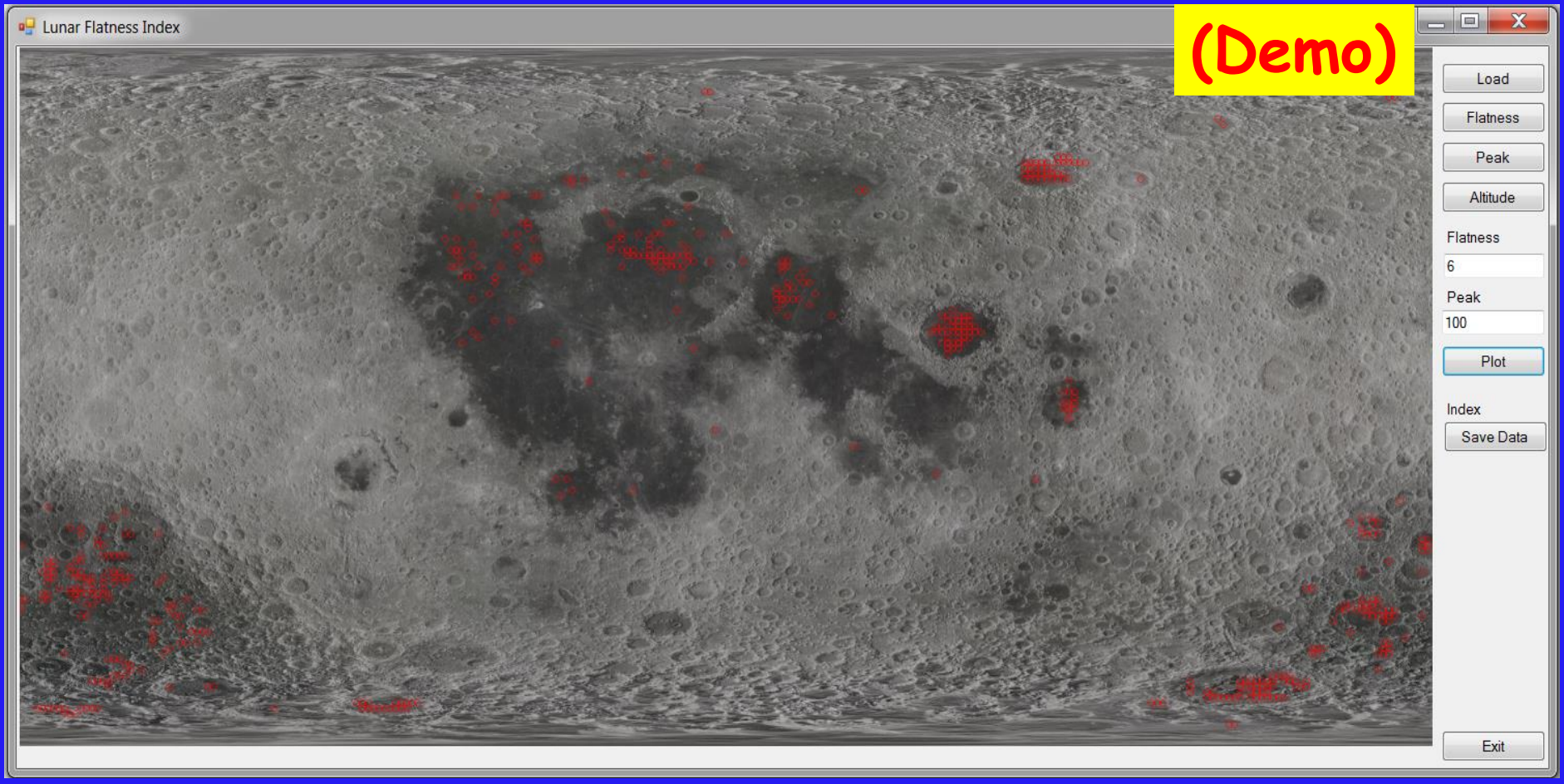
(a) cross section view,

(b) 3D projection view and

(c) 3D stereoscopic view.

The website provides three different views of selected impact crater as shown in figure, figure is of "Copernicus" lunar crater (Lat:-9.7N, Lon:-20.06W

Automatic Lunar Landing site Identification (STP-2013)



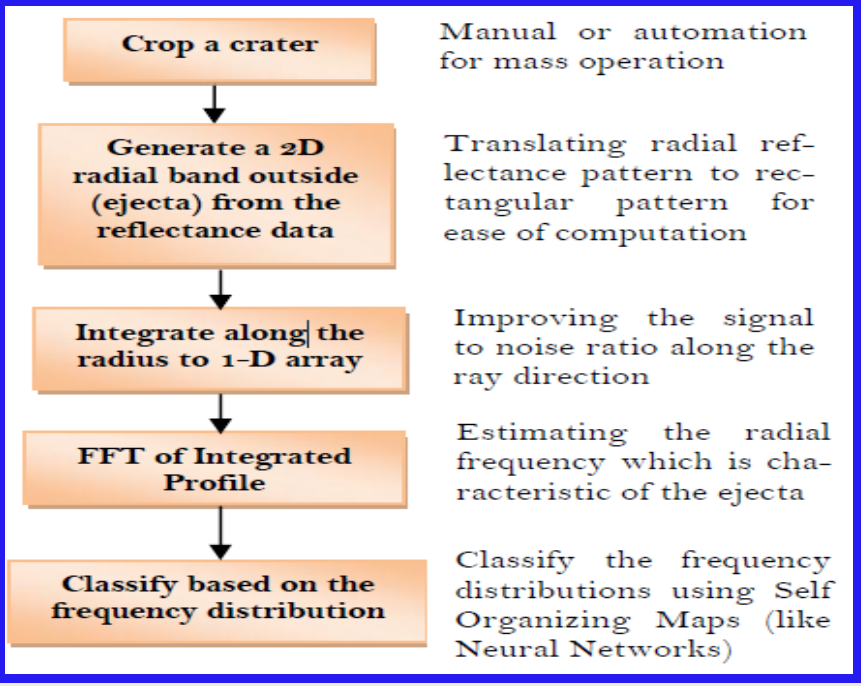
Some of the specifications are: (STP Project but Integrated in main package)

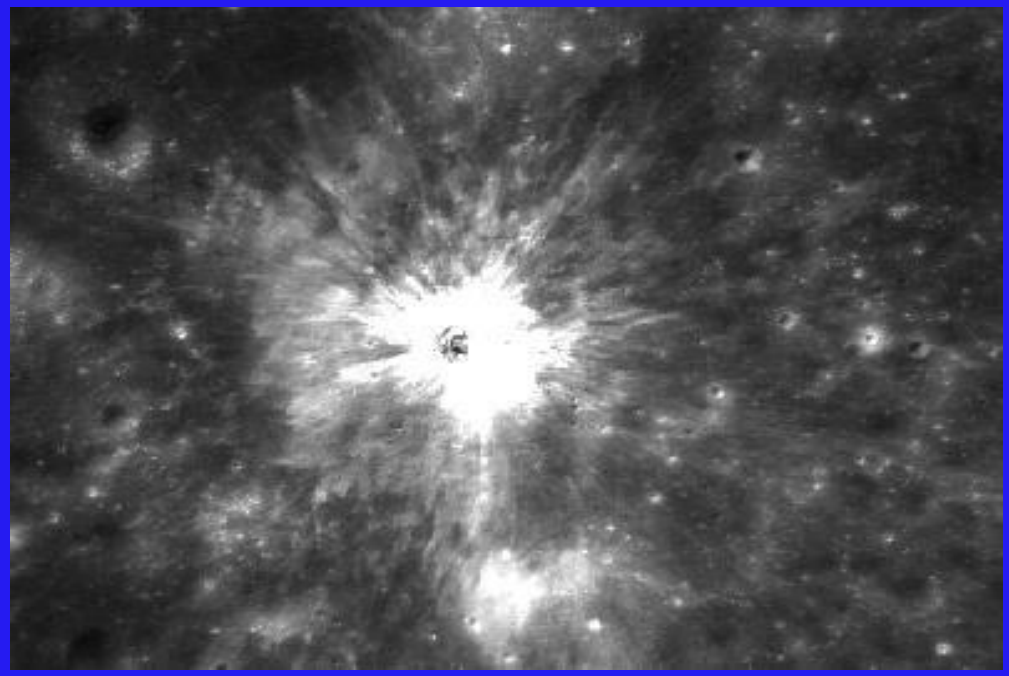
- Create a database of flatness index of entire planetary surfaces.
- Shortlist the landing sites for Lander/Rover using flatness index threshold.
- Manually or automatically count craters of each shortlisted sites and choose few sites coordinates
- Simulate landing camera in 3D for soft landing.

Red circles in figure shows possible landing sites on lunar surface.

Crater Identification and Classification Based On Ejecta Using Radial Band FFT (STP-2013)

- Impact crater characterization in view of ejecta is very useful to map the mineral composition in sub surface of t .





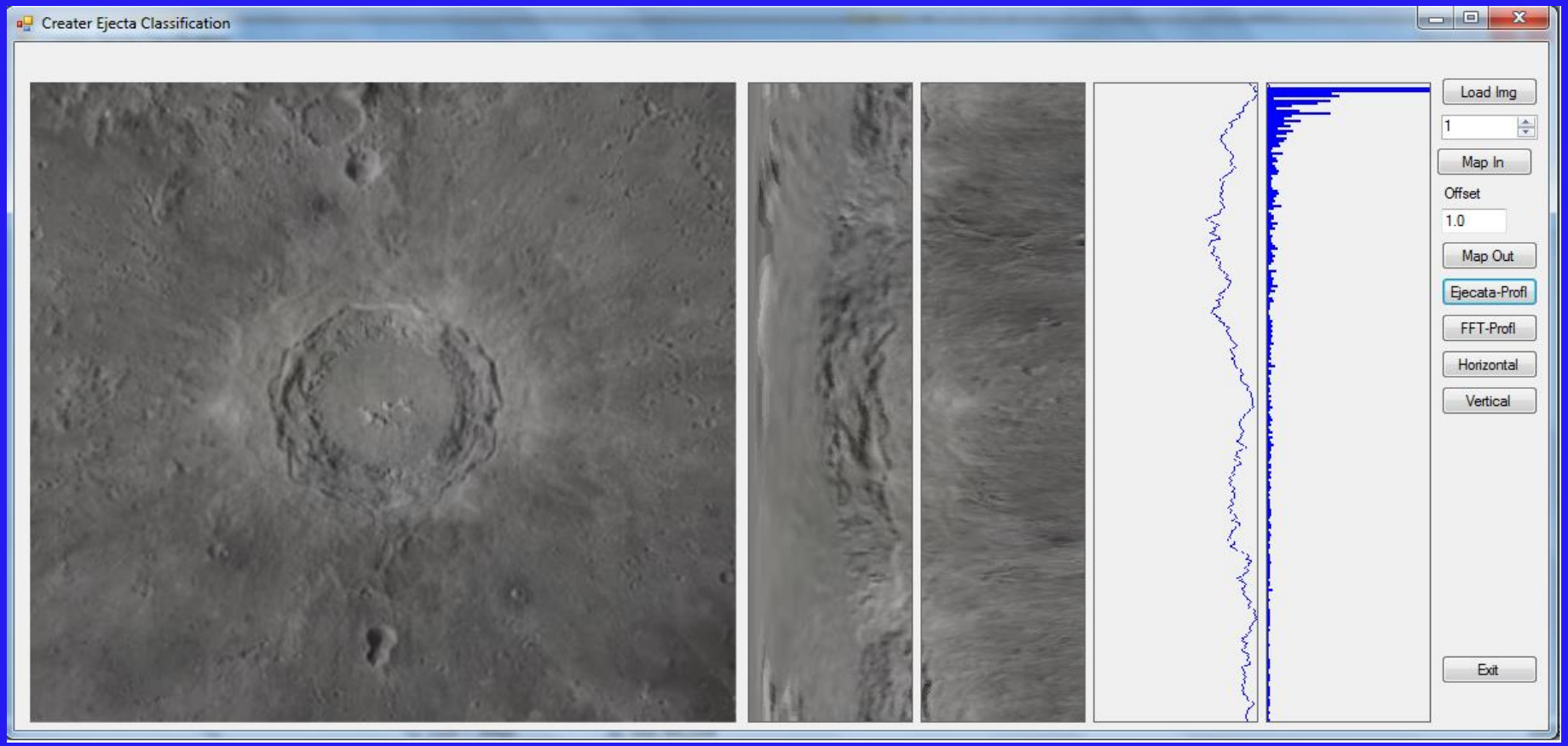
The classification of craters with 'Ejecta' as criteria has the following objectives:

- Identification and Classification of Craters for presence or absence of ejecta – Based on Reflectance.
- Automated Classification of Craters for the presence or absence of ejecta using FFT

Crater Identification and Classification Based On Ejecta Using Radial Band FFT (Demo)

- The results of the experiment conducted

Copernicus (With Ejecta)

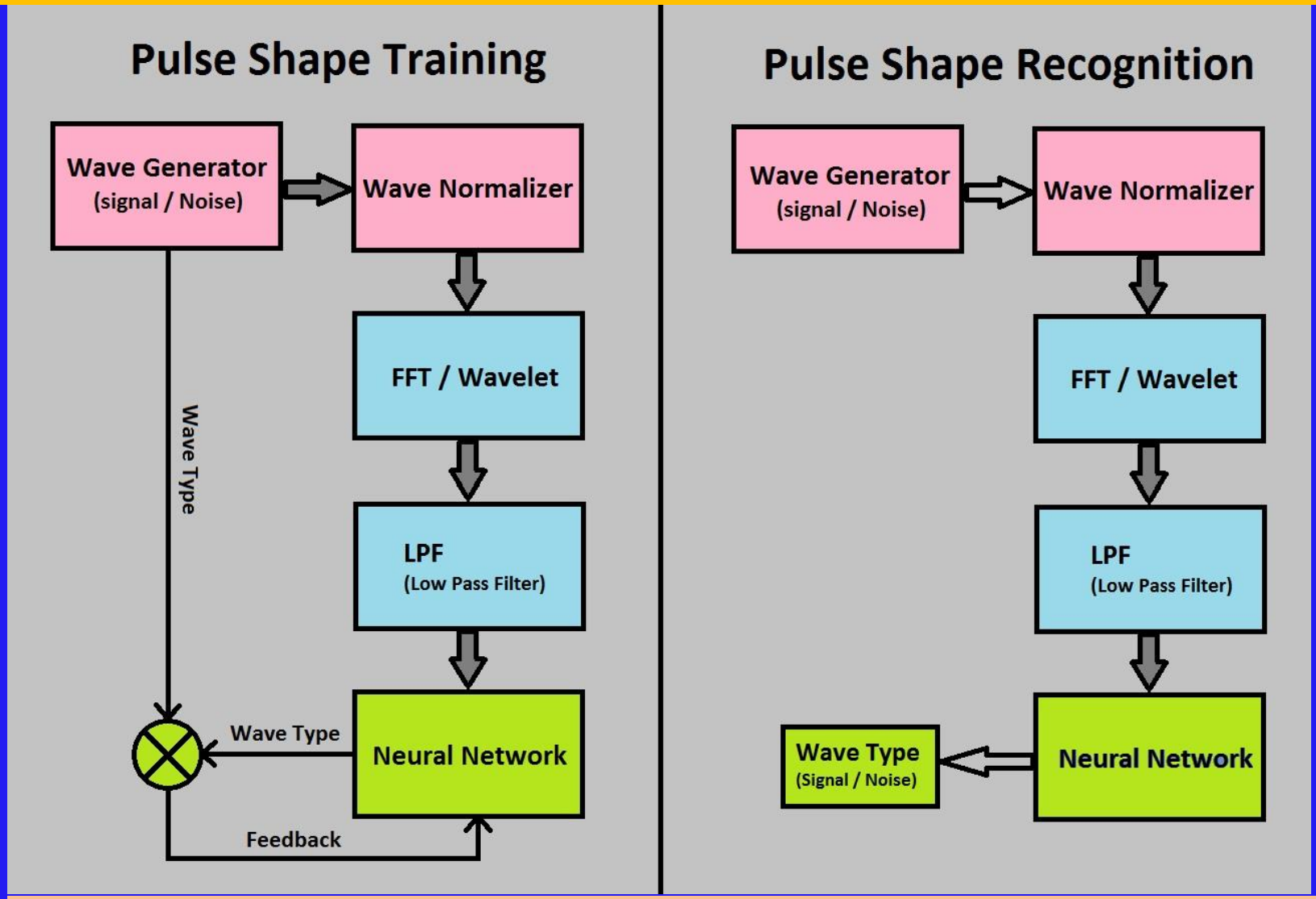


Radiation Counting Efficiency Improvement Using Noise Signature Anti-Coincidence

Objective

- To identify genuine radiation pulses from noise or superimposed impulses using high speed profile signature evaluation technique.
- To measure pulse event from weak source, which produces few counts per second to few counts per day is very difficult in presence of noise. This noise could be manmade or natural in the environment
- Proposed experiment is to analyze each signal and noise event to generalize noise and signal signature using advance signal processing and supervised learning algorithm
- **Such training can be imparted using supervised learning technique like back propagation algorithm with Neural Network.**

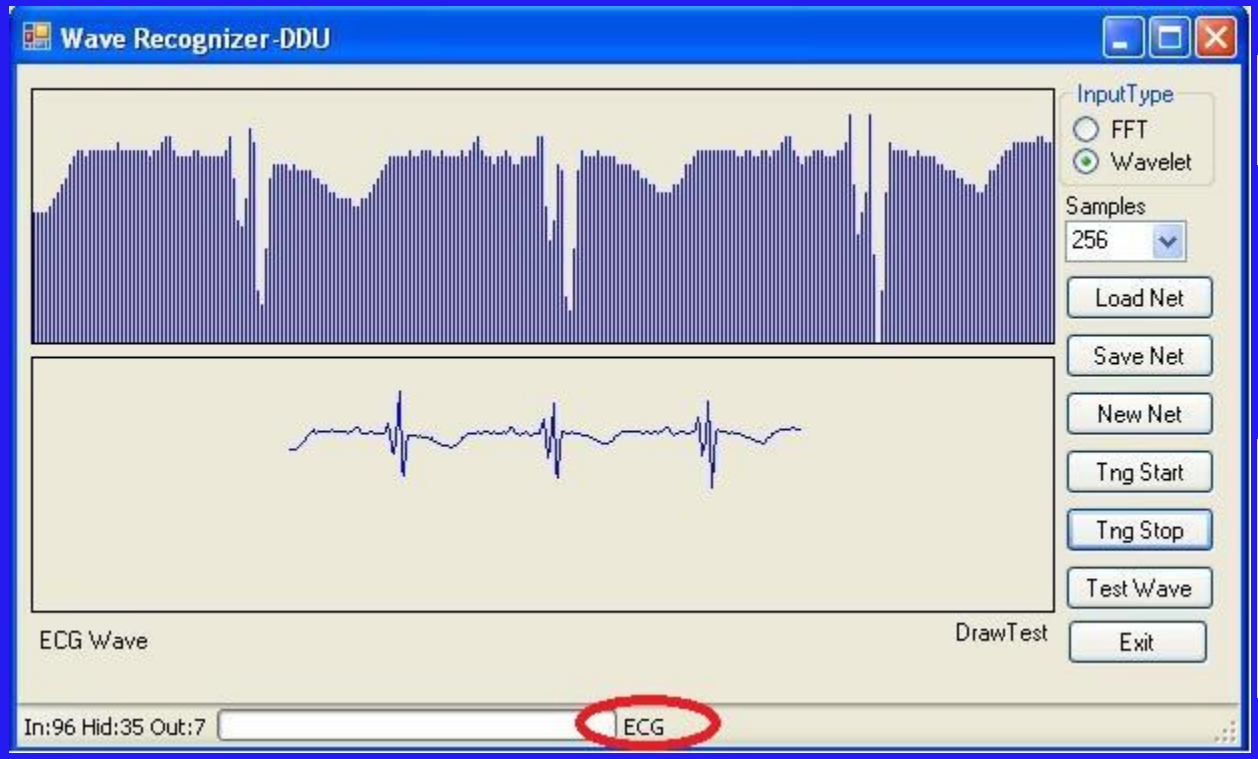
Block Diagram



Block Diagram shows the Pulse Shape training and recognition.

Simulation and Software Design for Wave Recognition

- Last year an application was developed to train the Neural Network for learning and identifying different types of standard wave shapes. (Time series wave data like Sine, Square, Triangle, Saw tooth, Pulse waves and Noise is classified using Neural Network Classification of FFT of input time series data.)
- Some wave shapes like ECG pulse shape is thought to neural network so it can recognize the ECG pulse shape.

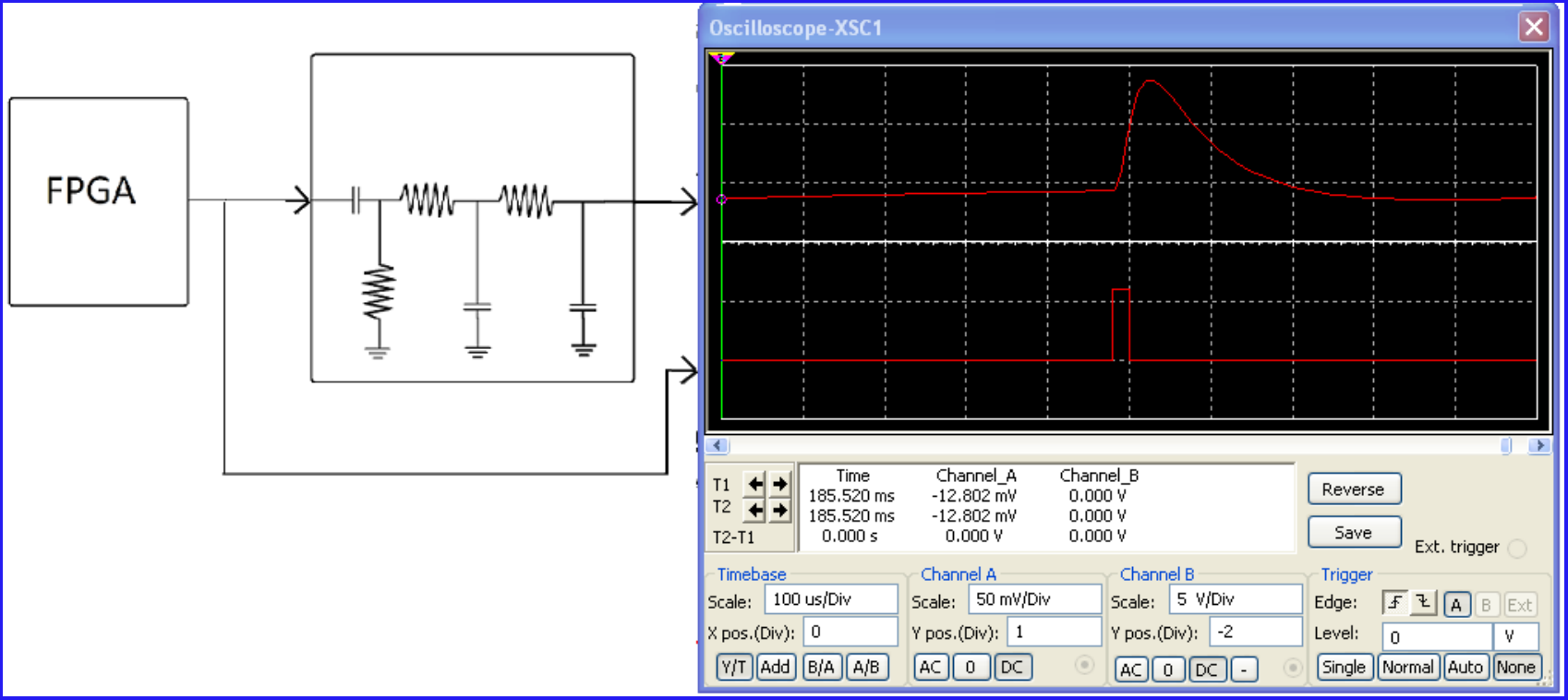


(Demo)

Screenshot of wave recognizer application and test result with hand drawn ECG

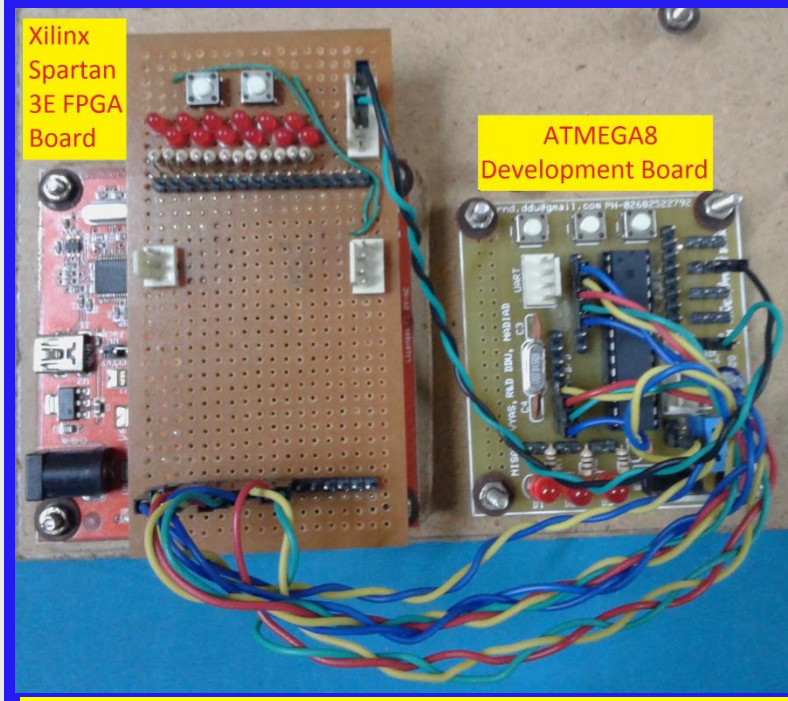
Radiation Counting Efficiency Improvement Using Noise Signature Anti-Coincidence

- To generate the required radiation pulse shape, **pulse emulator** based on differentiator-integrator-integrator type pulse shaping circuit is developed.



Radiation Counting Efficiency Improvement Using Noise Signature Anti-Coincidence

- Pulse emulator emulates a real detection system without the presence of radiation source and detector. It can generate infinite sequences of pulses of random amplitude and frequency.
- One most important advantage is to avoid expensive detector and radiation source which is a source of health hazard.
- These waveforms need to be digitized and used to generate pattern signature database.
- VHDL code is developed to interface high speed ADC for pulse profile digitization

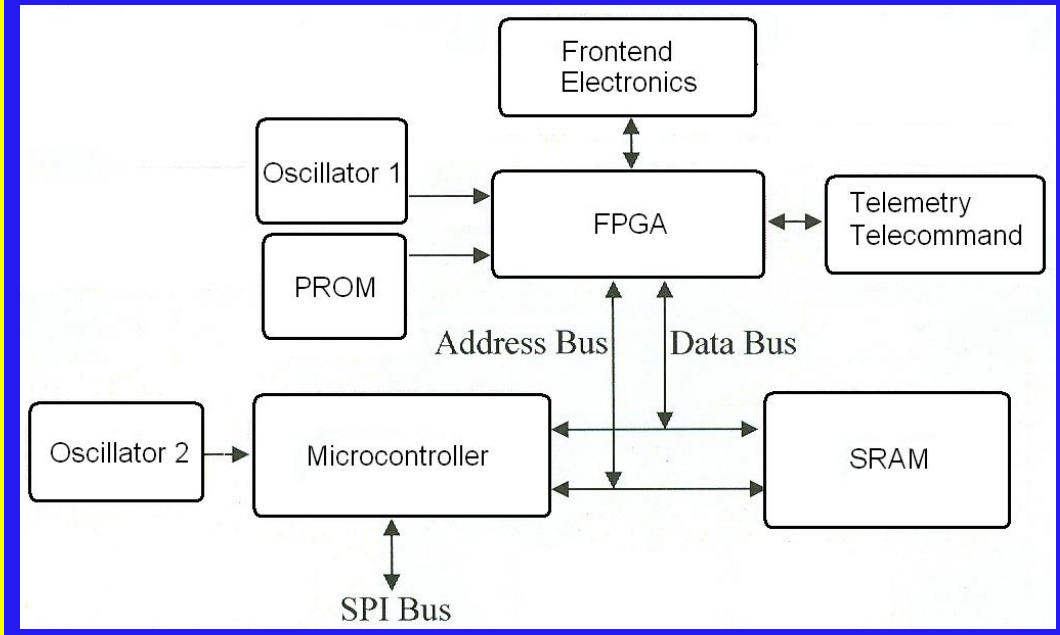


Interfacing of Xilinx Spartan FPGA and AT-Mega 8 microcontroller with IO devices

Conceptual Design for FPGA payload – A study report

- Extensive study of FPGA implementation of similar algorithms and conceptual design for reconfigurable payload using FPGA was carried out and a study report is produced for future research and implementation in this area

Multiple frontends and/or actuators are connected to FPGA. Different functional modules will be stored in PROM. Microcontroller works like function-scheduler and dataflow controller. Telemetry and Tele-command unit is connected to ground link for ground command and data acquisition. An SPI interface is provided for ground checkup. For development and testing of the system, frontend electronics will be replaced by FPGA based sensor or actuator simulators.



Block diagram of proposed reconfigurable FPGA architecture.

Research contribution of PhD scholars

- Algorithm for Image De-Blurring
- Algorithm for Image Encryption
- Prediction algorithm for forecasting rainfall
- Big Data of Life Science
- Multiple Protein Sequence Alignment

Algorithm for Image De-Blurring

Objective

•One of the most common problems in digital image restoration is motion blur caused by an image captured from a moving platform especially at low light condition having long exposure time of camera.

•Image de-blurring is the process of obtaining the latent (un-blurred) image by using the knowledge of the degradation factors.

•Recovering a de-blurred image from a single, motion-blurred photograph has long been a fundamental research problem in digital imaging.

•It is proposed to develop an interactive de-blurring technique to restore a motion blurred images.

Pixel-wise average of the translated image and original image gives a blurred image as;

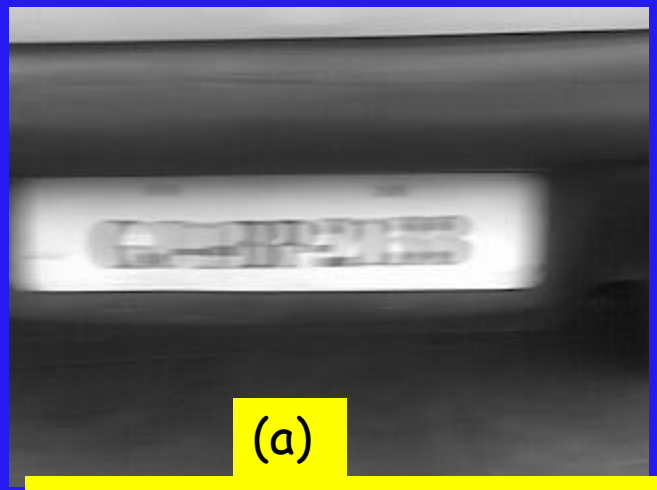
$$g(i,j)=\begin{cases}\dfrac{\left[f(i,j)+t(i,j)\right]}{2} & if\ 0\le(i+t_x)<M,\ and\ 0\le(j+t_y)<N\\ f(i,j) & Otherwise\end{cases}$$

Algorithm for Image De-Blurring

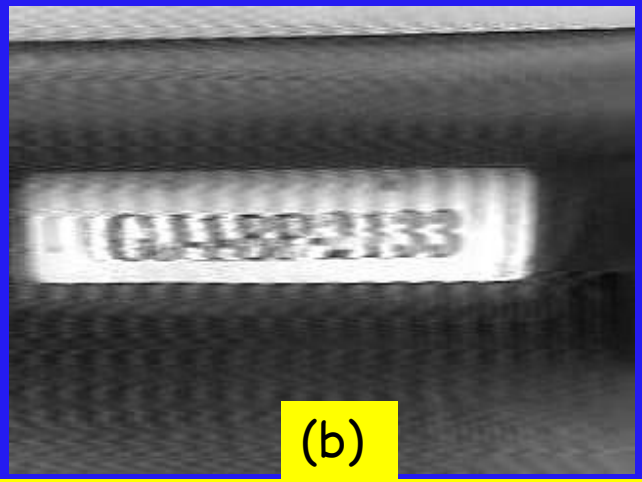
For a given blurred image, reverse process is pursued. Latent image f(x, y) is obtained by,

$$f(x,y) = \begin{cases} \left[2 * g(x,y)\right] - t_B(x,y) & \text{if } 0 \le (x + t_x) < M, \text{ and } 0 \le (y + t_y) < N \\ g(x,y) & \text{Otherwise} \end{cases}$$

- An interactive de-blurring technique to restore a motion blurred image is developed.
- Segment based semi-automated restoration method is used using an error gradient descent iterative algorithm.
- Experimental results show that proposed method gives sufficient restoration as interactive judgment gives the most desirable quality.



(a)



(b)

Restoration of captured blurred image (a) blurred number plate "GJ-1 BP-2133"captured from in motion mobile phone camera of 2 megapixel spatial resolution, (b) image after de-blurring.

Algorithm for Image Encryption

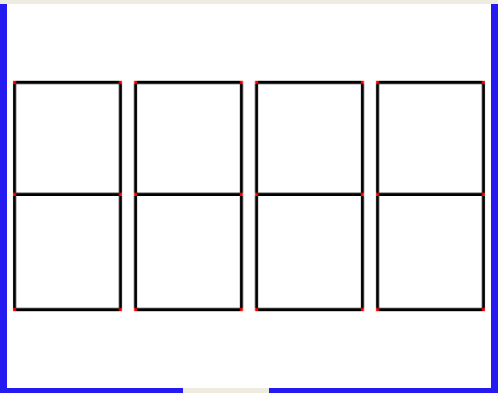
- It is part of the ongoing PhD research work on Imaging Systems with Embedded Intelligence.

Brief objective of the project

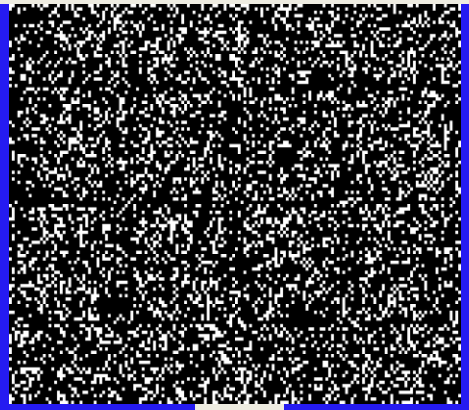
- The objective of this research is to explore an intelligent imaging hardware block that can be embedded & should be low cost and offer sufficient flexibility to address a wide range of applications.
- Emerging Visual Cryptography techniques are finding importance in secure space applications. Transfer of the thousands of images collected by the satellite is stored in public image library for access of specific end users only. A hardware block can be designed using discrete components or using existing well-known devices.

Algorithm for Image Encryption

- Result of proposed image encryption algorithm is shown in figure. Secret message length is 4 digits. Figure shows sample of secret image, actual superimposed image, captured superimposed image, and resultant image revealing secret.



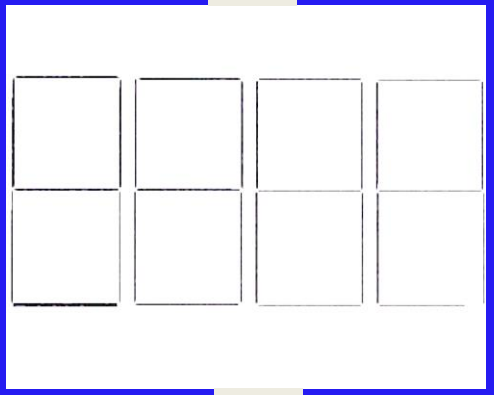
(a)



(b)



(c)



(d)

(a) secret message (b) actual superimposed image (c) captured image (d) revealed secret

Prediction algorithm for forecasting rainfall

- It is part of the PhD research work on Prediction of Rainfall. A new algorithm for rainfall time series prediction is developed and published. The method is based on prediction of frequency distribution using neural network.
- In this project four journal papers are published based on algorithms developed and the experimental results of previous year work.

Modeling and Prediction of Rainfall – India [1]

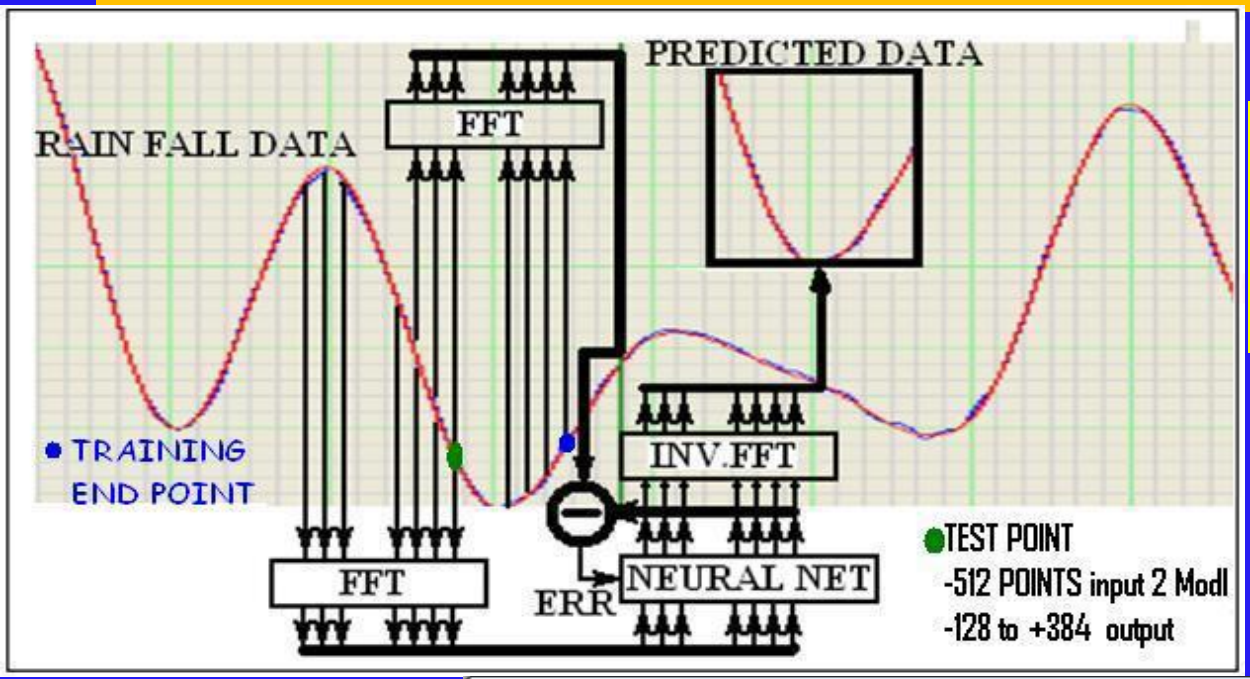
A Regenerative Prediction Algorithm for Indian Rainfall Prediction [2]

Rainfall Prediction Using Neural Net Based Frequency Analysis Approach [3]

A Fast Learning Algorithm for Rainfall Prediction [4]

63

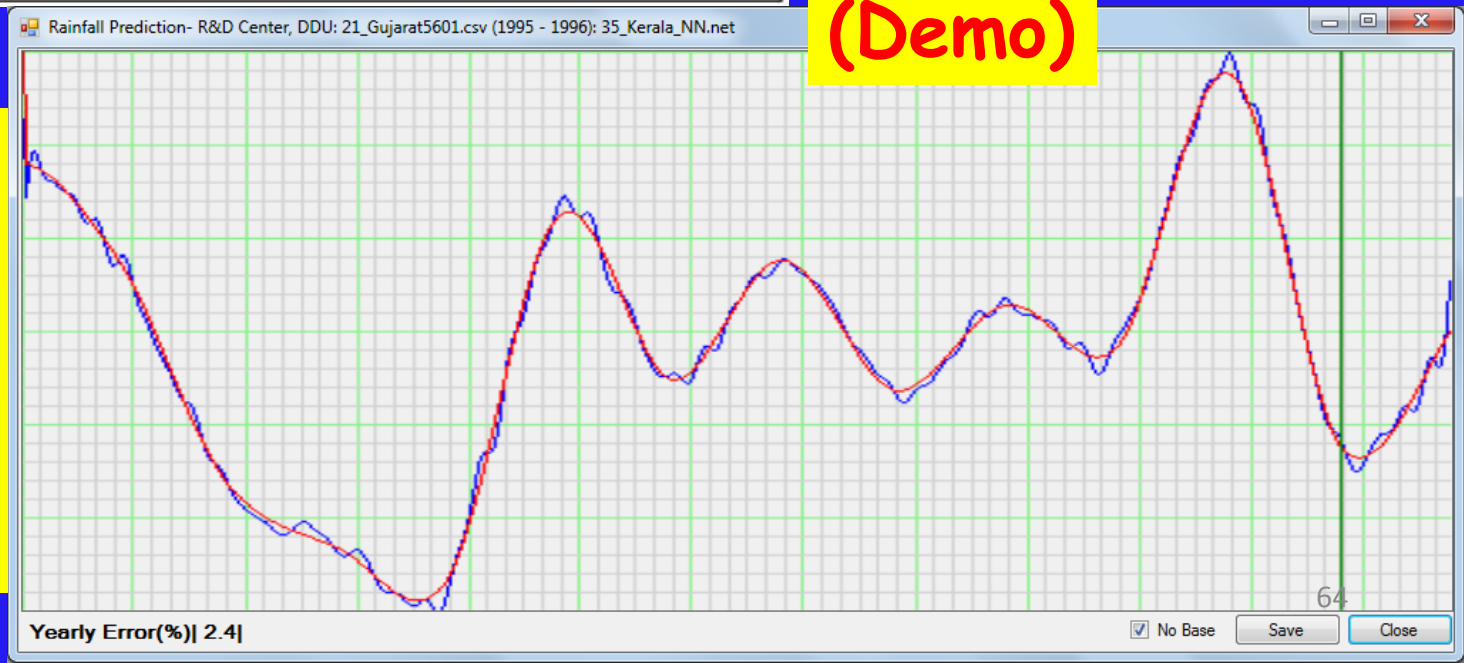
Rainfall Prediction Result



Diagrammatic representation of a proposed rainfall prediction model

Red line in figure shows the actual rain fall and blue line is the predicted rainfall of last one year after green line.

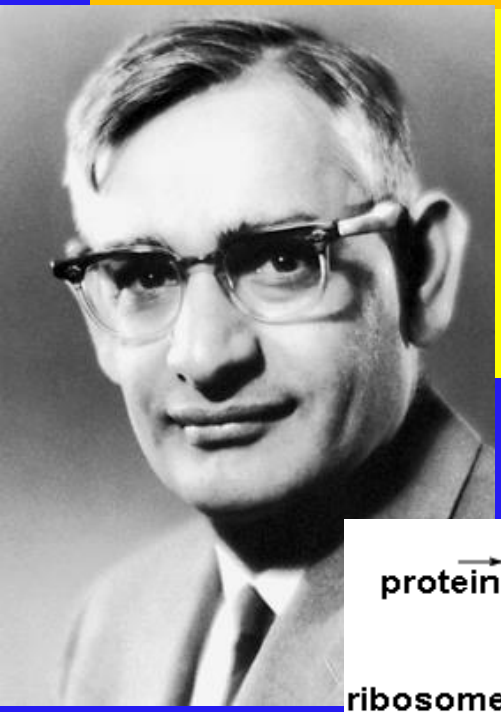
(Demo)



Big Data of Life Science

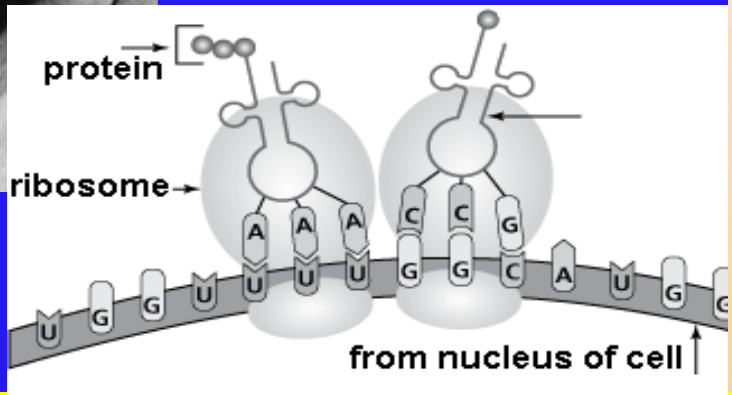
- From year 2000, there is a phenomenal growth in computer storage capacity and public life science database.
- Data memory size increased from Terabytes(10^{12}) to Petabytes(10^{15}) and more.
- Life science experiments produced huge genomic database of RNA and protein sequences.
- These two remarkable developments, one being the container for other is immerging rapidly with the help of other branches of science, like, mathematics, chemistry, physics and computer science as a new big data discipline named Bioinformatics.
- Bioinformatics is rapidly evolving field with an extreme shortage of skilled manpower to write programs and analyze data.

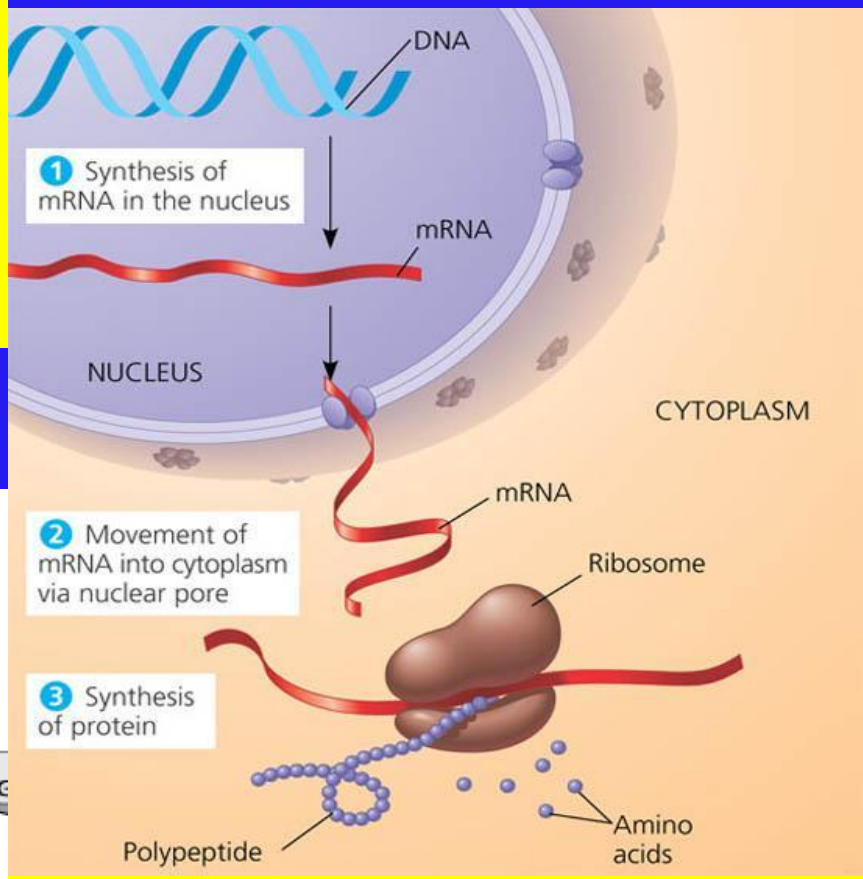
Protein Synthesis



Hargobind Khorana

(January 9, 1922 – November 9, 2011)





He was an Indian American biochemist who was conferred the 1968 Nobel Prize for Physiology or Medicine for research that helped to show how the nucleotides in nucleic acids, which carry the genetic code of the cell, control the cell's synthesis of proteins.

Big Genomic & Proteomics Database

Genomic Database:

- These databases collect organism genome sequences, annotate and analyze them, and provide public database.
- These databases may hold many species genomes, or a single model organism genome

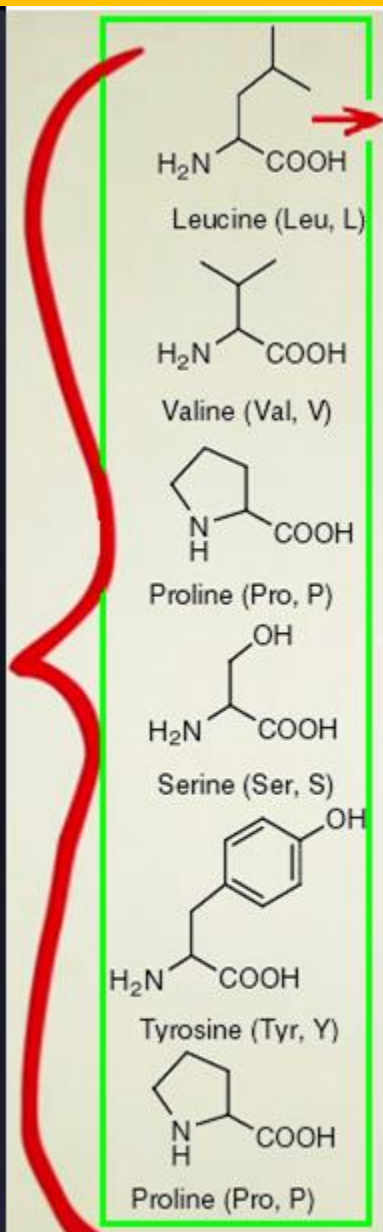
The complete set of proteins found in each cell is known as the proteome

Proteomic Database:

- A public repository for proteomics data, containing protein and peptide identifications and their associated supporting evidence as well as details of post-translational modifications
- A mitochondrial proteomics database integrating large-scale experimental datasets from mass spectrometry and green fluorescent protein (GFP) studies for 12 species.

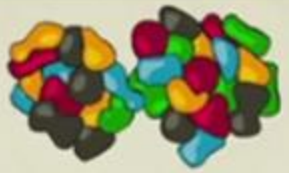
Amino Acid the Building Block of Life







Amino Acids



Proteins



Living Cells



Tissue







Organs

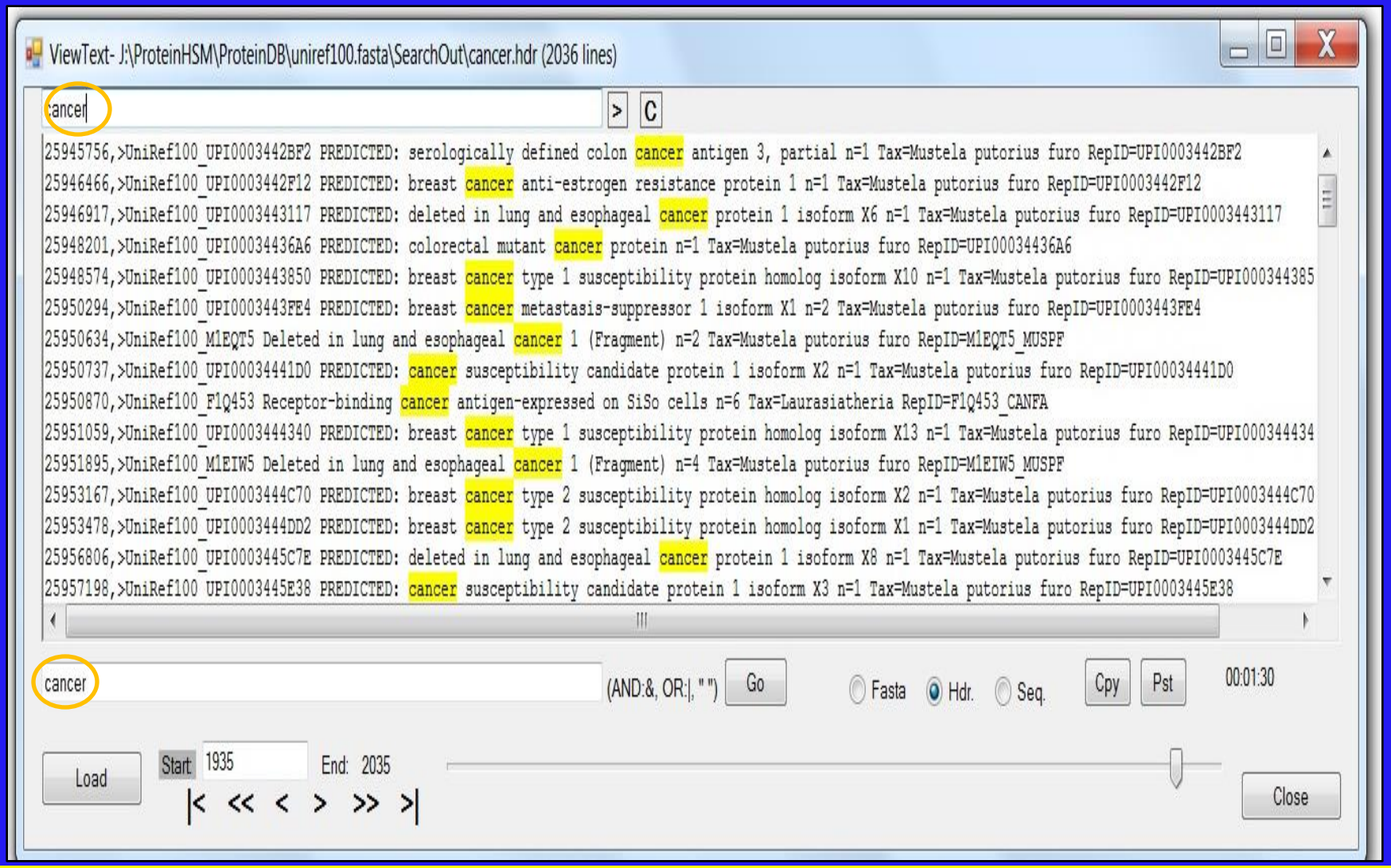
The Twenty Amino Acids

- alanine - ala-A
- arginine - arg-R
- asparagine - asn-N
- aspartic acid - asp-D
- cysteine - cys-C
- glutamine - gln-Q
- glutamic acid - glu-E
- glycine - gly-G
- histidine - his-H
- isoleucine - ile-I
- leucine - leu-L
- lysine - lys-K
- methionine - met-M
- phenylalanine - phe-F
- proline - pro-P
- serine - ser-S
- threonine - thr-T
- tryptophan - trp-W
- tyrosine - tyr-Y
- valine - val-V

154416,>UniRef100_O43719
HIV Tat-specific factor 1 n=3 Tax=Homo sapiens RepID=HTSF1_HUMAN

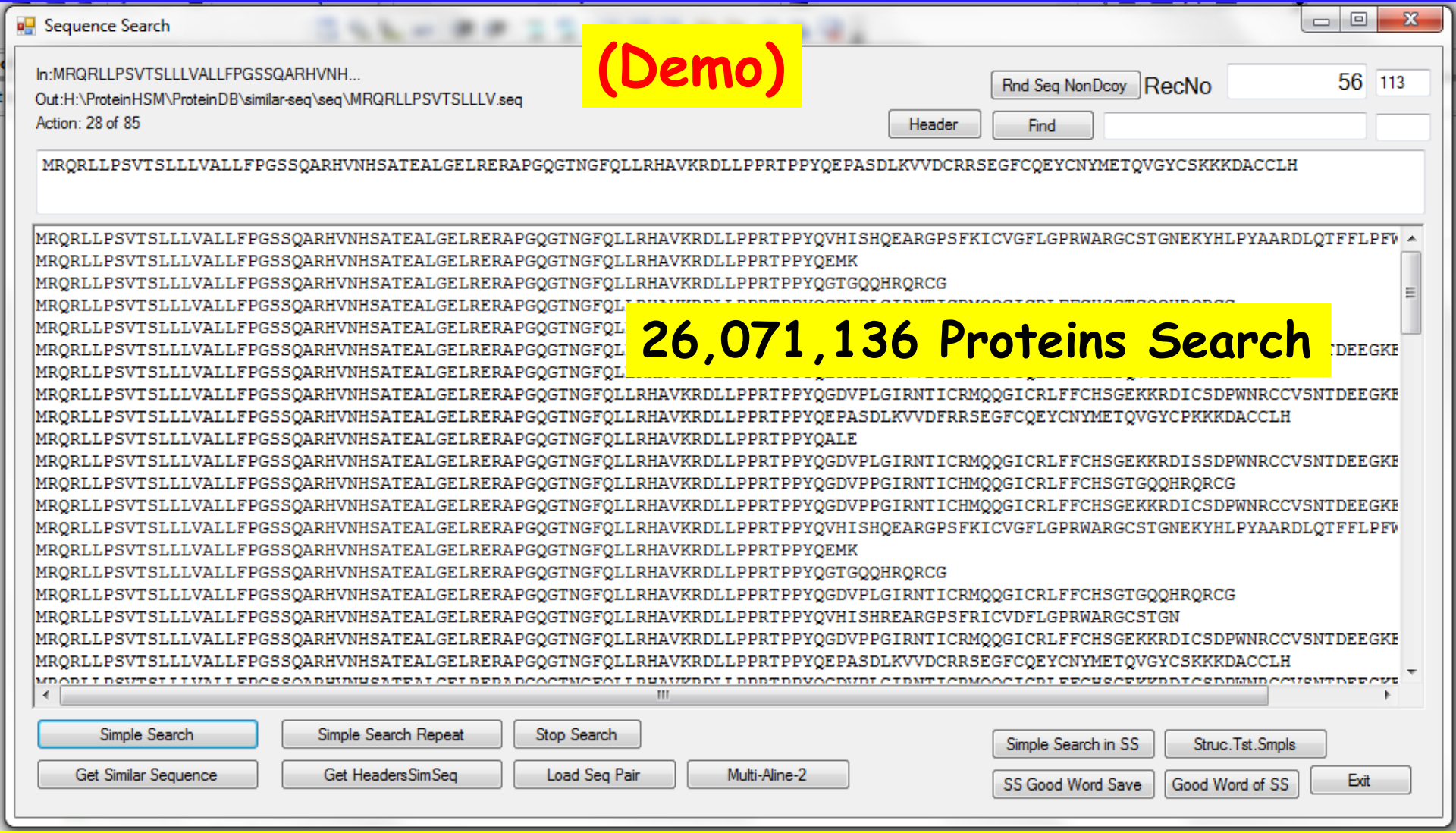
MSGTNLDGNDEFDEQLRMQELYGDGKDGDTQTDAGGEPDSLGQQPTDTPYEWDLDKKAWFPKITEDFIATYQANYGFSNDGASSSTANV
EDVHARTAEEPPQEKAPEPTDARKKGEKRKAESGWFHVEEDRNTNVYVSGLPPDITVDEFIQLMSKFGIIMRDPQTEEFKVKLYKDNQGNLK
GDGLCCYLKRESVELALKLLDEDEIRGYKLHVEVAKFQLKGEYDASKKKKCKDYKKKLSMQQKQLDWRPERRAGPSRMRHERVVIIKNMFHP
MDFEDDPLVLNEIREDLRVECSKFGQIRKLLLFDRHPDGVASVSFRDPEEADYCIQTLDGRWFGGRQITAQAWDGTTDYQVEETSRERREERL
RGWEAFLNAPEANRGLRRSDSVSASERAGPSRARHFSEHPSTSKMNAQETATGMAFEEPIDEKKFEKTEDGGEFEEGASENNAKESSPEKE
AEEGCPEKESEEGCPKRGFEGSCSQKESEEGNPVRGSEEDSPKKESKKKTLKNDCEENGLAKESEDDLNKESEEEVGPTKESEEDDSEKESDEDC
SEKQSEDGSEREFEENGLEKDLDEEGSEKELHENVLDKELEENDSENSEFEDDGSEKVLDEEGSEREFDEDSDEKEEEEDTYEKVFDDESDEKE
DEEYADEKGLEAADKKAEEGDADEKLFEESDDKEDEDADGKEVEDADEKLFEDDDSNEKLFDEEEDSSEKLFDDSDERGTLGGFGSVEEGPLST
GSSFILSSDDDDDDI (Total 755 AAs)

Protein Big-Record Browser (Demo)



A fast intelligence based keyword search application is developed to search from all header keywords of huge protein database. Package shown above is developed at DDU for this application.

Protein Sequence Similarity Search



Discovery of new protein sequence or drug, would need confirmation by comparing its similarity (not identity) with the largest(12GB) available protein database which is a challenging task. Package shown above is developed at DDU for this application.

Protein Structure

- Protein structures are indicator of its functionality.
- Structure prediction using experimental methods are time consuming and expensive
- Release of Jan 2012 of UniProtKB/TrEMBL database contained 19,434,245 sequences, while the number of discovered protein structures as on Aug 2012 was 77,195 14.
- The gap between the discovered protein sequences and discovered protein functions is increasing rapidly
- This issue is being successfully addressed by theoretically predicting the protein structures.

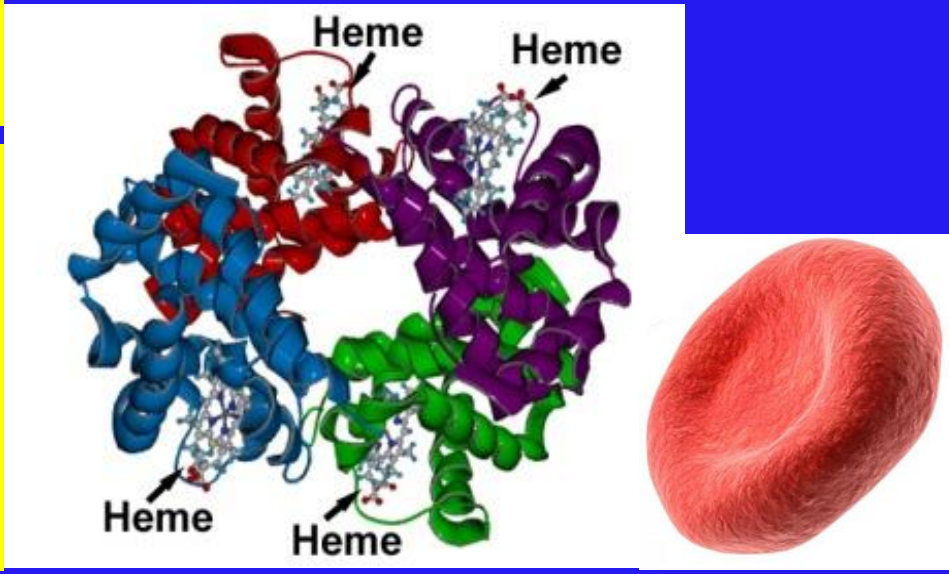
Growth of Protein Vs Protein Structure Database

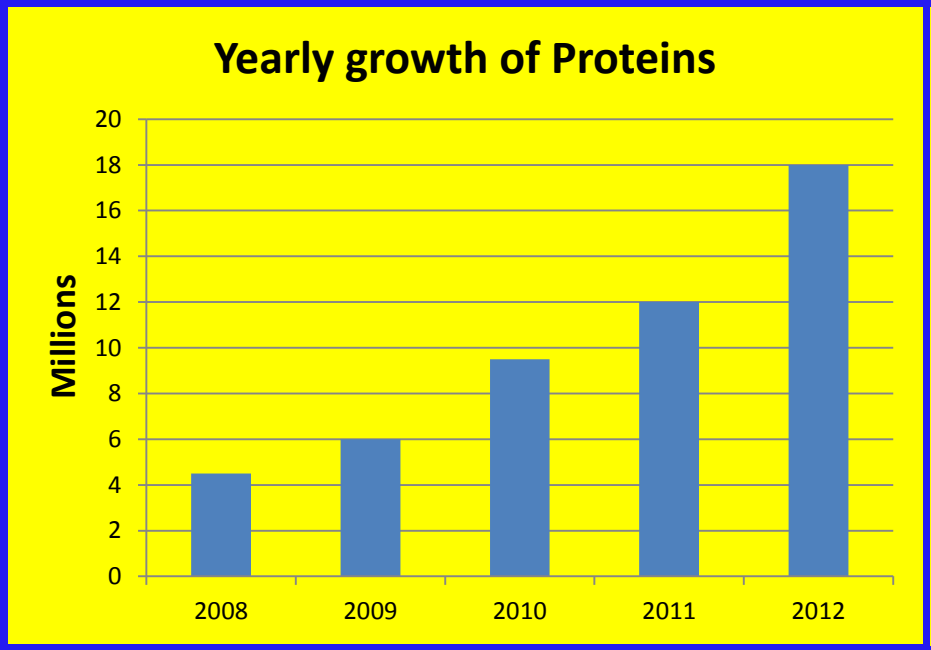
Amino Acid sequence of Hemoglobin: A protein capable of oxygen transfer in human body

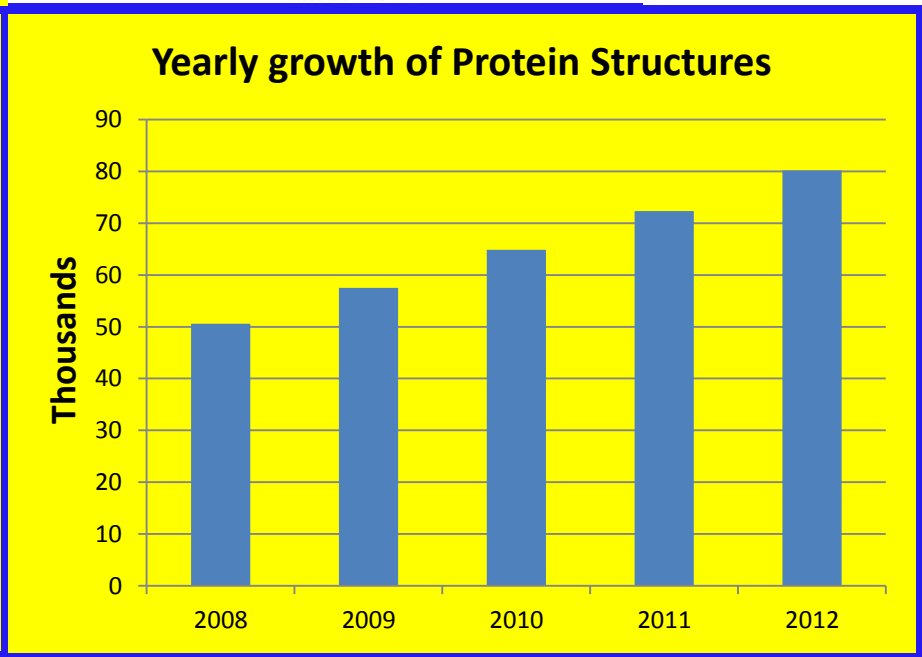
>UniRef100_Q865F8
Alpha-hemoglobin-stabilizing protein

MALIQTNKDLISKGIKEFNILLNQQVFS
DPAISEEAMVTVVNDWVSFYINYYKKQ
LSGEQDEQDKALQEFRQELNTLSASF
LDKYRNFLKSS

3dimensional structure of Hemoglobin







Protein Structure Knowledge Database (DDU)

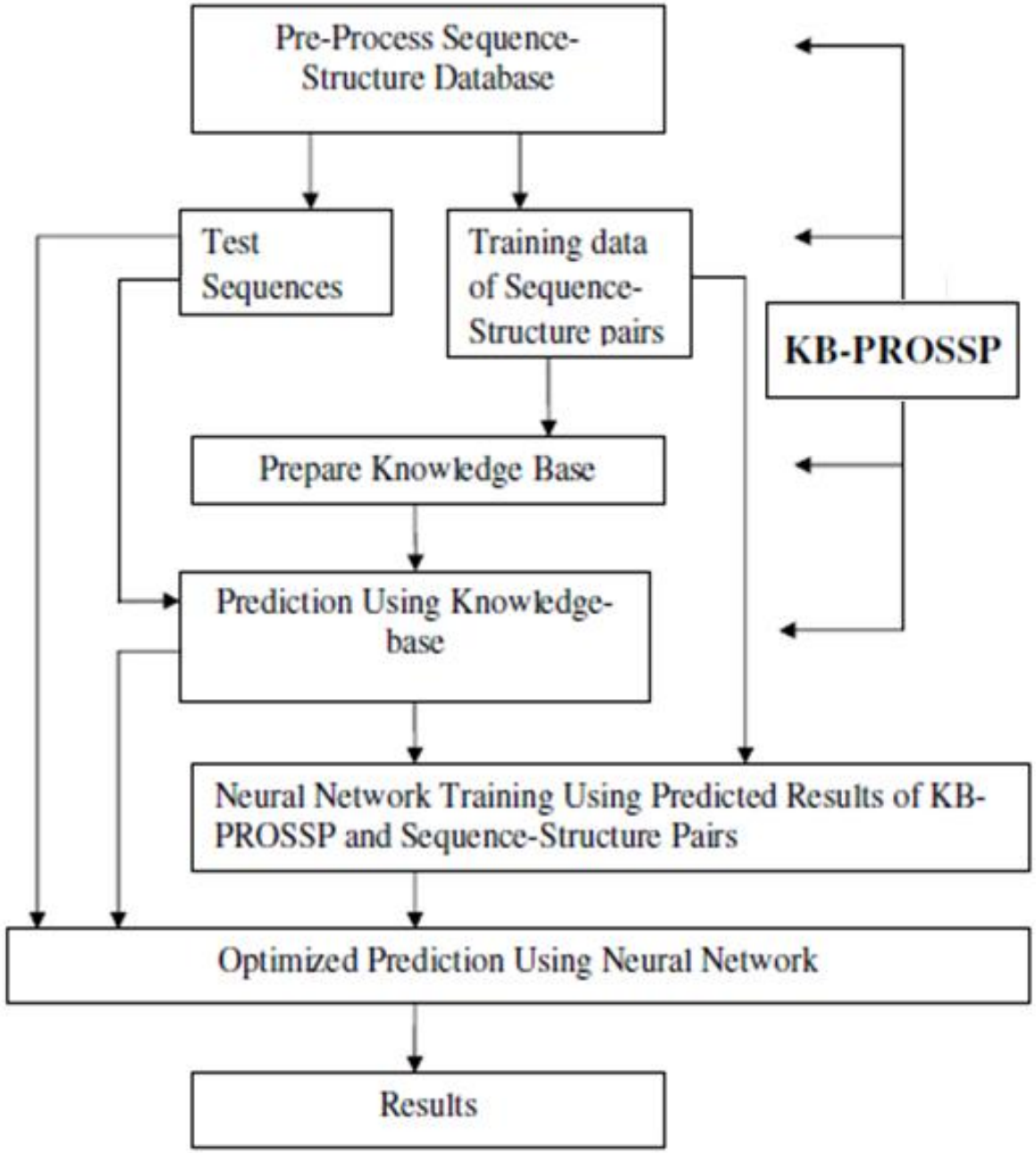
- 1,116,480 Protein sequences of Amino Acids (AA) are available with corresponding Secondary Structure (SS) information in public domain
- 26,071,136 Protein sequences are available without Secondary Structure information that needs to be predicted for Structure to understand their functions
- We extract from 1,116,480 proteins, 5 letter AA sequences with all 3 letter SS co-occurrences as shown below. There are (20^5) 3,200,000 AA sequences of length 5 e.g.

PTLWSRVTKFGSGWGFWVSPTVFITTTHVVPTGVKEFFGEPLSSIAIHQ
HHHHTTEEEETTEEEEESSSSEEEEEGGGS.SS.SEETTEEGGGSEEEE

Protein Structure Knowledge Database Format

- AAAAA,HHH:000843,---:000743,HHT:000063,TTS:000039,S-S:000026,--S:000026,TSS:000025,HTT:000023
- AAAAC,S--:000016,-TT:000012,HHH:000004,SSS:000002,BSB:000001
- AAAAD,HHH:000141,---:000033,-ST:000023,T-T:000012,-TT:000012,B-S:000012,-GG:000009,HH-:000008
- ZZVBD,---:000002

Protein Secondary Structure Prediction (PSSP)



- KB-PROSSP-NN algorithm of DDU is a combination of known Proteomic knowledge base of structures and modeling of the exceptions using neural networks for PSSP
- The knowledge base consists of the statistics of association between the 5-residue peptide and corresponding secondary structure
- Accuracy of 90% is achieved on the RS126 and CB396 test sets

Experimental Results of Secondary Structure Prediction

[1] Amino Acid Sequence
[2] Secondary Structure Experimental
[3] Secondary Structure Predicted using Knowledgebase
[4] Secondary Structure Predicted using correction using Neural Network
[5] Score of [3] and [4] wrt [2]

```
[1] DDDKAPPTLWSRVTKFGSGWGFWVSPTVFITTTHVVPTGVKEFFGEPLSSIAIHQAGEFTQFRFSKKMRPDLTGMVLEEGCPEGTVCS--
[2] ......HHHHTTEEEETTEEEEESSSSEEEEEGGGS.SS.SEETTEEGGGSEEEEETTEEEEE.SS.S.TTS...EE.SS..TT.EEE--
[3] ........HHHHEEEESSEEEEESSSSSEEEEGGGE.....HETTS....EEEEEETTEEEEEEES....T.....E.SS...T..EE--
[4] ..........HHHEEESSEEEEESSSSSEEEGGGGS.SS.SESTTSGEEEEEEEEETTEEEEE.ES.E.TTS...EE.SS..TT.EEE--
[5] Score: 79.84,Score NN: 87.90

[1] DDDKAPPTLWSRVTKFGSGWGFWVSPTVFITTTHVVPTGVKEFFGEPLSSIAIHQAGEFTQFRFSKKMRPDLTGMVLEEGCPEGTVCS--
[2] ......HHHHHTEEEETTEEEEESSSSEEEEEGGGS.SS.SEETTEEGGG.EEEEETTEEEEE.SS.S.TT....EE.SS..TT.EEE--
[3] ........HHHHEEEESSEEEEESSSSSEEEEGGGE.....HETTS....EEEEEETTEEEEEEES....T.....E.SS...T..EE--
[4] ..........HHHEEESSEEEEESSSSSEEEGGGGS.SS.SESTTSGEEE.EEEEETTEEEEE.ES.E.TT....EE.SS..TT.EEE--
[5] Score: 81.45,Score NN: 90.32

[1] DDDKAPPTLWSRVTKFGSGWGFWVSPTVFITTTHVVPTGVKEFFGEPLSSIAIHQAGEFTQFRFSKKMRPDLTGMVLEEGCPEGTVCS--
[2] ...SS.HHHHTTEEEETTEEEEESSSSEEEEEGGGS..S.SEETTEEGGGEEEEEETTEEEEEESS.S.TTS...EE.SS..TT.EEE--
[3] ........HHHHEEEESSEEEEESSSSSEEEEGGGE.....HETTS....EEEEEETTEEEEEEES....T.....E.SS...T..EE--
[4] ..........HHHEEESSEEEEESSSSSEEEGGGGS..S.SESTTSGEEEEEEEEETTEEEEEEES.E.TTS...EE.SS..TT.EEE--
[5] Score: 75.81,Score NN: 86.29

[1] DDDKAPPTLWSRVTKFGSGWGFWVSPTVFITTTHVVPTGVKEFFGEPLSSIAIHQAGEFTQFRFSKKMRPDLTGMVLEEGCPEGTVCS--
[2] ......HHHHTTEEEETTEEEEESSSSEEEEEGGGS.SS.SEETTEEGGG.EEEEETTEEEEE.SS.S.TTS...EE.SS..TT.EEE--
[3] ........HHHHEEEESSEEEEESSSSSEEEEGGGE.....HETTS....EEEEEETTEEEEEEES....T.....E.SS...T..EE--
[4] ..........HHHEEESSEEEEESSSSSEEEGGGGS.SS.SESTTSGEEE.EEEEETTEEEEE.ES.E.TTS...EE.SS..TT.EEE--
[5] Score: 81.45,Score NN: 89.52
```

Utilities for Efficient Usage of Large Biological Databases

Objective

Samples acquired from outer space like comet bodies can be analyzed for its bio-molecular characteristics. We have been witnessing a meticulous expansion in the amount of biological databases as an outcome of the human genome-sequencing project. These biological databases like Protein Data Base (PDB) are created and updated by the inventions of new molecules by the biologists.

Computational biology tasks such as multiple sequence alignment, sequence similarity, motif finding, and structure prediction have yanked many researchers. The objective of this research is to develop a set of utilities and tools to efficiently use these large data base for further analysis.

```
Result of Protein Secondary Structure prediction using NN-
SVQATREDKFSFGLWTVGWQARDAFGDATRTALDPVEAVHKLAEIGAYGITFHDDDLVP.
.....GGG.EEEEHHHHT....BTTB..SS....HHHHHHHHHHHT.SEEE.BHHHHS..
.....GGG.EEEEHHHHT.....TTS.........HHHHHHHHHHT...EEEEHHHHS..
.....GGG.EEESHHHHT....BTTB..SS....HHHHHHHHHHHT.SEEE.BHHHHS..
Accuracy :84.86,  Corrected :96.87
```

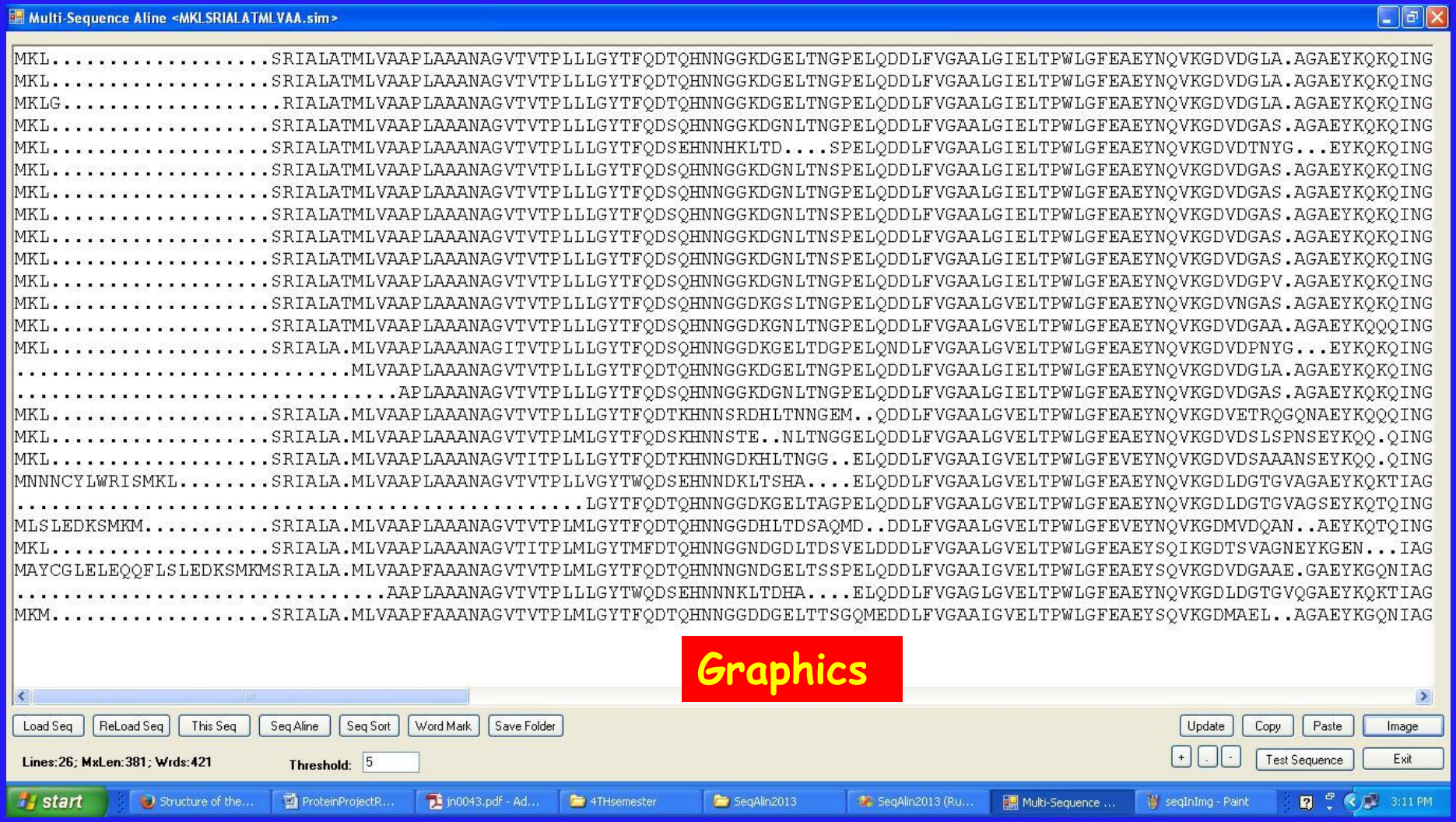
Avg :79.96, Avg Corrected :86.87 (average of 857266 proteins)

Multiple Sequence Alignment Input Sequences



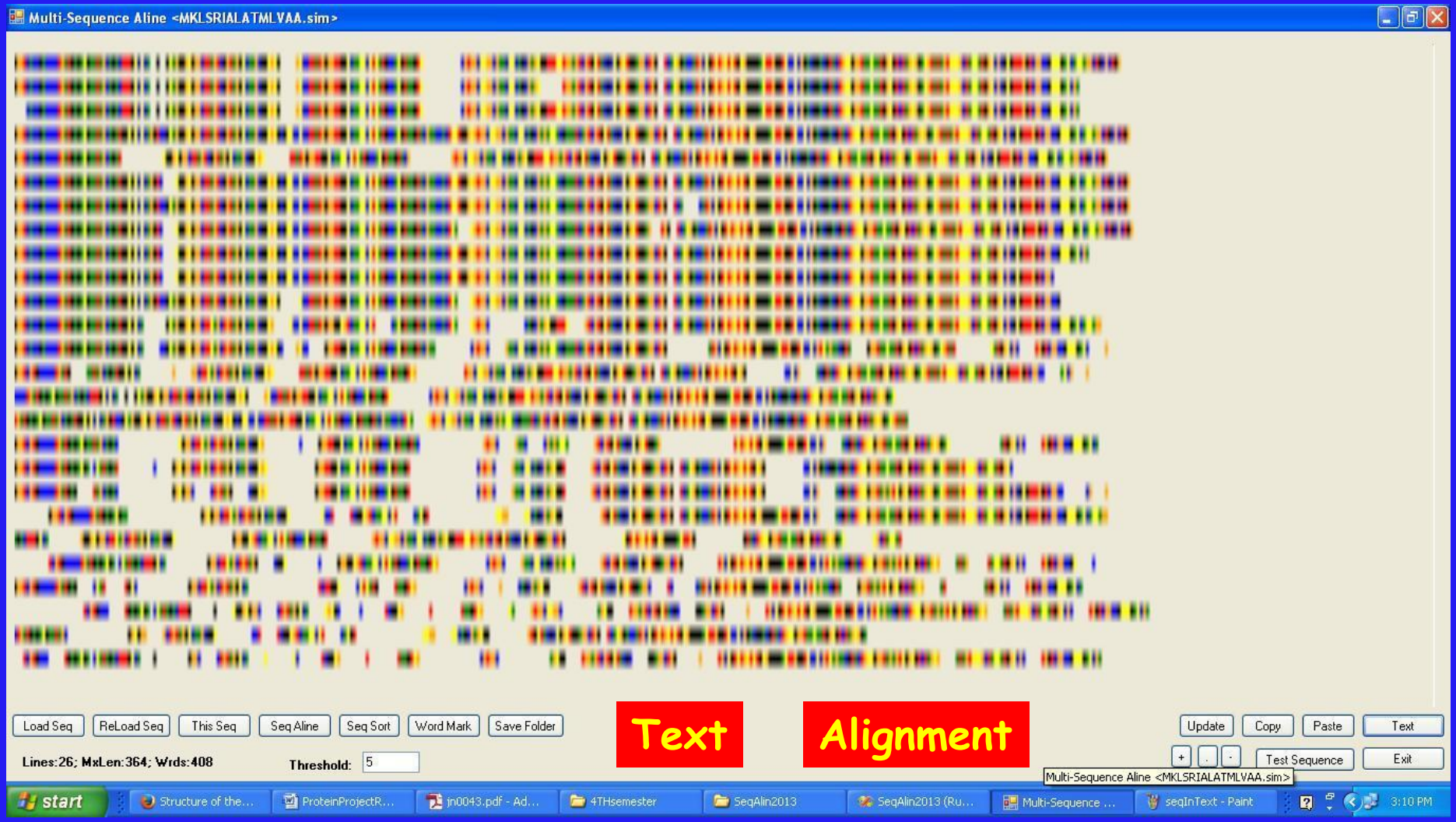
Similar protein sequences like shown above needs feature alignment for better representation and differences. Package shown above is developed at DDU for this application.

Multiple Sequence Aligned Output Sequences



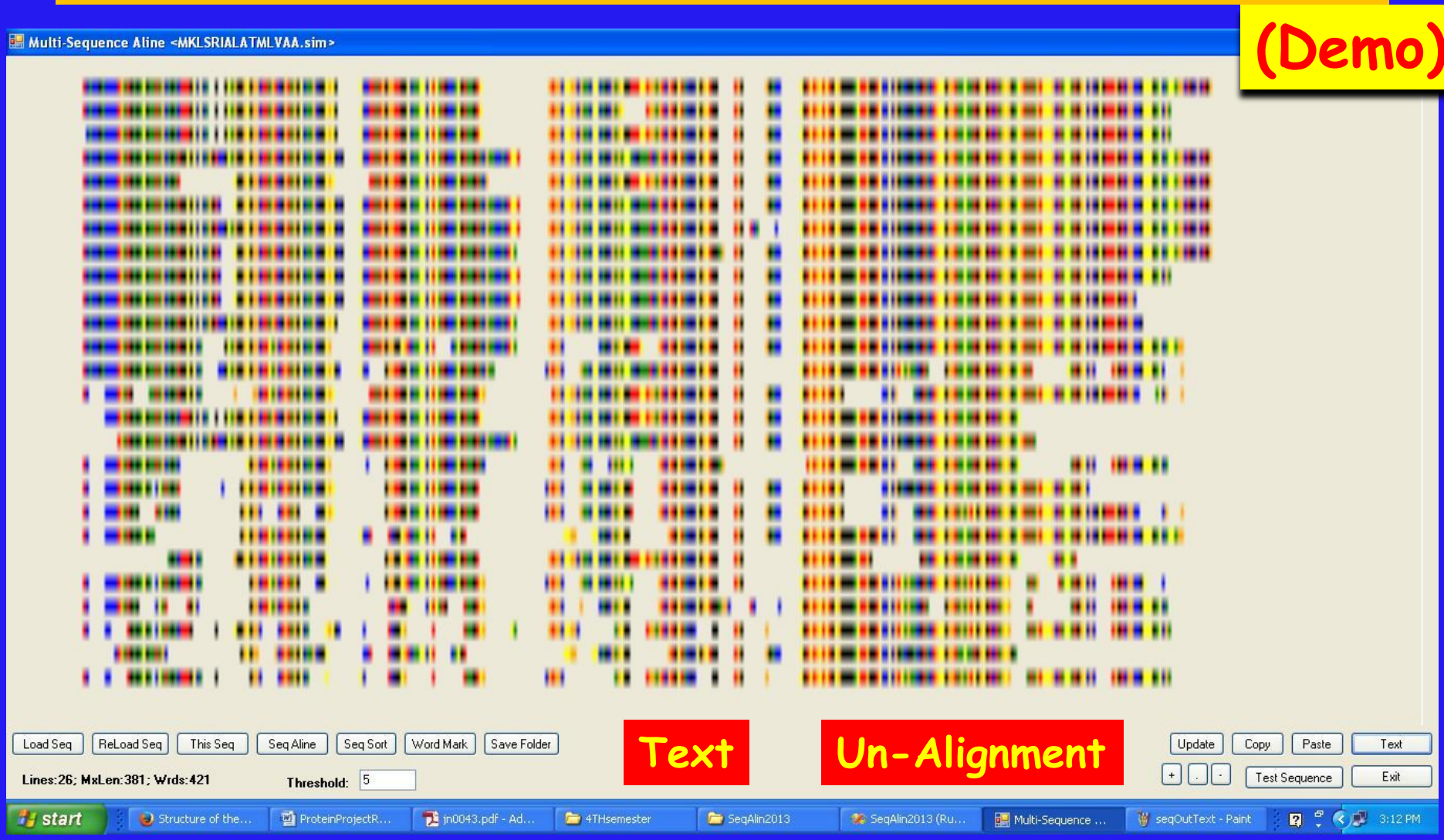
Similar multiple protein sequences shown earlier are aligned to understand the similarities and differences at quick glance. Package shown above is developed at DDU for this application.

Multiple Sequence Alignment Graphics representation of Input



Similar protein sequences like shown earlier is better visualized in colour coded graphic representation as shown above. Package shown above is developed at DDU for this application.

Multiple Sequence Aligned Graphics representation of Output



Similar multiple protein sequences after alignment as shown earlier is better visualized in colour coded graphic representation. Package shown above is developed at DDU for this application.

Web based Multiple Sequence Alignment input



A web based Multiple Sequence Alignment is developed for analysis of similar looking protein sequences. Each color represents one keyword and it is not unique to keyword that is one-to-many mapping is done among color and keywords. This is useful for viewing and analysis of the alignment results efficiently and with ease.

Web based Multiple Sequence Alignment output



Figure shows the aligned output in the text and image format. The aligned sequences can be sorted based on the number of keywords present in the sequences or these keywords can be highlighted for further analysis.

Other Supported Projects

- Hand Written Character Recognition
- Simulated Walking Robot
- 3D Human face Reconstruction from 2D images
- Web based Protein Analysis Tools
- Space Vector Modulation (SVM) algorithm for motor control
- Solar powered sensor networking system
- Adoptive and Predictive Neuro-Fuzzy Temperature Controller (IEDC, DST)
- Smart Predicting Thermometer

Hand Written Character Recognition-1



Digitised Hand Written Character Docoment

Line Seperate

Hand Written

Character Seperate and Normalize 24 X 24

W

Segmentation 8x8 of 3x3

Feature Extractor Vector Quantizer Neural Net 64-8-64 Input- 8x8 Output- 8

Feature Vector Assembler 8 x (3 X 3)

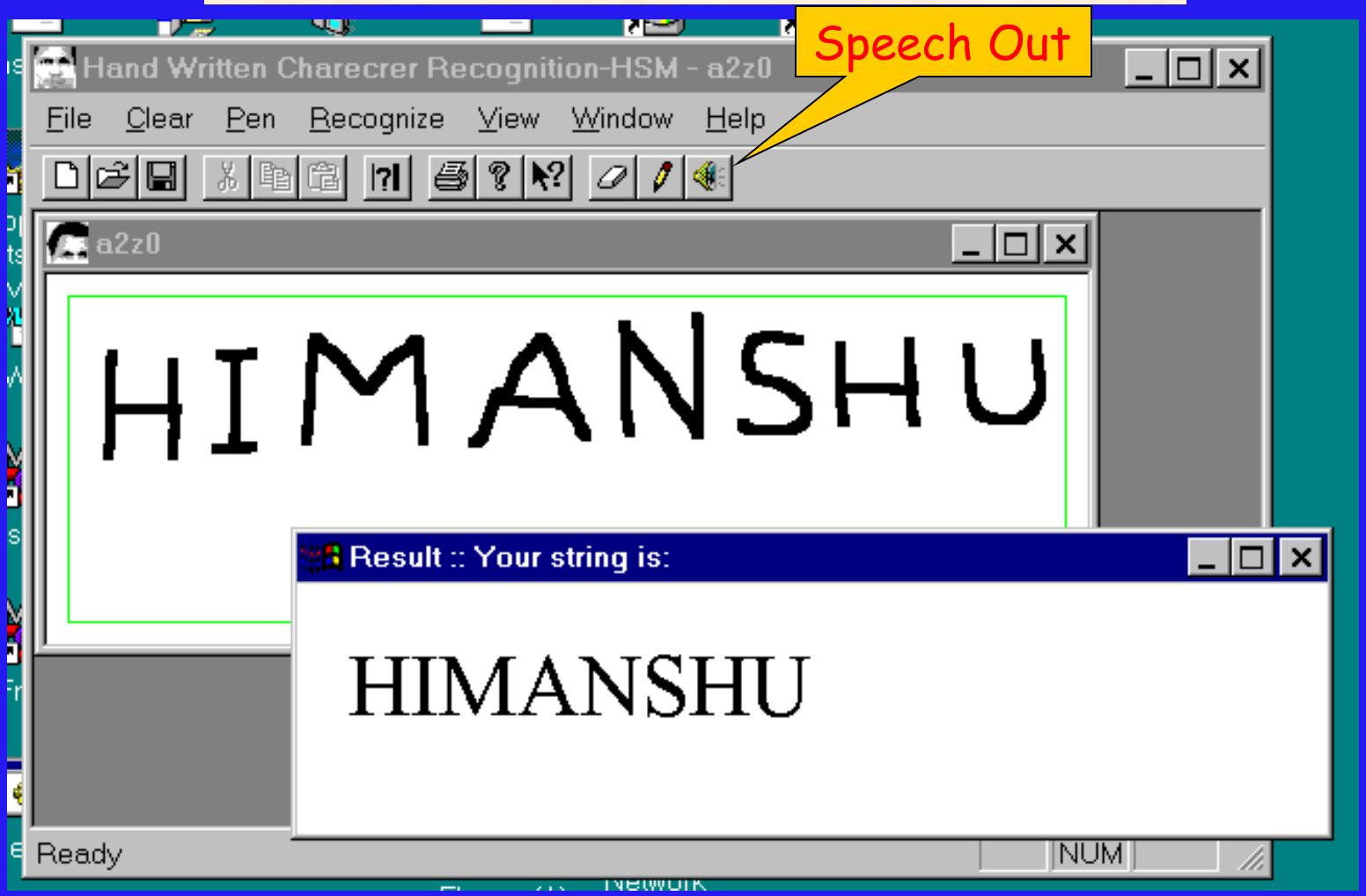
Character Recognition Neural Network Input- 72 (8 x 3 x 3) Hidden- 64 Output- 26

Word Processor

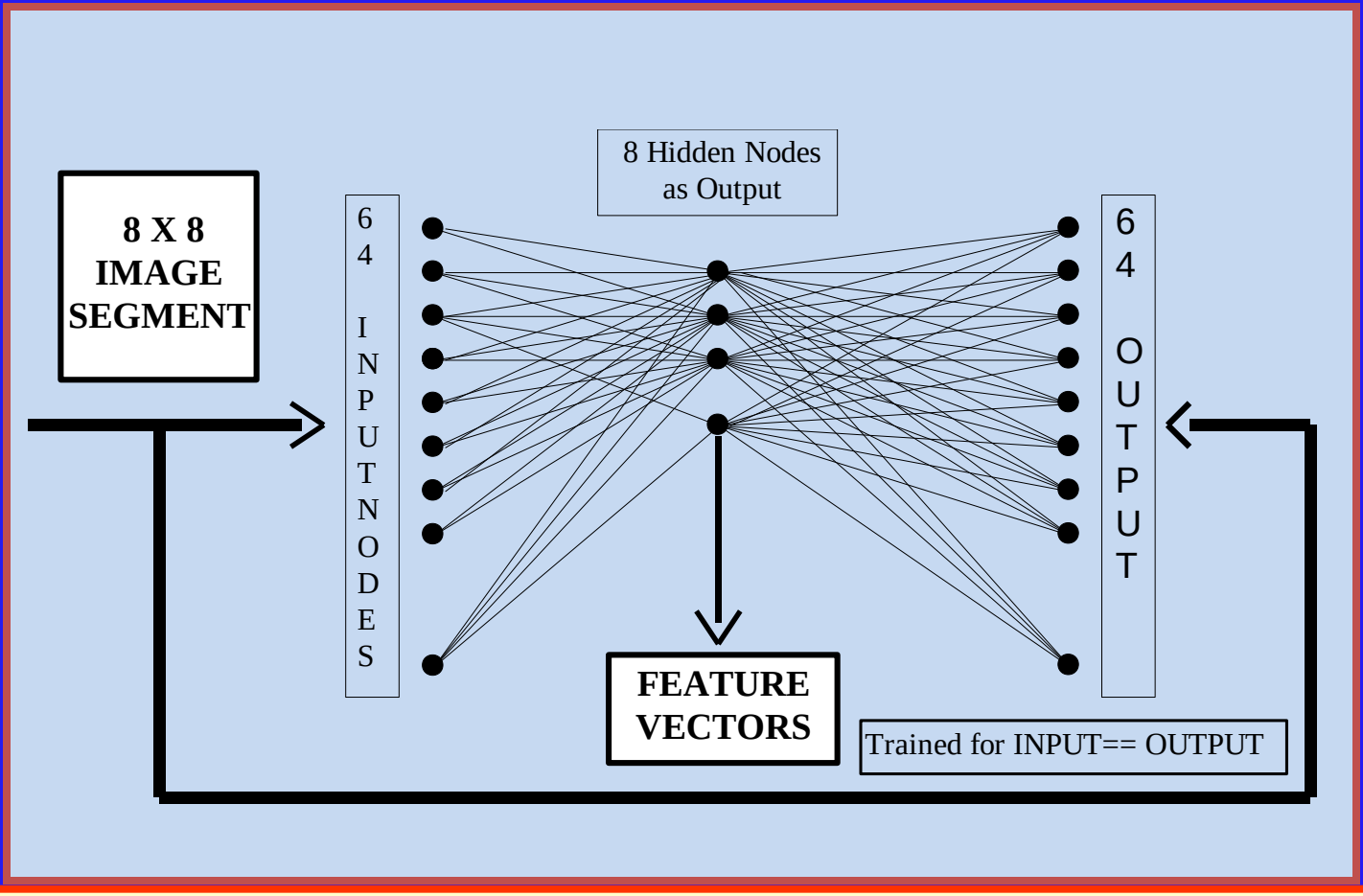
The block diagram of a *Hand Written Character Recognition System* using Neural Network based feature extraction and feature classification.

Hand Written Character Recognition-2

using Multi-Layer Neural Net



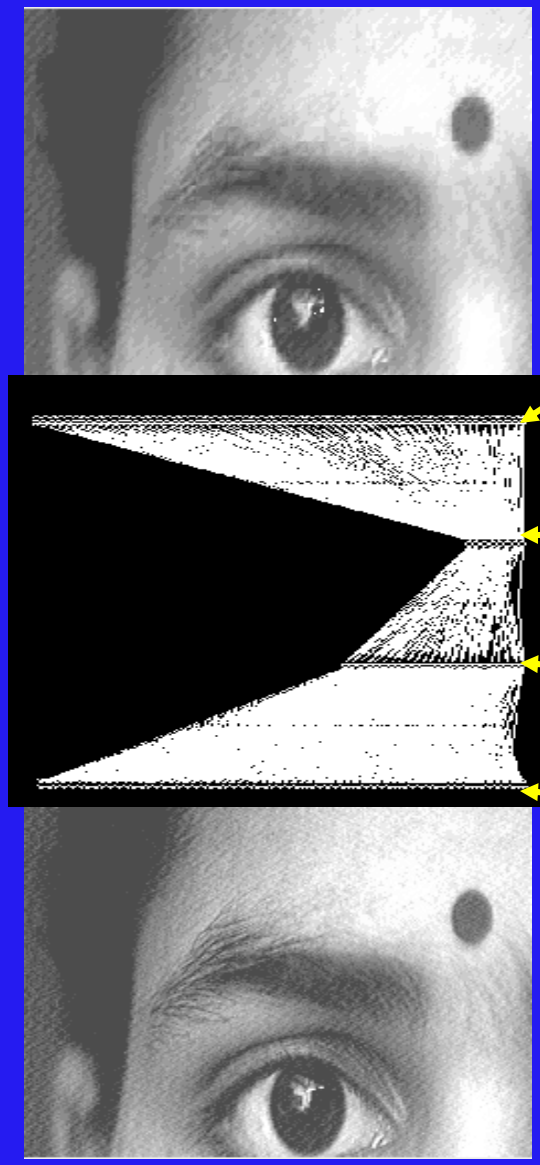
Feature Extraction Using Multi Layer Neural Network



In above diagram 64 output neurons are trained to reproduce 64 input neurons (8x8 image segment) through 8 hidden neurons. The hidden node outputs are used to further classify the image segment.

Image Feature Extraction

Using Multi Layer Neural Network
(Vector Quantization)



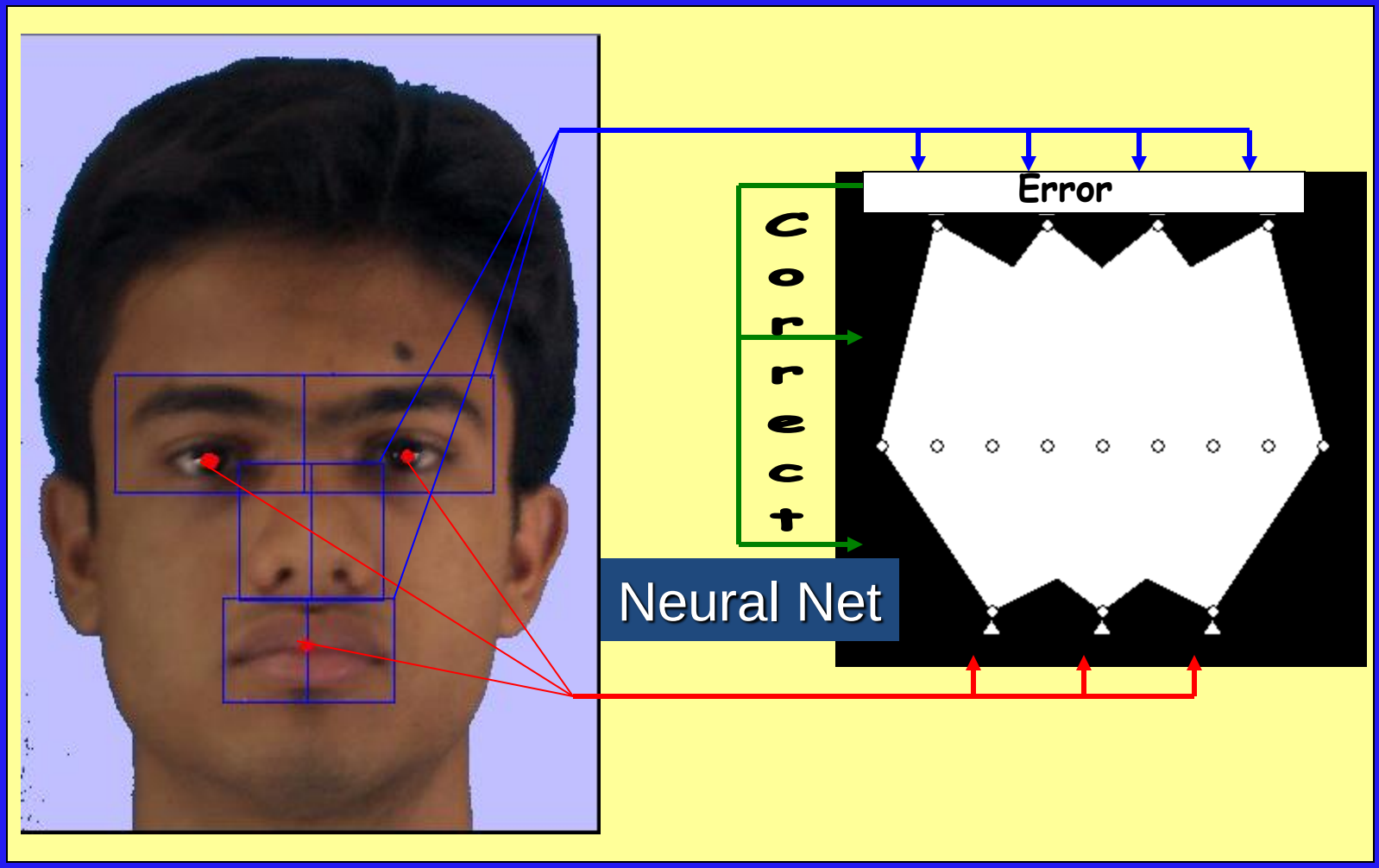
Input Image- 256x256 pixels 256 gray Laval portrait.

Processing Method- Sliding Window of 8x8 (64 pixels).

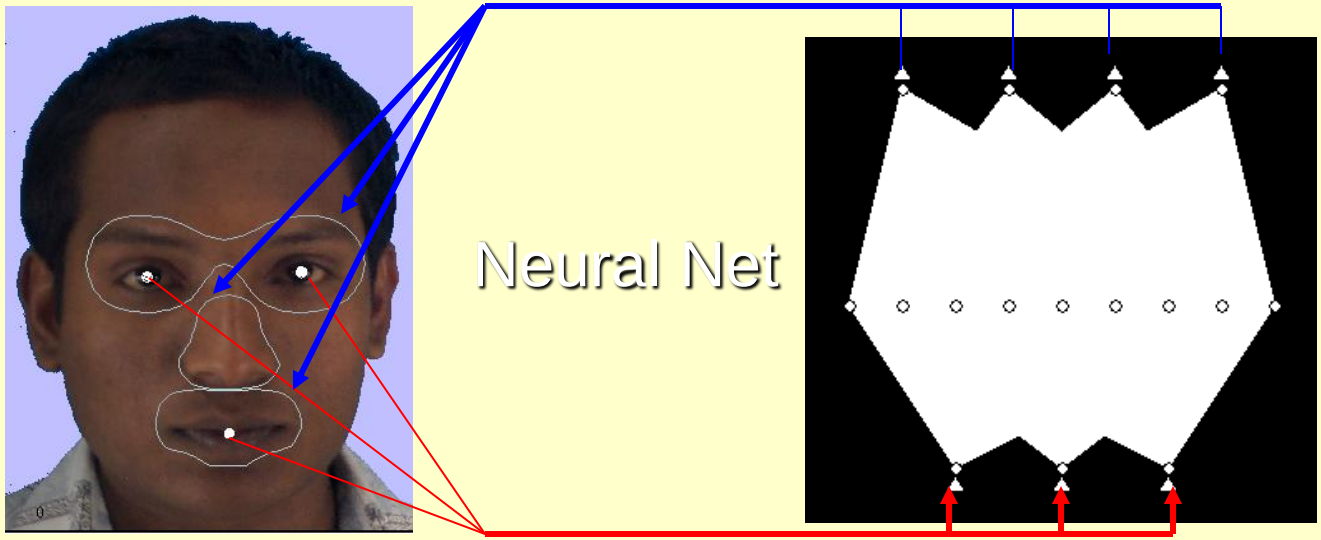
Processing- 64-24-8-64 Multi Layer Neural Net with Analog input-output. Desired Output is kept same as Input while training.

Application-
- Image Compression
- Pattern Recognition
- Noise Filtering

Face Component Boundary Training

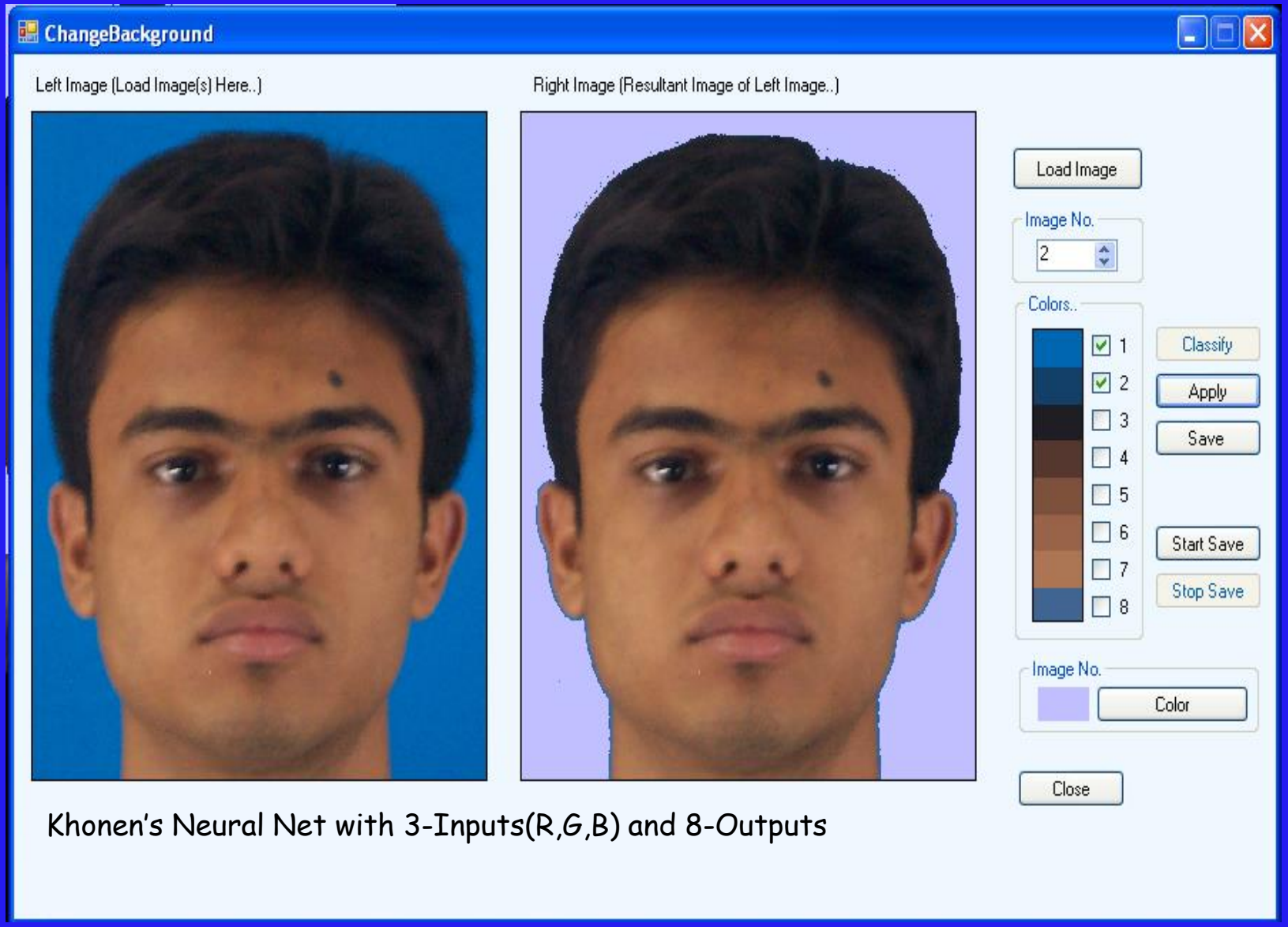


Face Component Boundary Recall



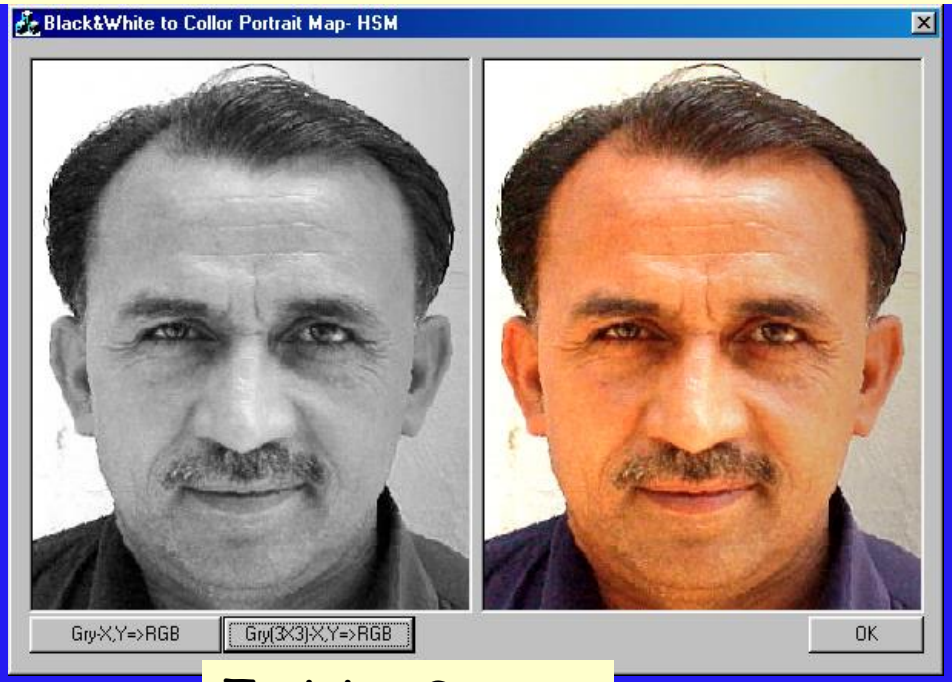


Background Color Change using Neural Net

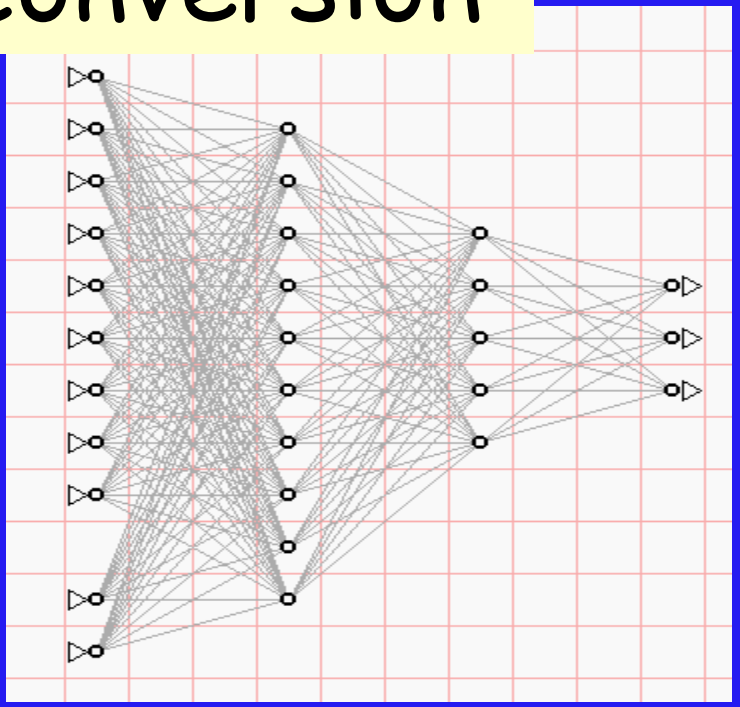


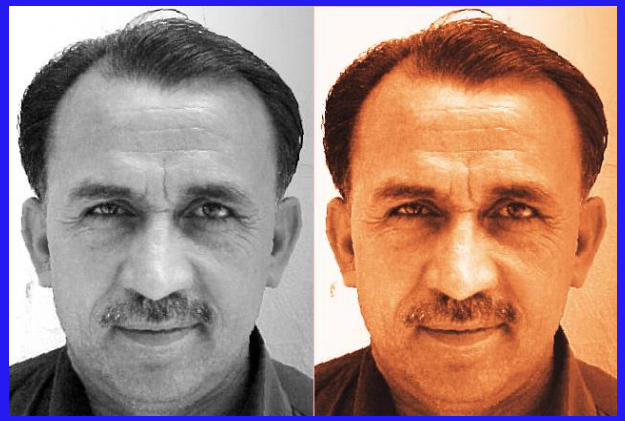
Khonen's Neural Net with 3-Inputs(R,G,B) and 8-Outputs

Gray to Color image conversion



Training Set

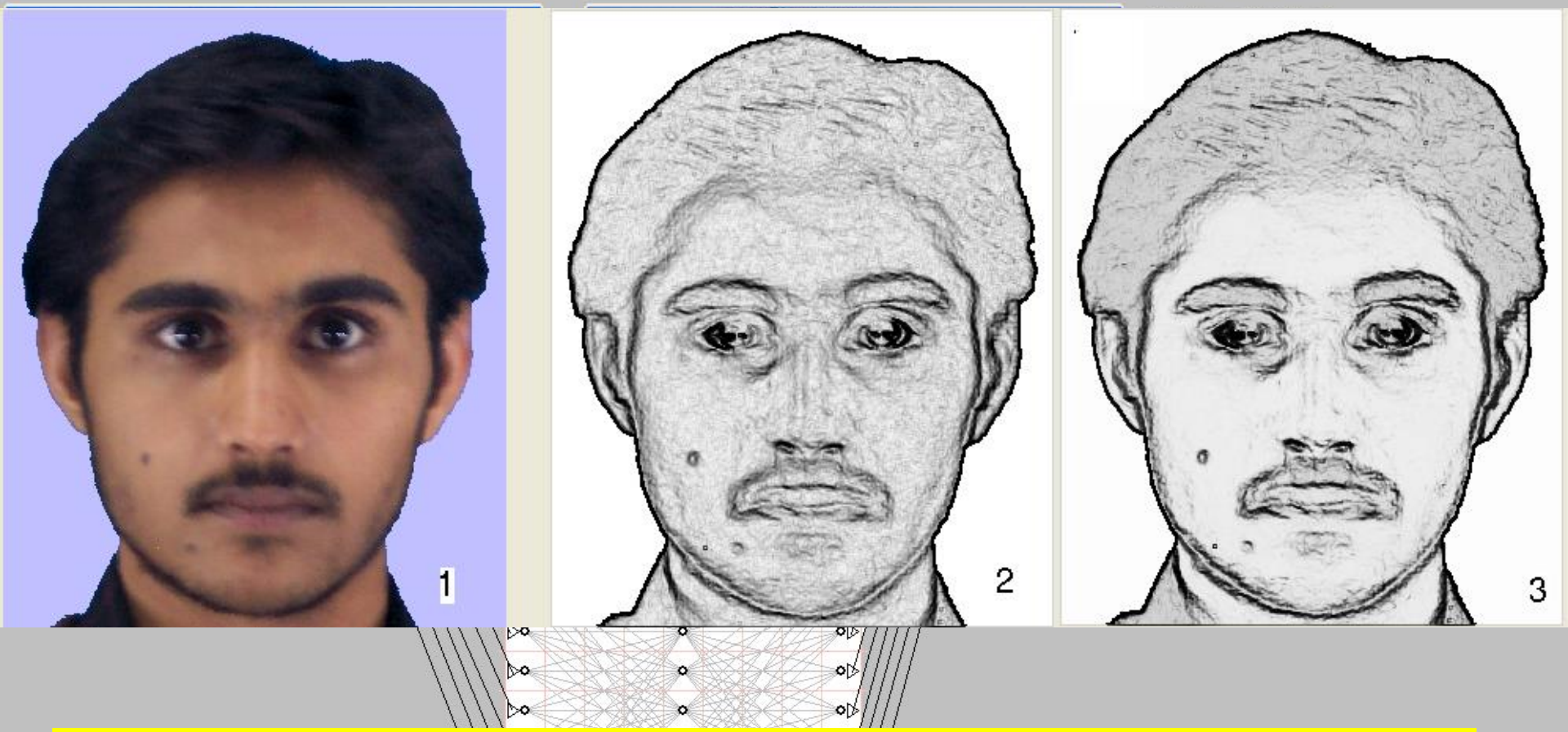




Test Results

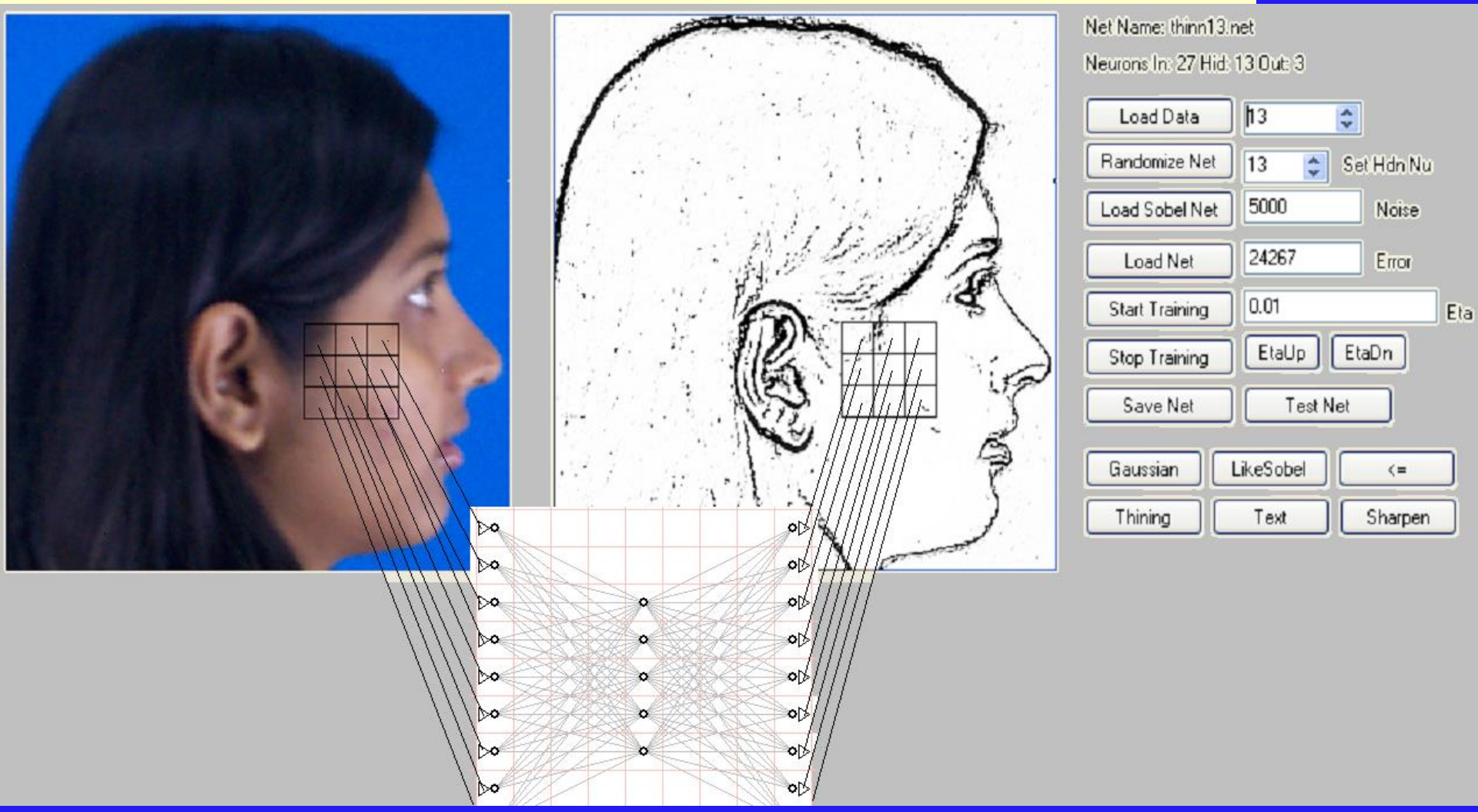


Edge Detection using NN (27-12-3)

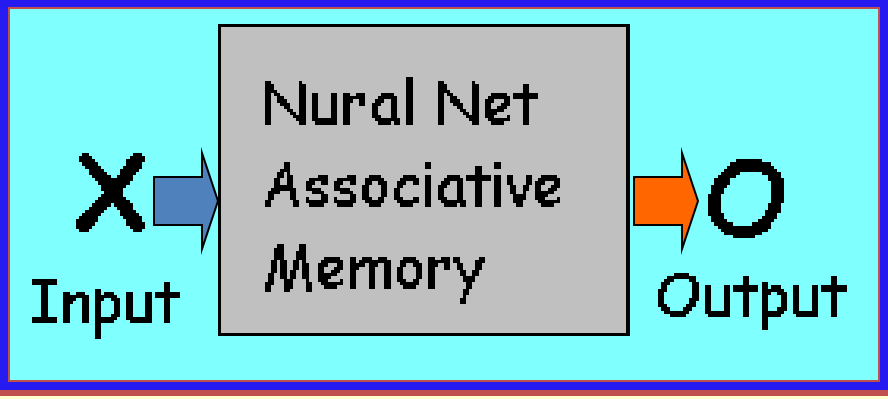


1. Input Image-24bit RGB, sampled 3X3 pixel, 27 inputs
2. Desired output using 4 pass Sobel Operator used for training
3. Output of Neural Net (BP 27-12-3) with reduced noise.

Color image to Sketch



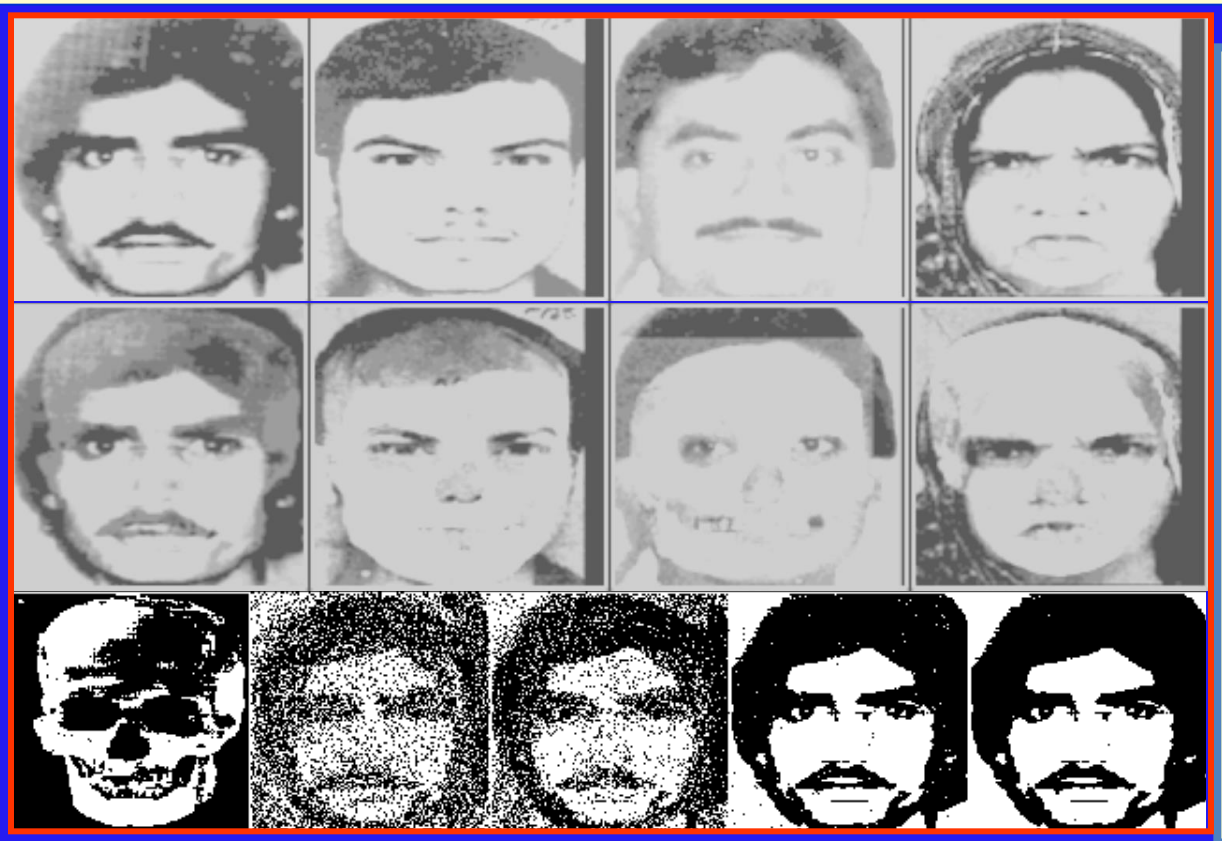
Recalling Orthogonal Image



Successful experiments are carried out with feedback type neural network to recall an image from completely dissimilar (orthogonal) input image.
For example the network is inputted with the alphabet X and output is trained to converge to the alphabet O.

Skull to Face Recall

Feedback type Neural Network Recalls from Skull to Face



Row 1 here show 128 X 128 x 16 grey image of four faces.

Row 2 shows auto-superimposition of images of rows 1 and corresponding skull images.

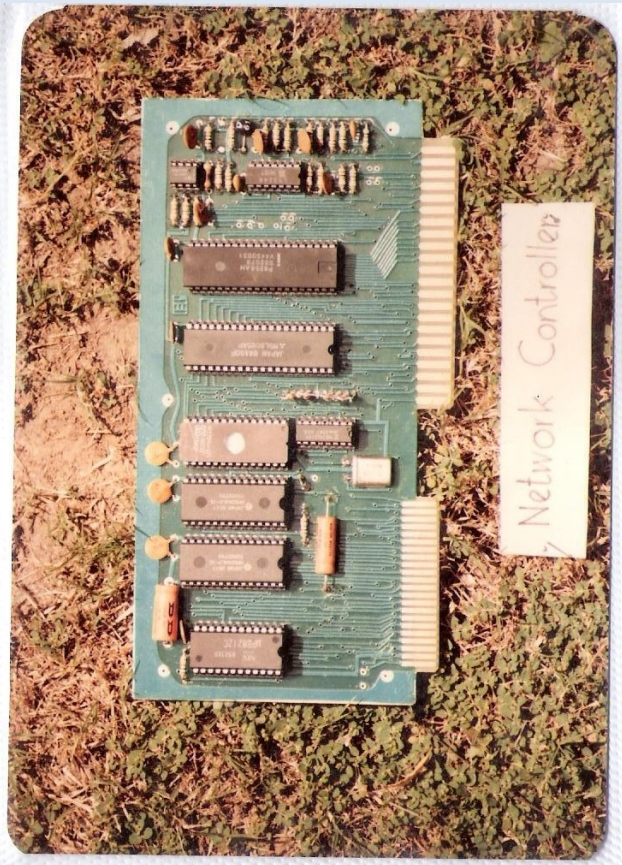
Trained from skull to Face.

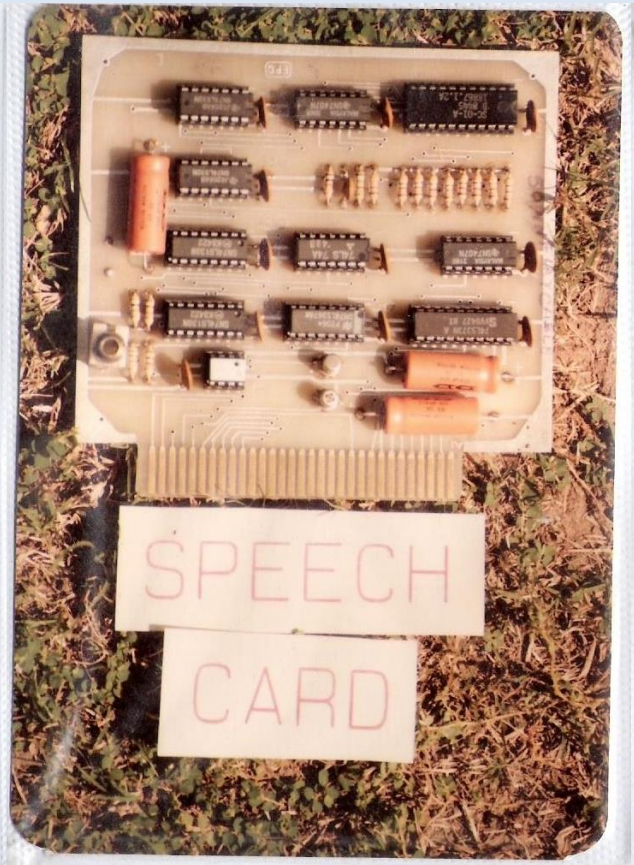
Binary images corresponding to skull and face are used to train a Feed-back type Neural Network (16,000 neurons and 256,000 interconnections). Recall of one of the face image from the skull data is shown in row-3 in different iterations

Walking and Speaking PRL-Robot (1980)

This Robot was developed at PRL before the era of PCs and Compilers. It had an onboard 8085 with 4K-ROM & 4K-RAM. The Robot took typed natural language navigation commands in English, Hindi and Gujarati. We (hsm, rsc) developed a FORTH language cornel for this Robot of definable syntax.

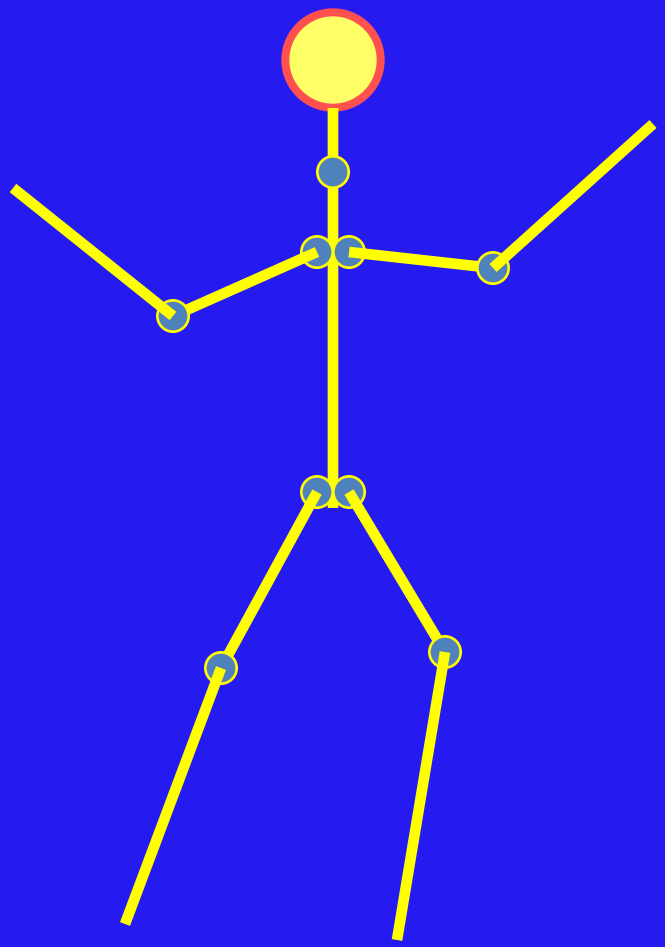






Simulated Walking Robot's Limbs

Limbs	Joints
Head and Neck	1
Body	5
Left Arm1	2
Left Arm2	1
Right Arm1	2
Right Arm2	1
Left Thigh	2
Left Leg	1
Right Thighs	2
Right Leg	1



Walking Rules-

(a) Keep the CG between Legs

(b) Minimize the Energy

(c) Minimize the Time

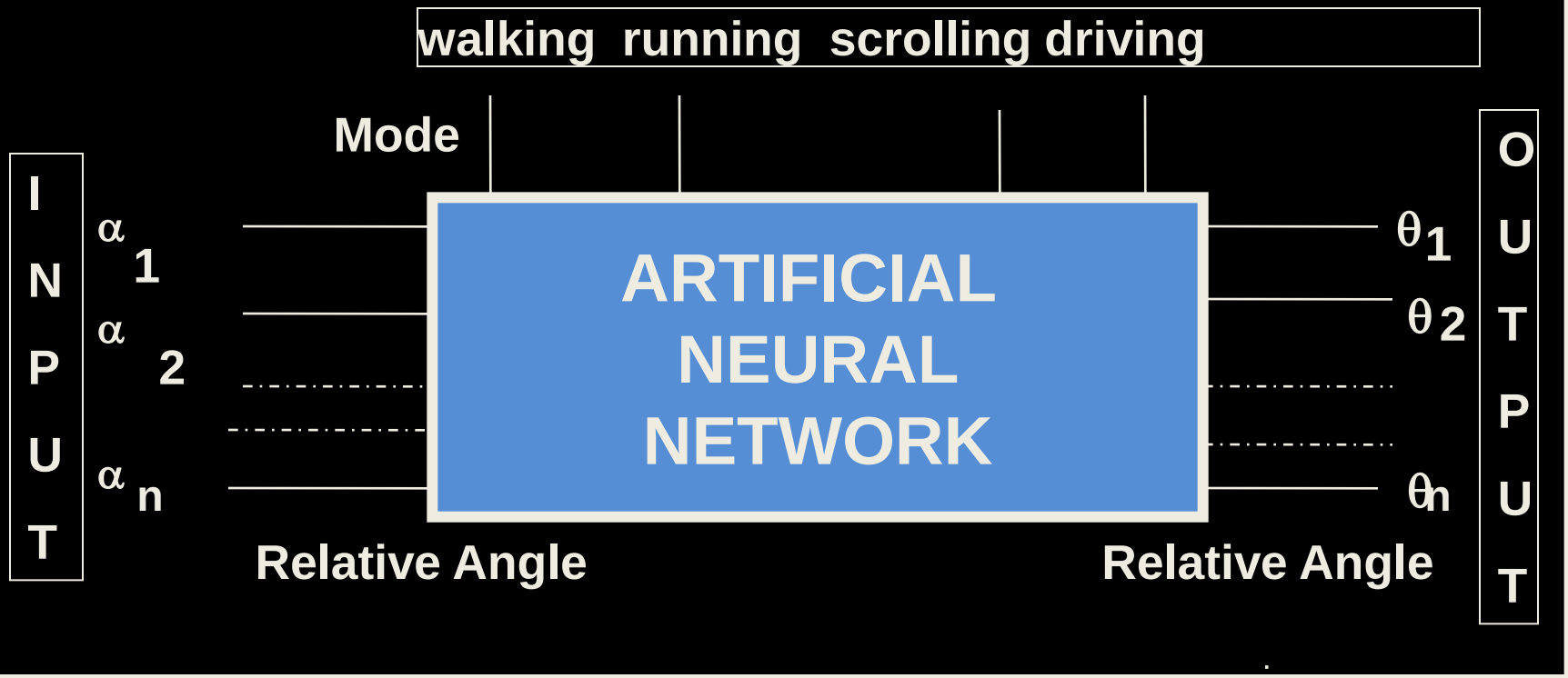
(d) Minimize the distance between the present CG and the next desired position of CG

(e) Keep at least one leg touching ground surface At all times

(f) Do not drag the limbs on the ground surface

(g) No limb should go below ground surface

Walking Algorithm of Two Legged Robot

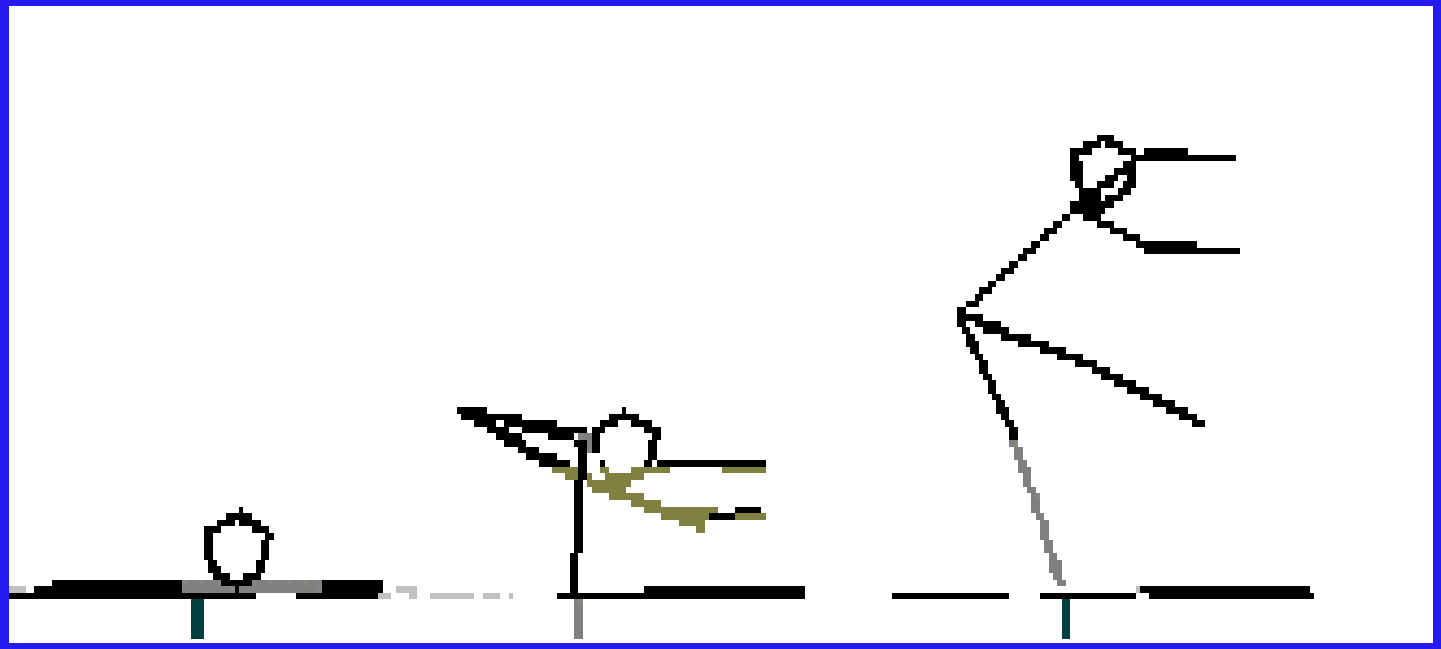


Error = (Desired CG – Present CG) //CG is Center of Gravity

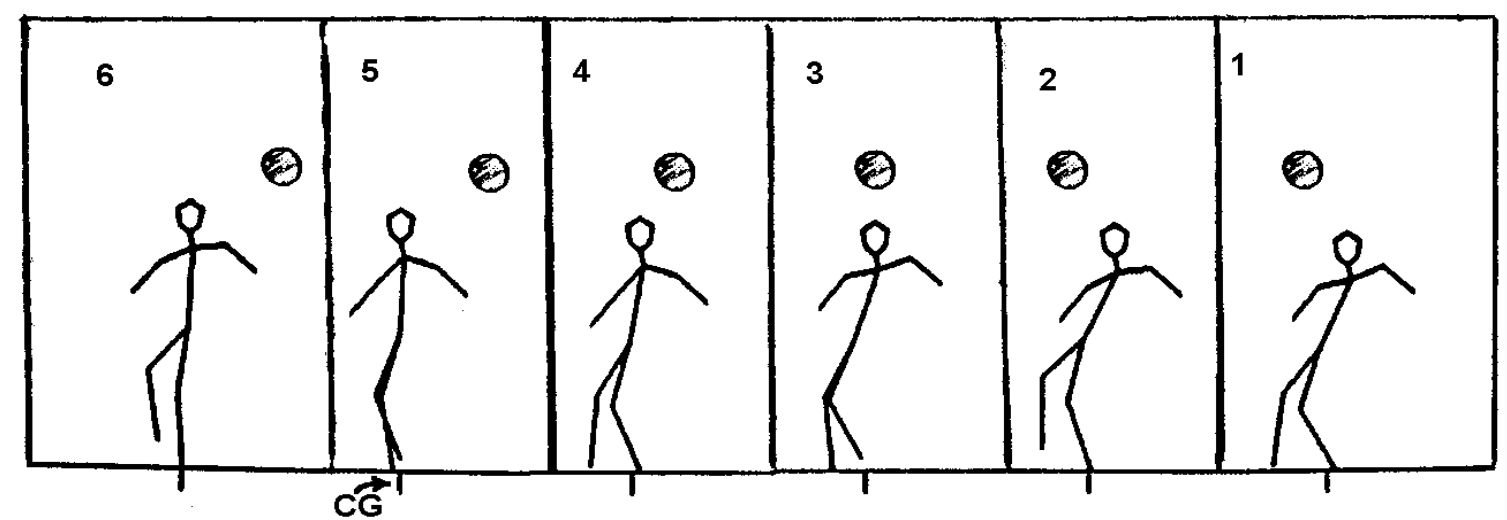
Error Gradient = $\delta(\text{Error})/\delta(\alpha_n)$

$\theta_{n} = \alpha_n + \eta$ * Error Gradient (where η is between 0 to 0.1)

Initial Random Position before Walking

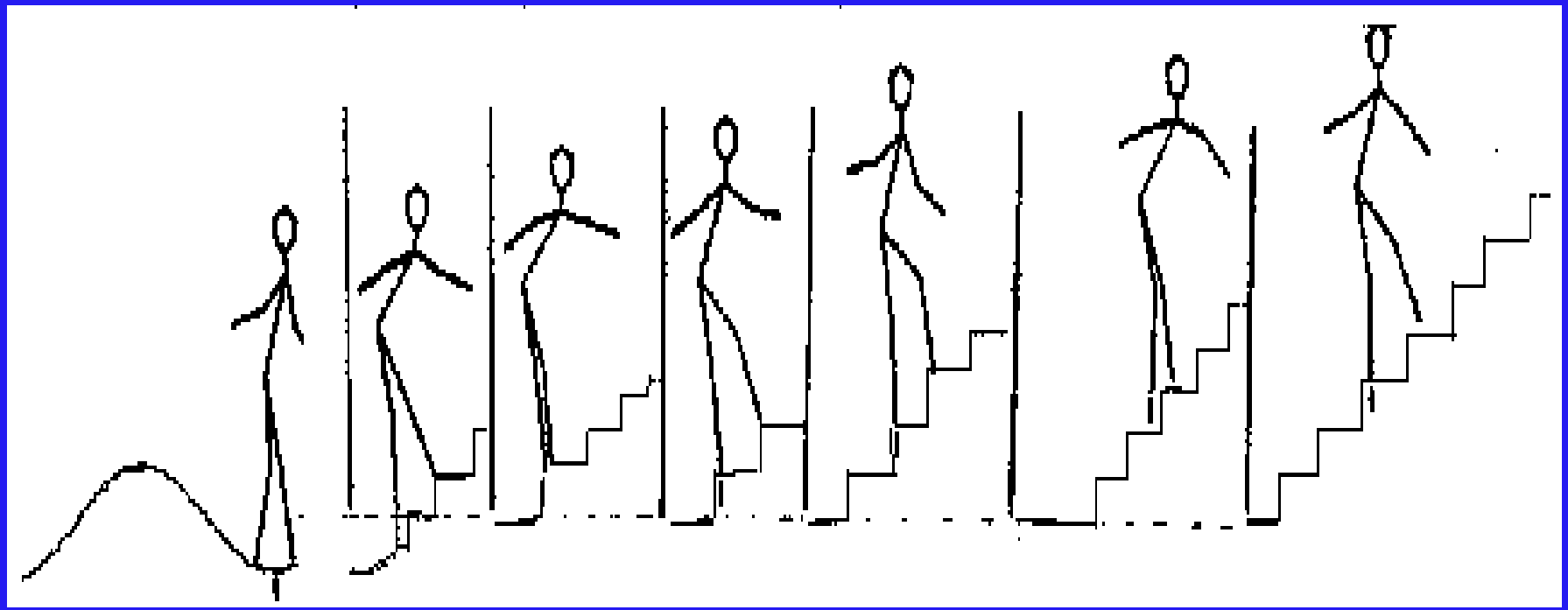


Robot waking from right to left

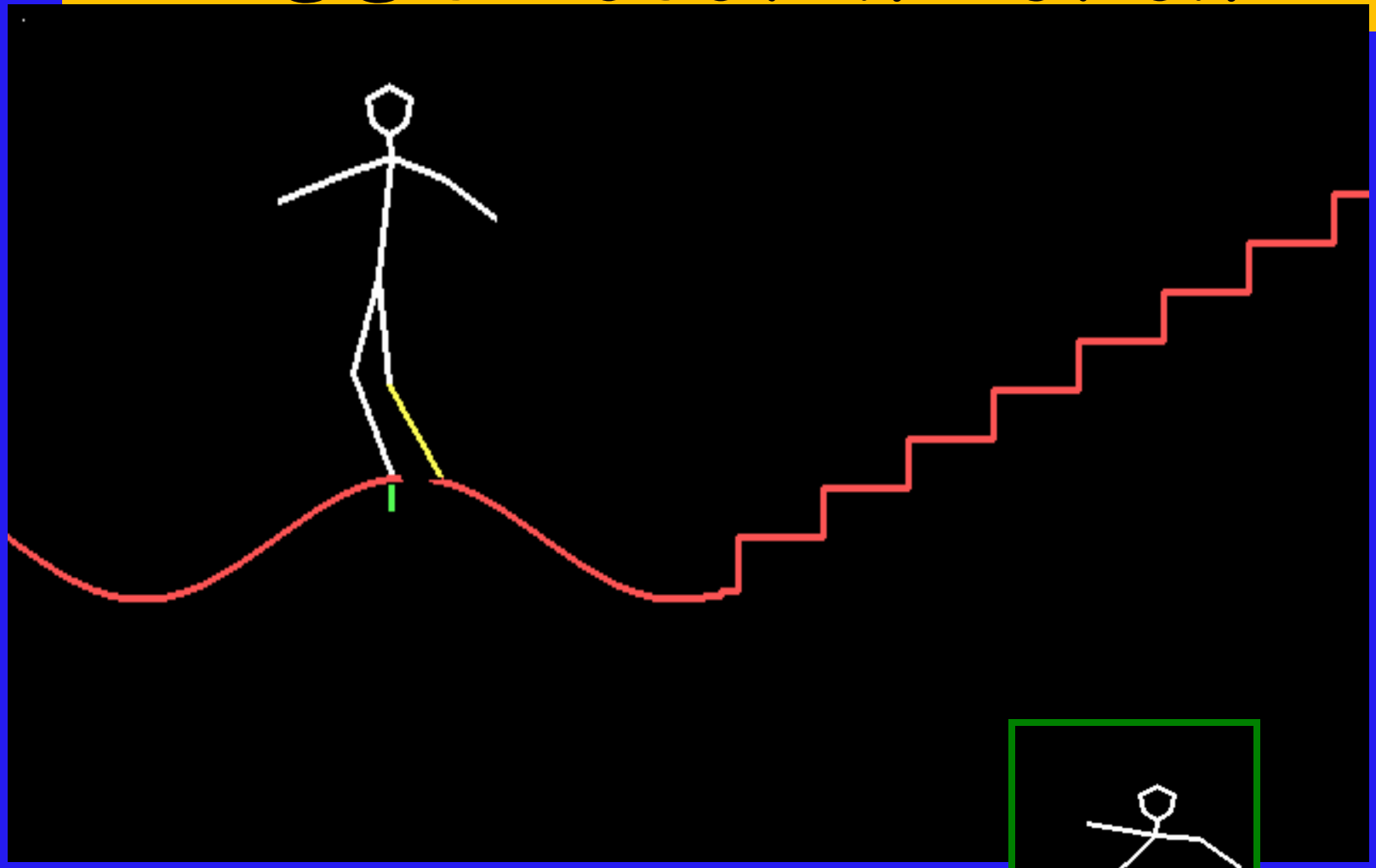


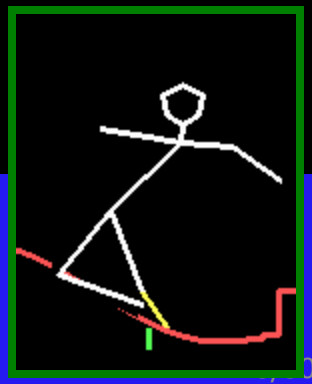
(captured pictures of several frames)

The simulated model climbing staircase



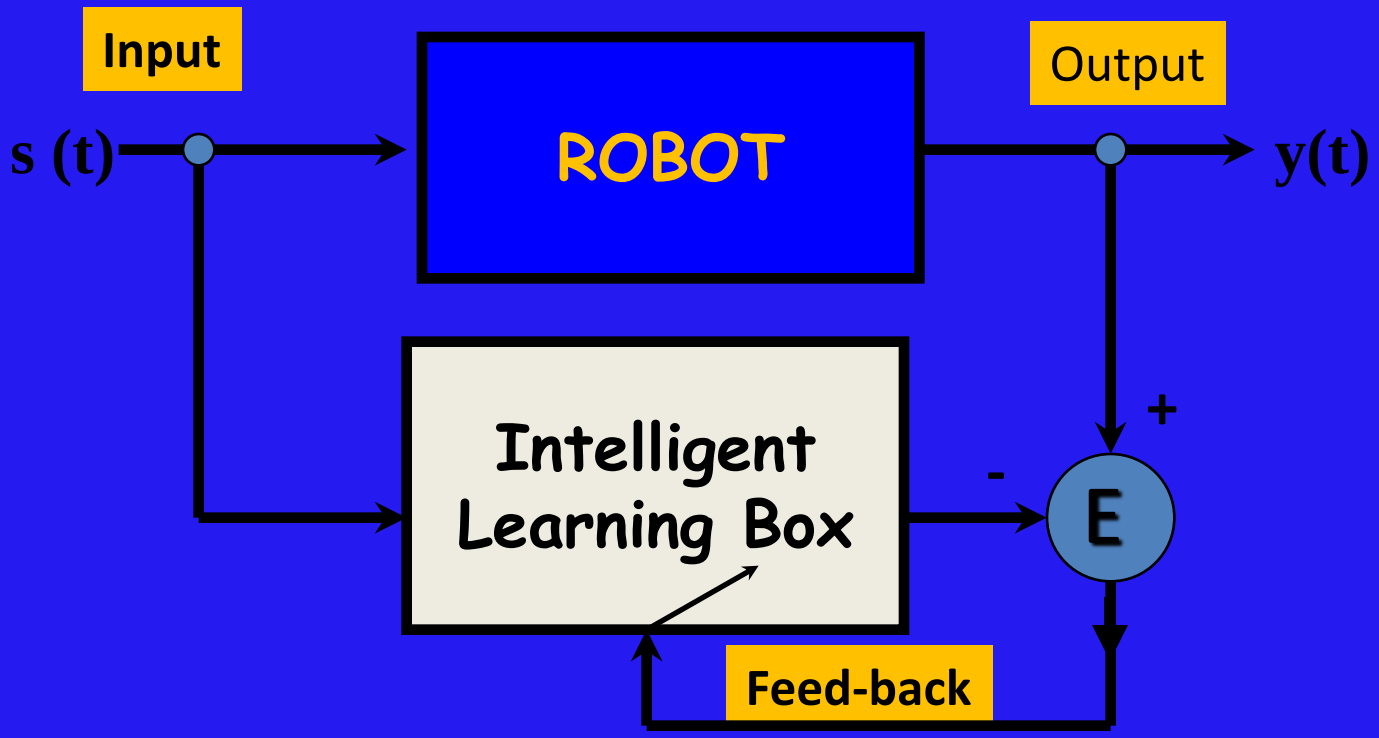
DDU Robot in Action



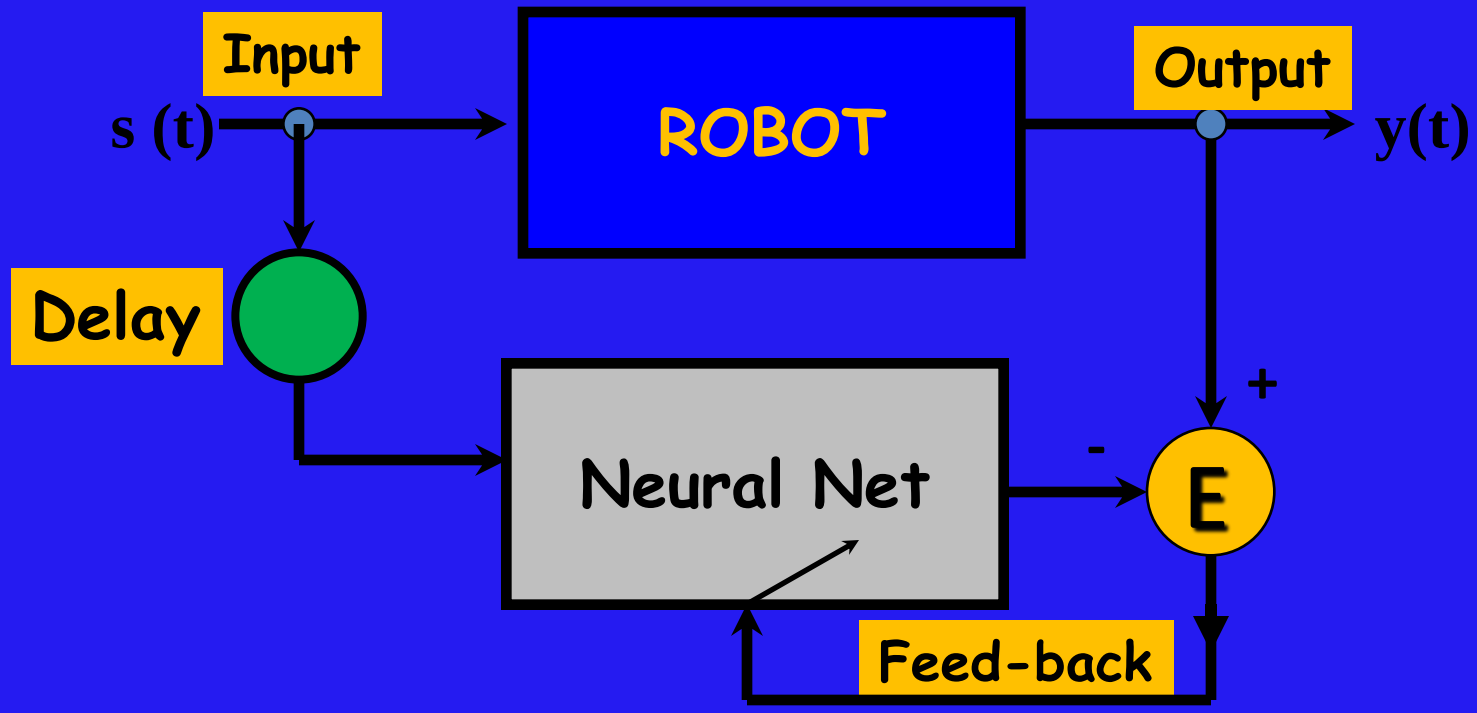


Walking with Amputated Leg

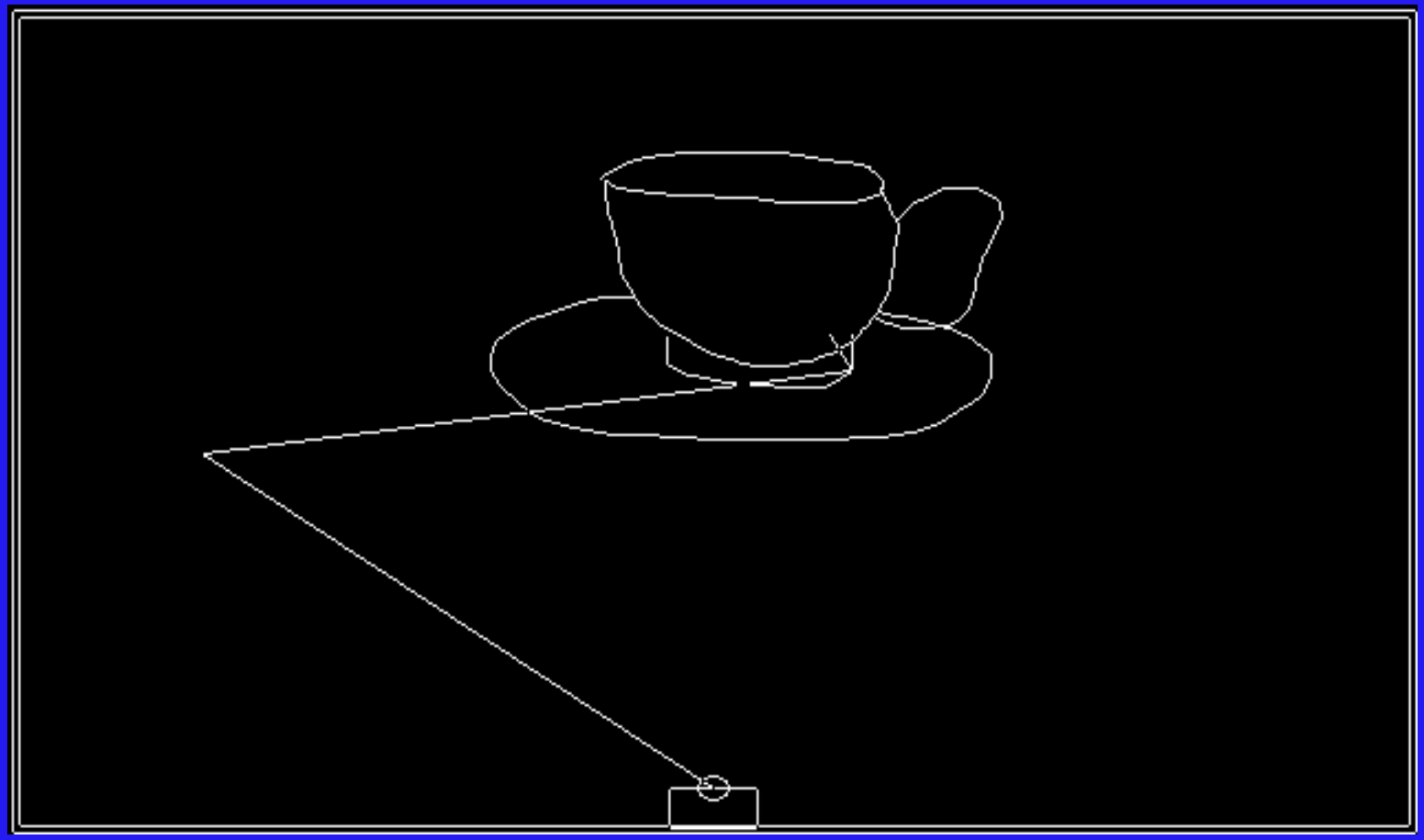
Neural Net Modeling



Predictive Modeling of Robot for Security



Simulation of Pick and Place Robotic Arm



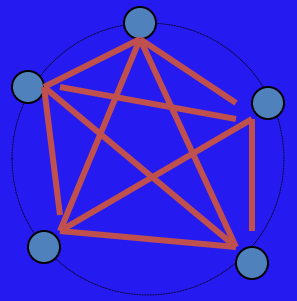
Demo of Robotic Arm
cup, robo, boy, raja, wishes

Partially Connected Feedback Neural Network

*Hopfield's Net of N neurons needs N^2 connections. *Number of connections increases rapidly with number of neurons.
*To implement content addressable large image memory, partially connected net is used. *The connection needs to be optimized for given set of images to be remembered.
An algorithm is developed to optimize the connections-

Algorithm-

- Connect small number of links randomly.
- Load one of the Image with small random noise.
- Update and train the net couple of times.
- Accumulate the error for each neuron.
- Add new few links randomly between max. and min. error neurons.
- Remove few links at random.
- Repeat the operation till error reduces.



20 Inter Links
+ 5 Bias Links
= 25 Links
for 5 Neurons

Example of Partially Connected Feedback Neural Network

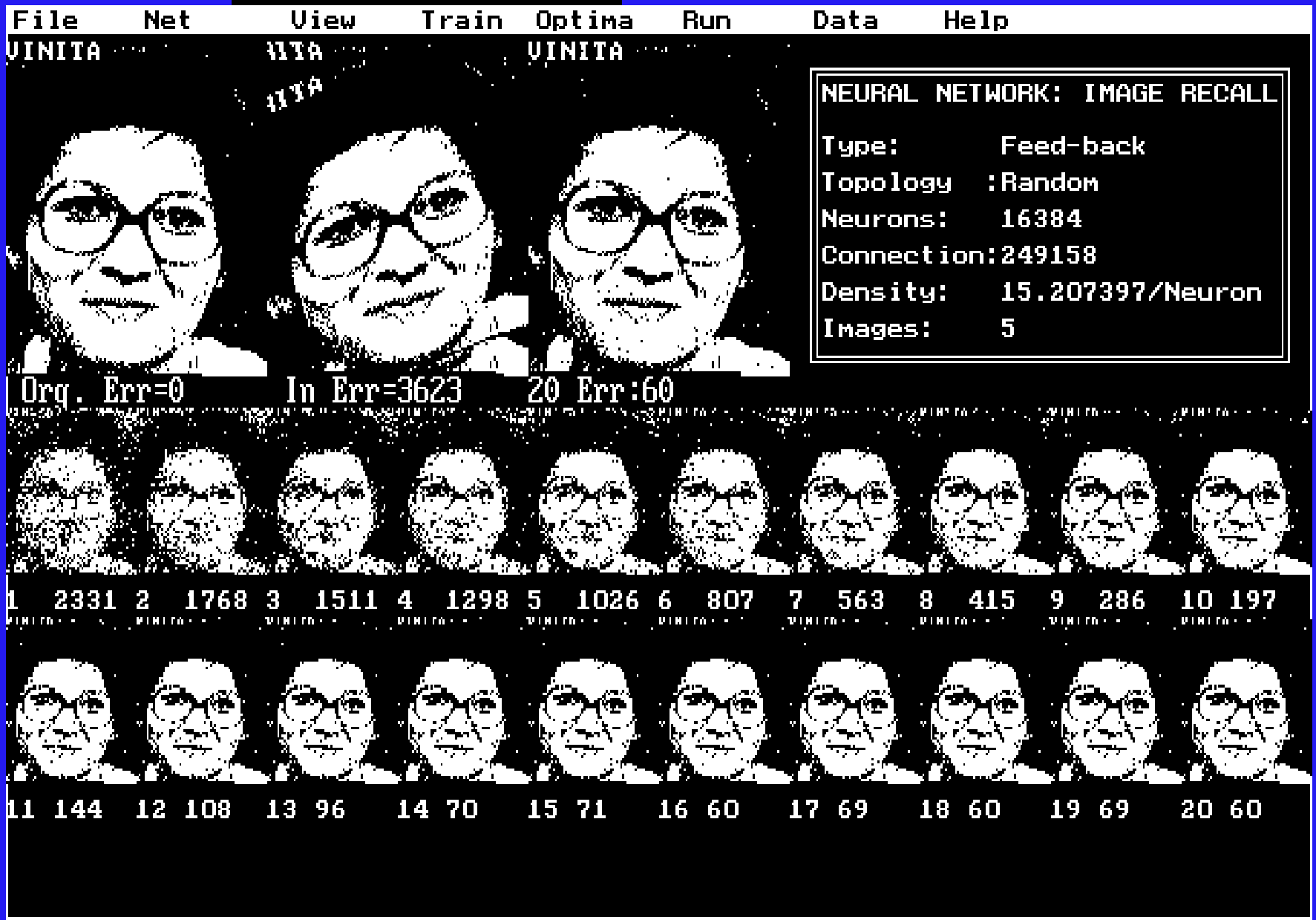
Network Configuration-

Neurons- 16384 (128x128)
Connections- 249158
Connection Method- Randomly Partial.
Average Connection
Per Neuron - 15.207/Neuron

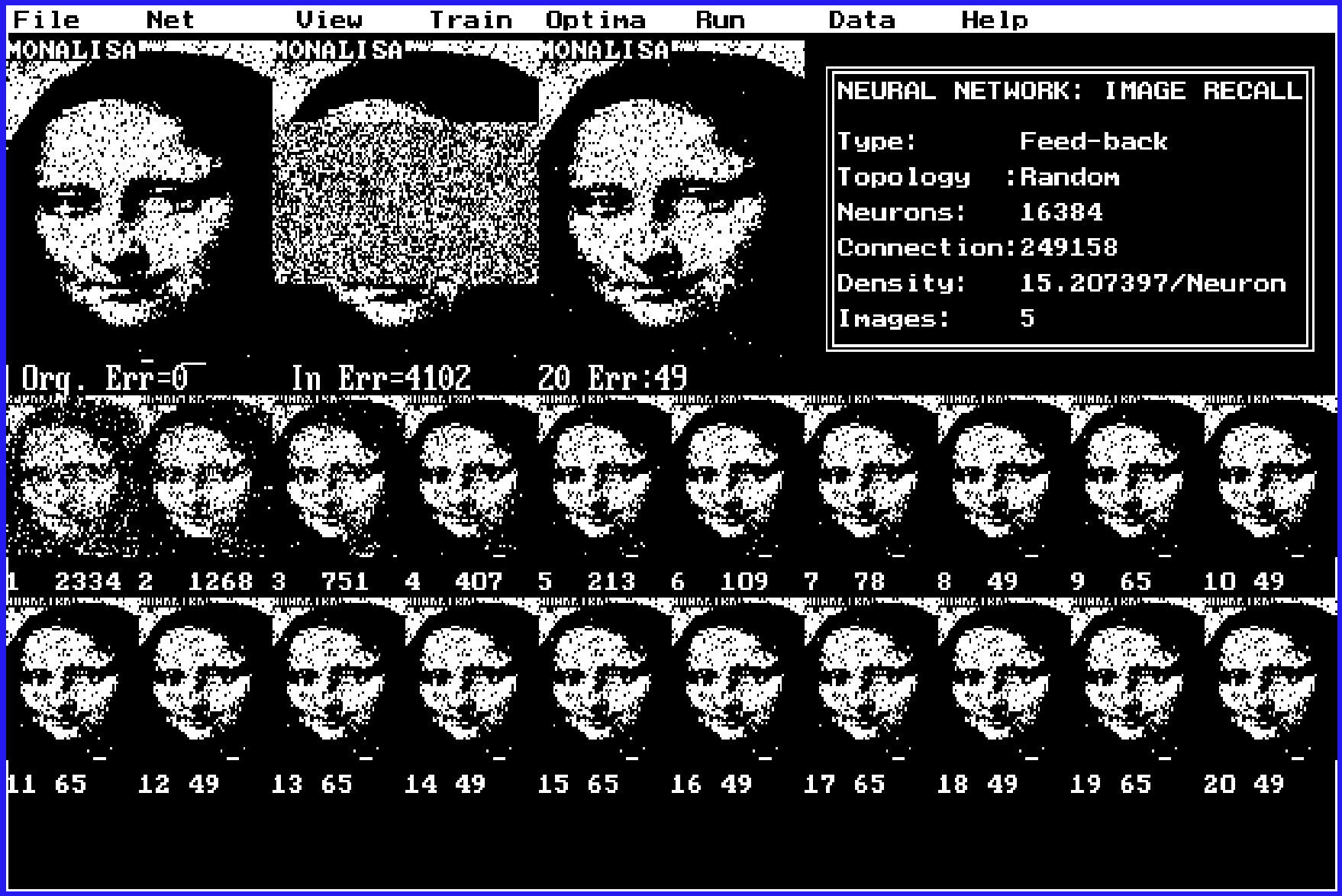
Training- $Wgt_{ij} = Wgt_{ij} + eta * (Y_i - d_i) * Y_j$

Application- Human Face Recognition (Associative Memory)
Input Images- 5 Binary Images of Face (128x128)
Average Recall Error-50 in 8128 or 0.6 %

TILTED INPUT

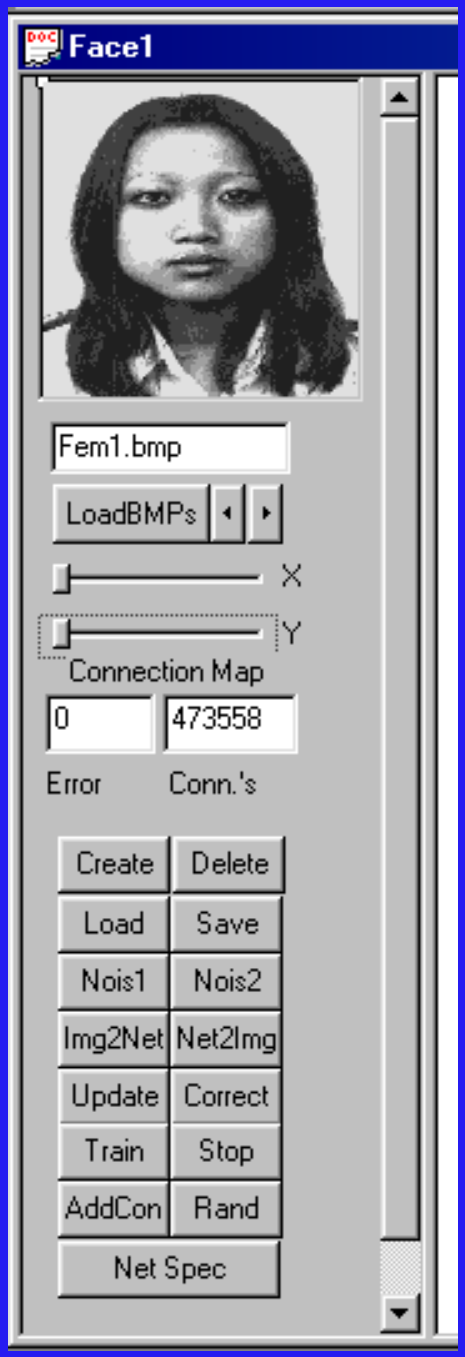


PARTIAL INPUT



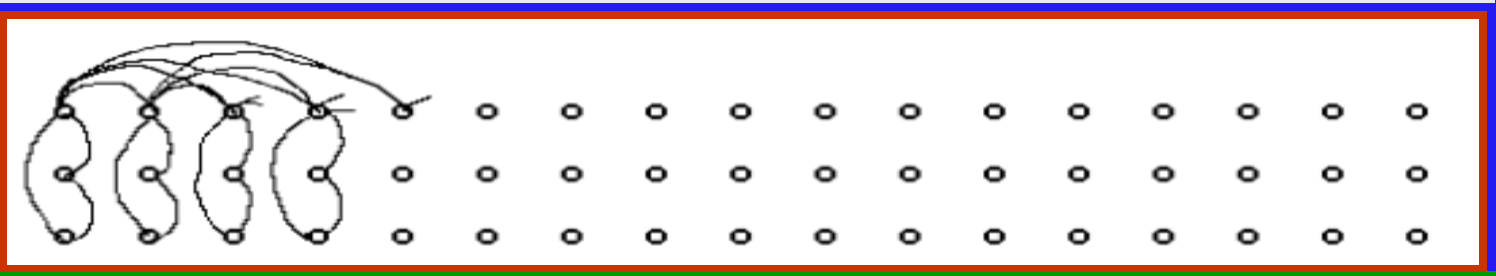
NOISY INPUT


File Net View Train Optima Run Data Help
PIYU
PIYU
NEURAL NETWORK: IMAGE RECALL
Type: Feed-back
Topology :Random
Neurons: 16384
Connection:249158
Density: 15.207397/Neuron
Images: 5
Org. Err=0
In Err=6011
20 Err:52
1 4279 2 2753 3 2030 4 1546 5 1187 6 901 7 631 8 395 9 236 10 127
11 87 12 61 13 59 14 53 15 56 16 52 17 56 18 52 19 56 20 52



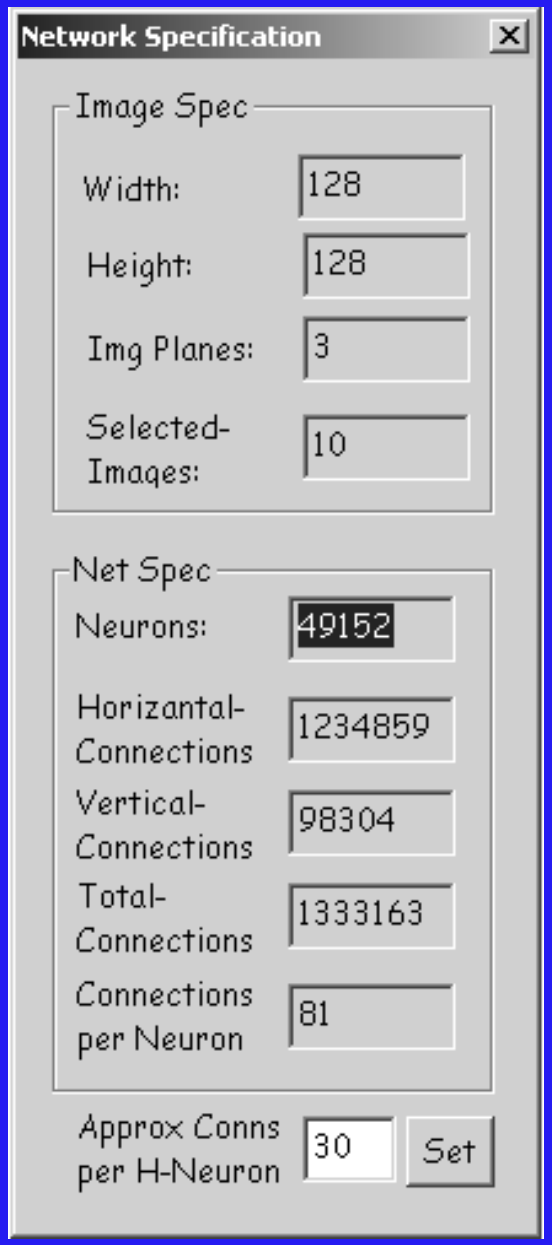
Feedback Neural Net Toolbox

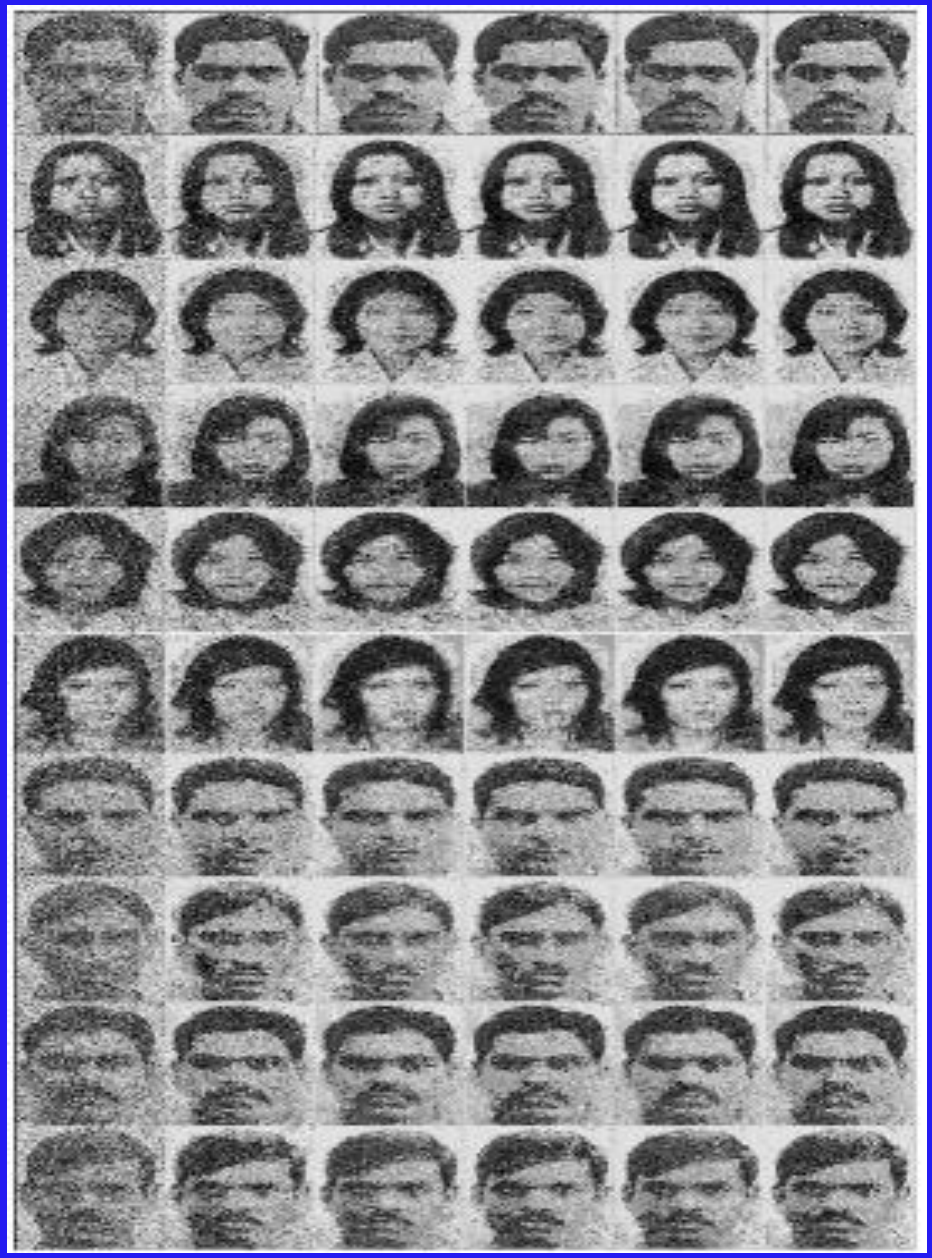
Gray Image Associative Memory



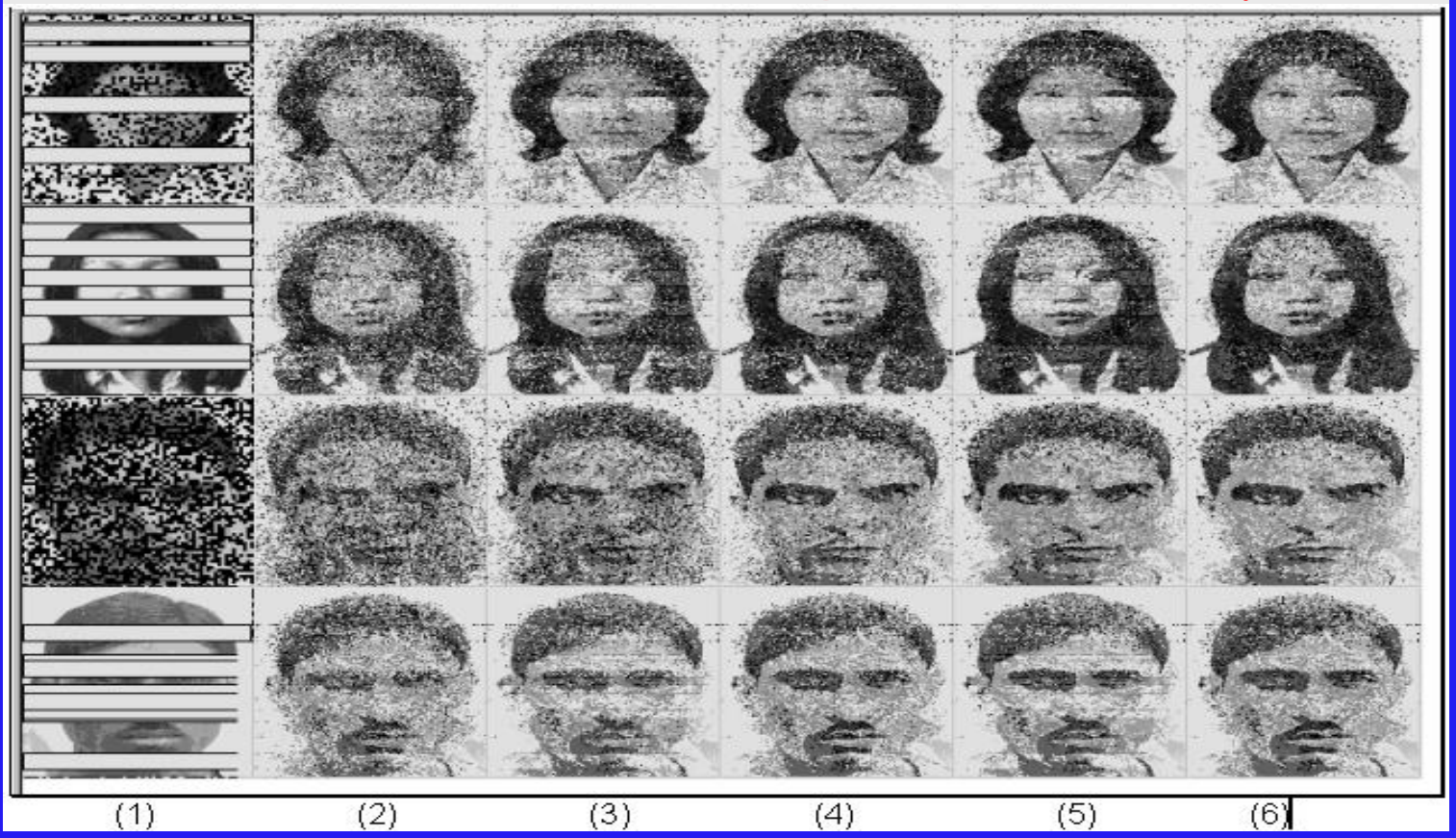
Hopfield's network can store and recall binary images only. A gray level associative image memory model is developed using horizontally and vertically connected neural network configuration. Each vertical group represents a 3 bit(8 gray level) pixel. Vertical neurons are fully connected. Only top layer horizontal neurons are laterally connected. Lateral connections are data dependent and connected partially. Above network is tested successfully to store and recall gray and color images.

Gray Image Associative Memory Toolbox



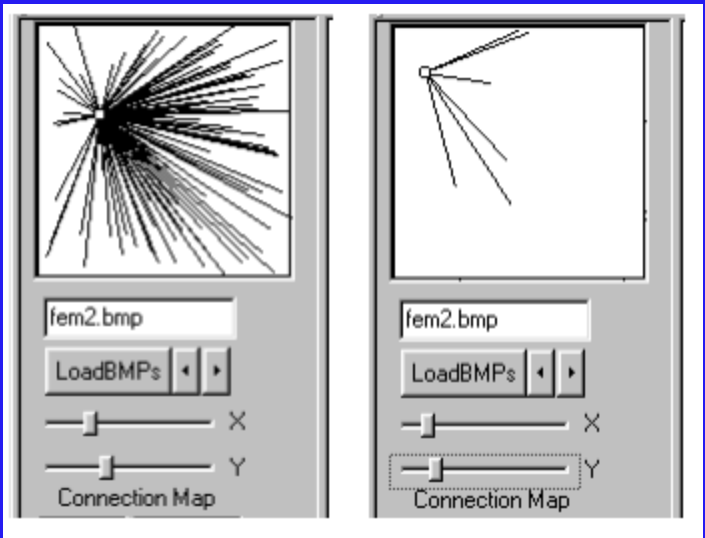


Results of Image Memory



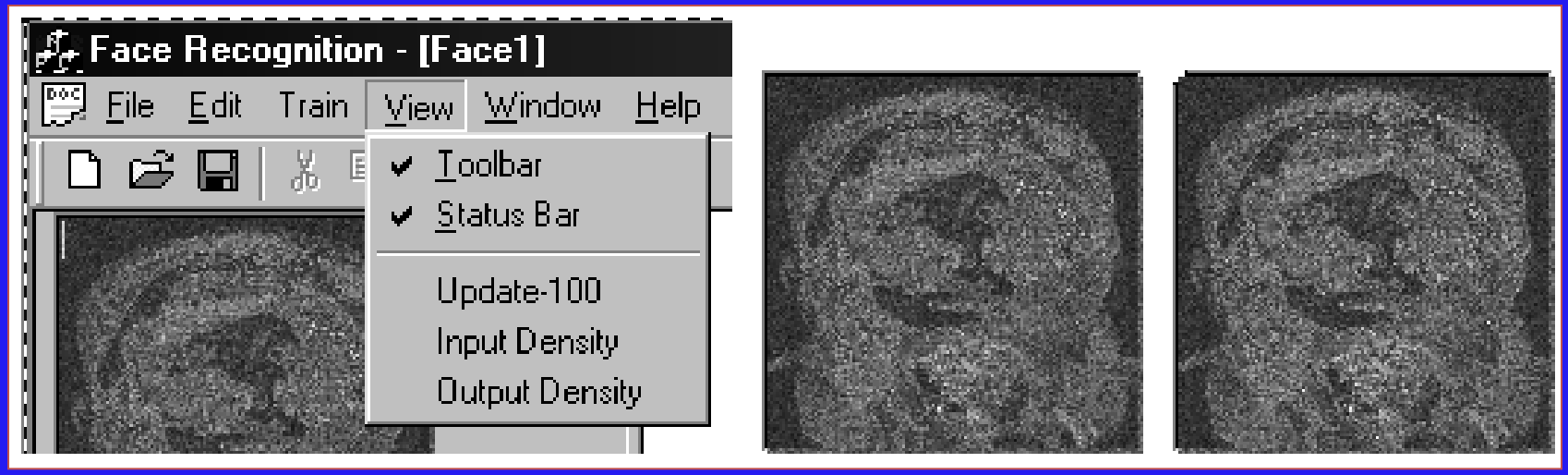
Above figures are result of successive 100 updates of corresponding noisy input image (1) in a partially connected 3 layer feedback type network. Network demonstrates stable memory state for each image(6).

Connection Optimization Result 2



Connection map display of two neurons input at two different places. Difference in connection density is result of network optimization and depends on the training set.

Connection Optimization Result 3



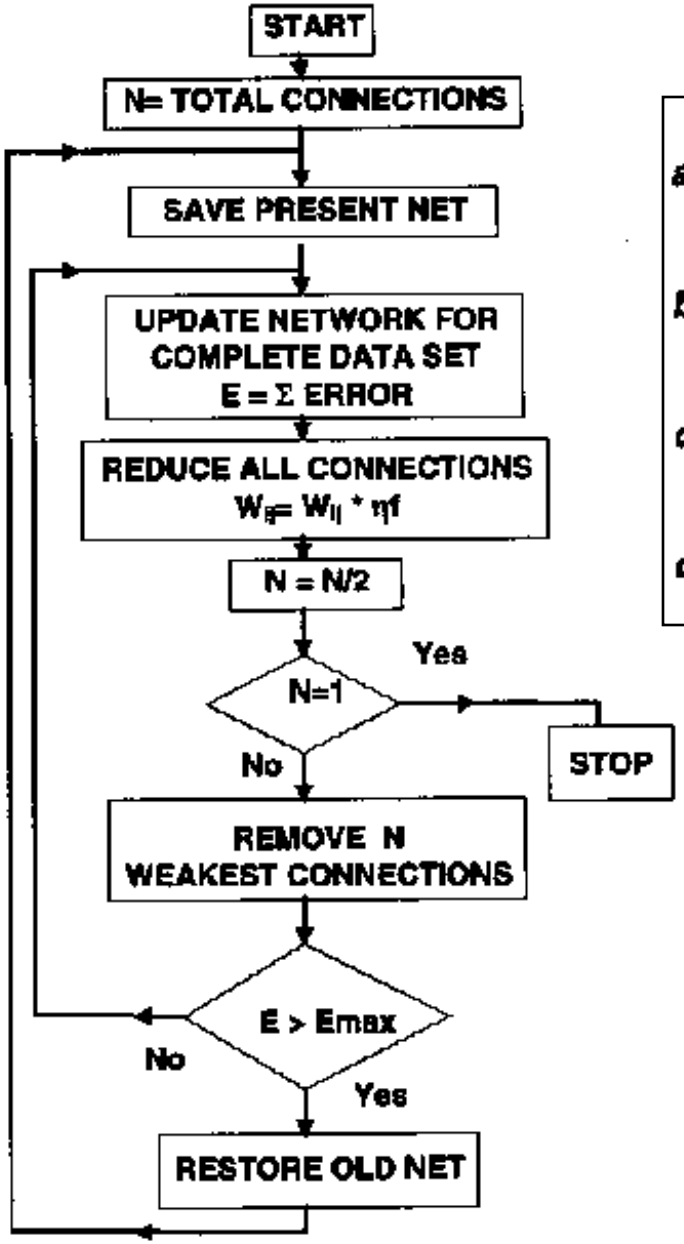
Results of network of face image optimization (1) shows the menu to display connection density. (2) input connection density and (3) output connection **density after optimization**

Connection Optimization Result 1

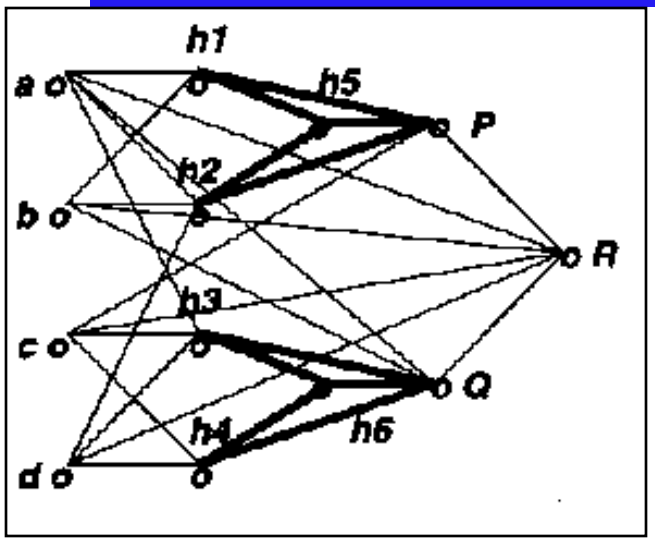


Above figures are result of connection optimization algorithm. Images demonstrate stable memory state for each image

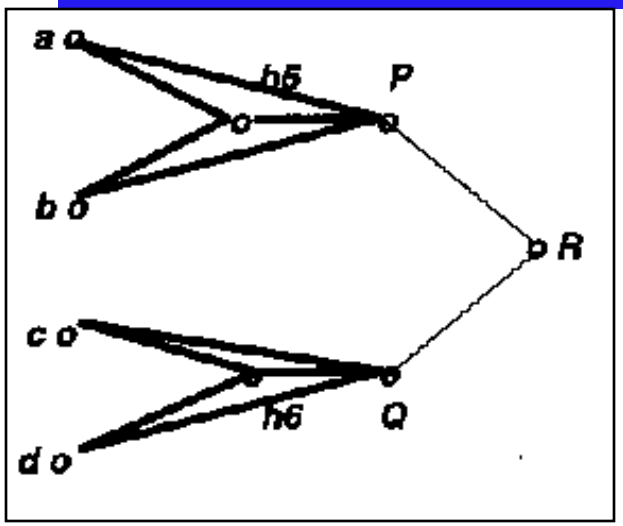
Pruning of MLP



Network Optimizing Algorithm



(a)



(b)

Example-

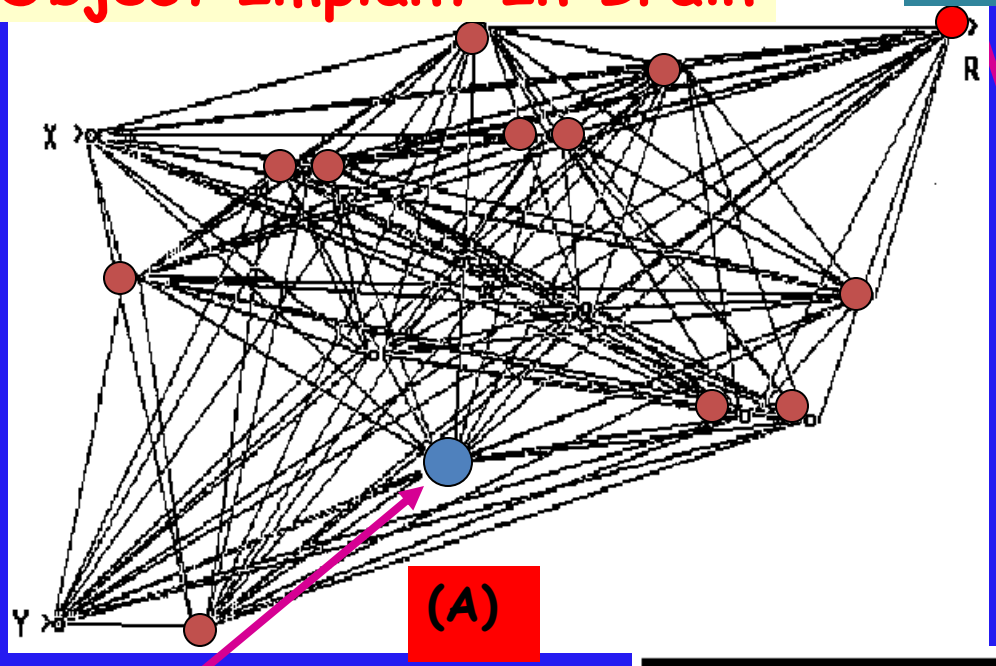
Net (a) is trained to solve logical problem-
R= (a^b) | (c^d)
using-
9 neurons and
64 connection

The net (a) is pruned to net (b) using weak link remove method.

The final net reduces to-
5 neurons and
12 connections

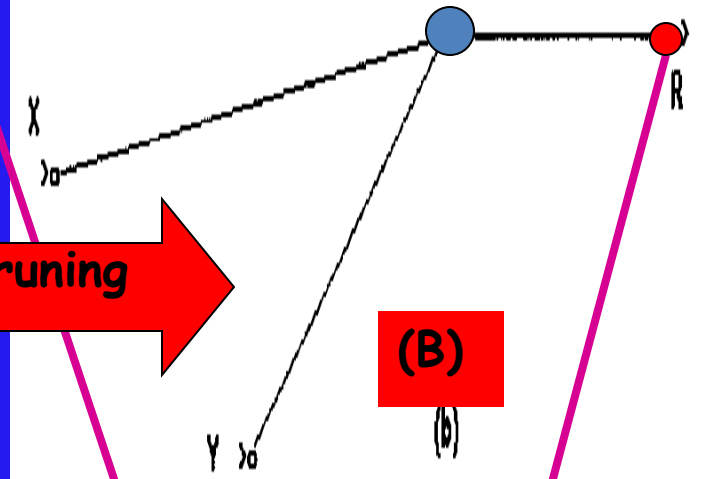
Object Implant In Brain

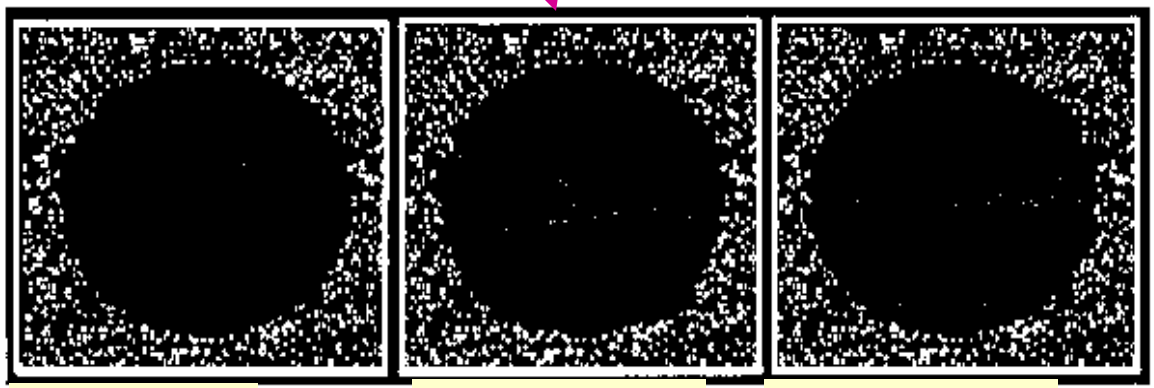
The Discovery Machine



(A)

This neuron uses square of inputs sum





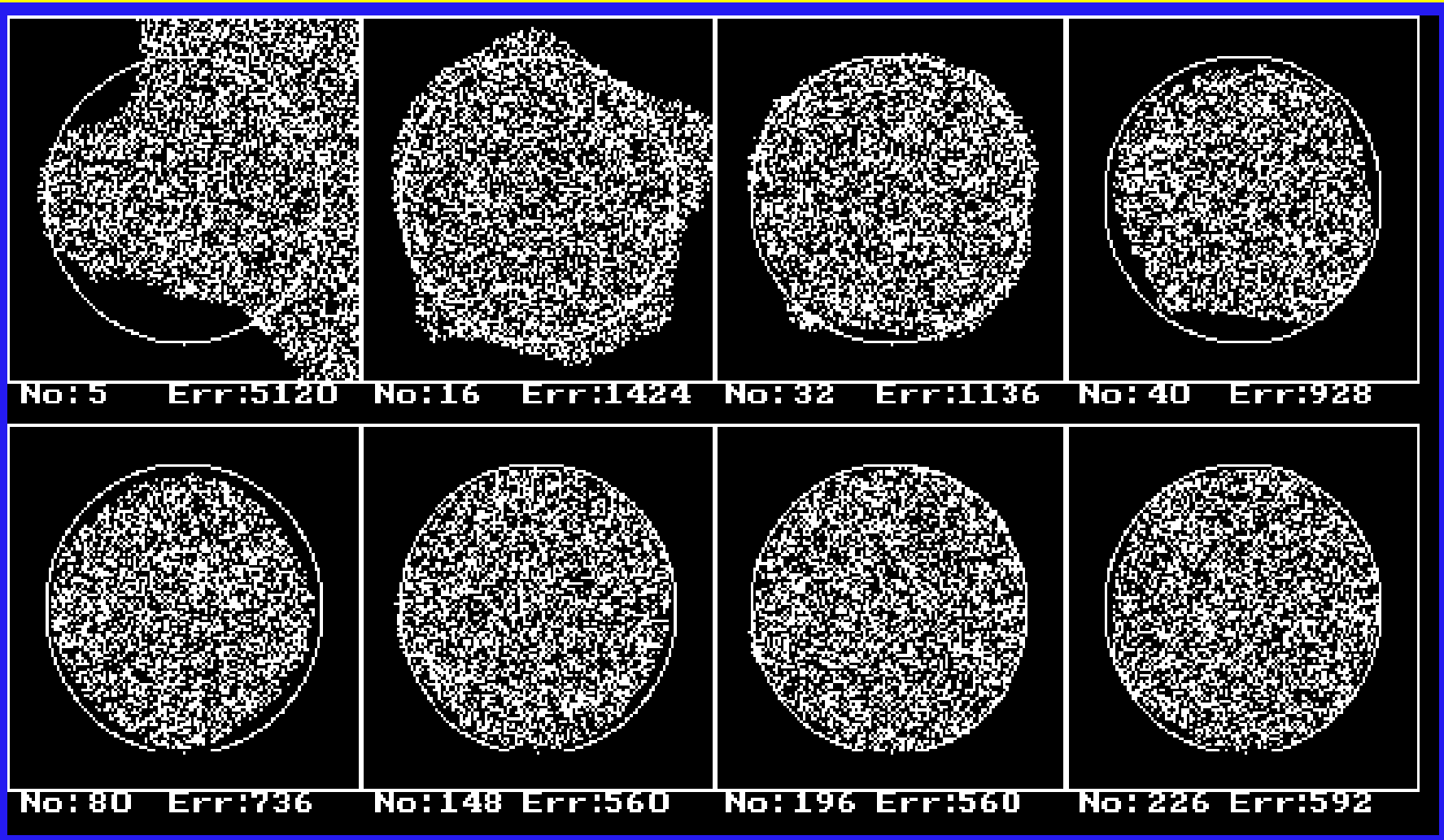
Training Pattern

Output of Net (A)

Output of Net (B)

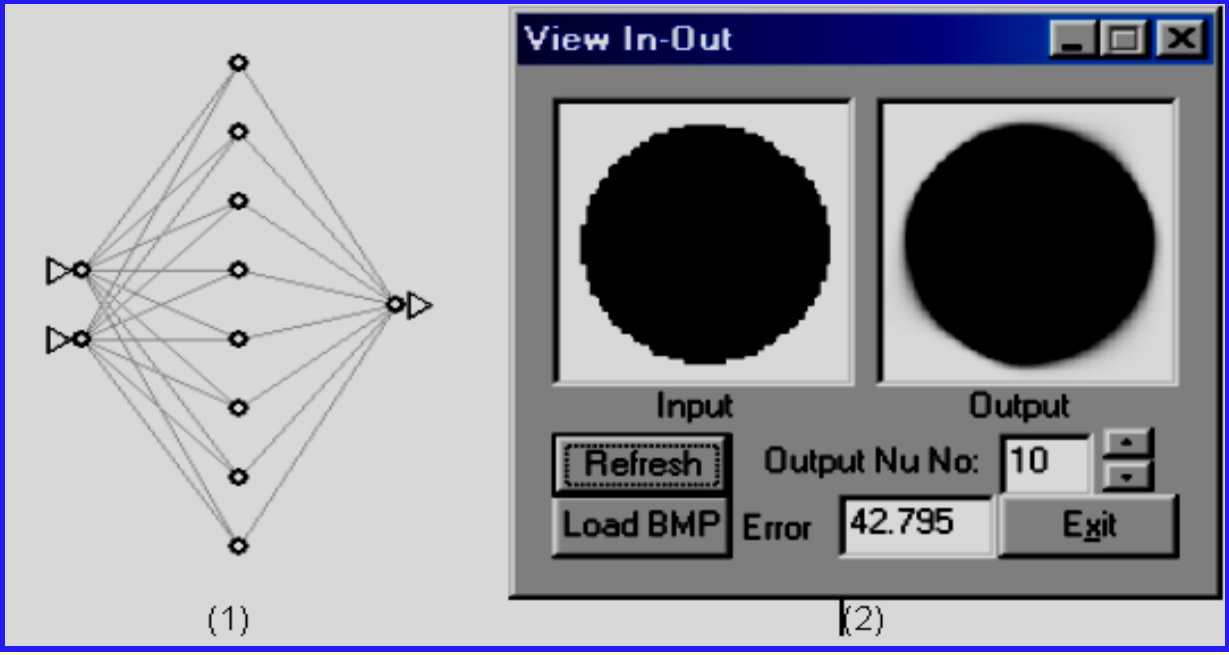
Example of Network Compression Using Higher Function Neuron

Example of Circular Boundary Mapping using Multi Layer Neural Net



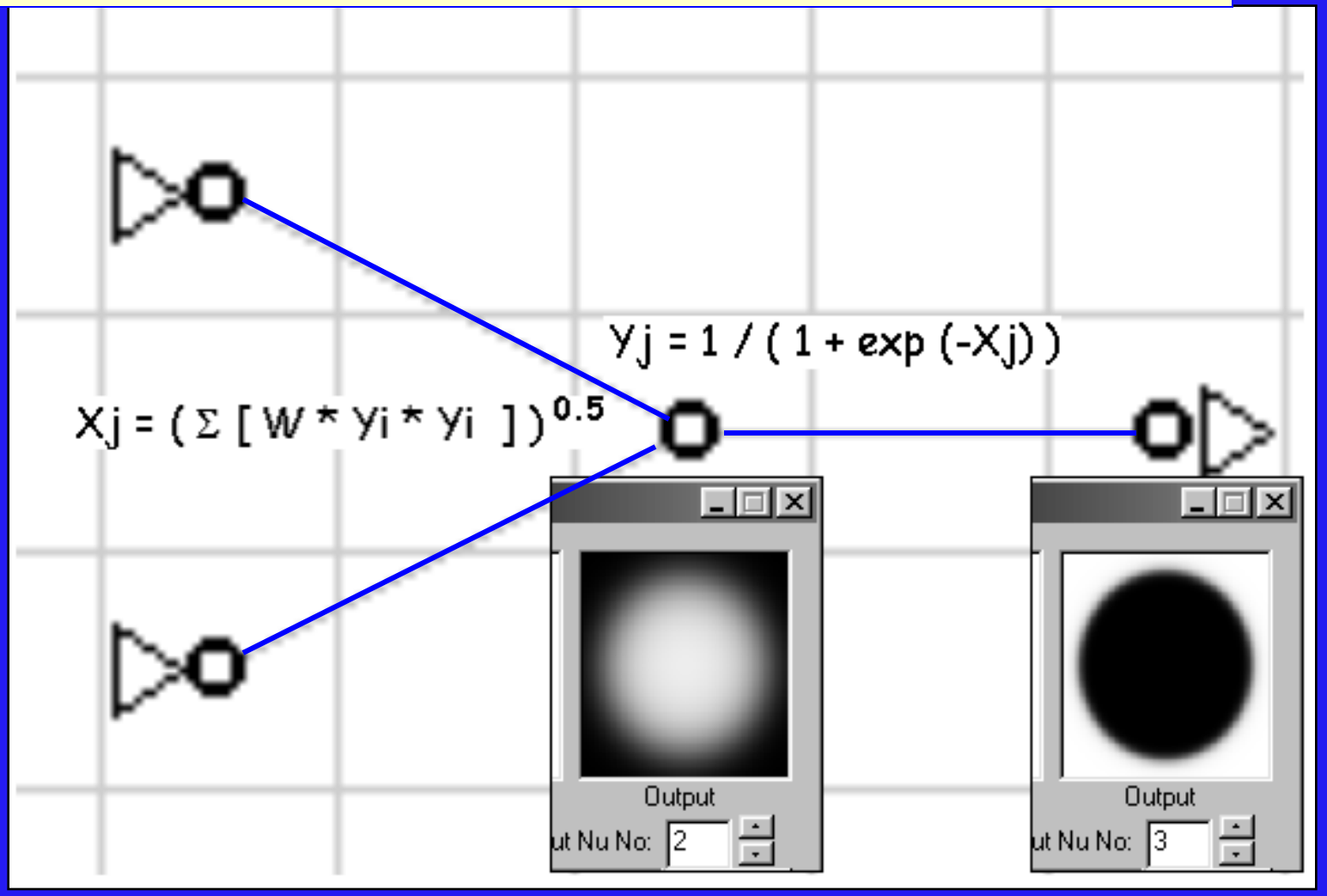
Network Configuration- Multi Layer Neural Net : 2 Analog Inputs : 13 Hidden Neurons : 1 binary output. Random inputs X and Y. Training-If (X,Y) is inside circle desired out is 1 (white).

Circular Boundary Mapping

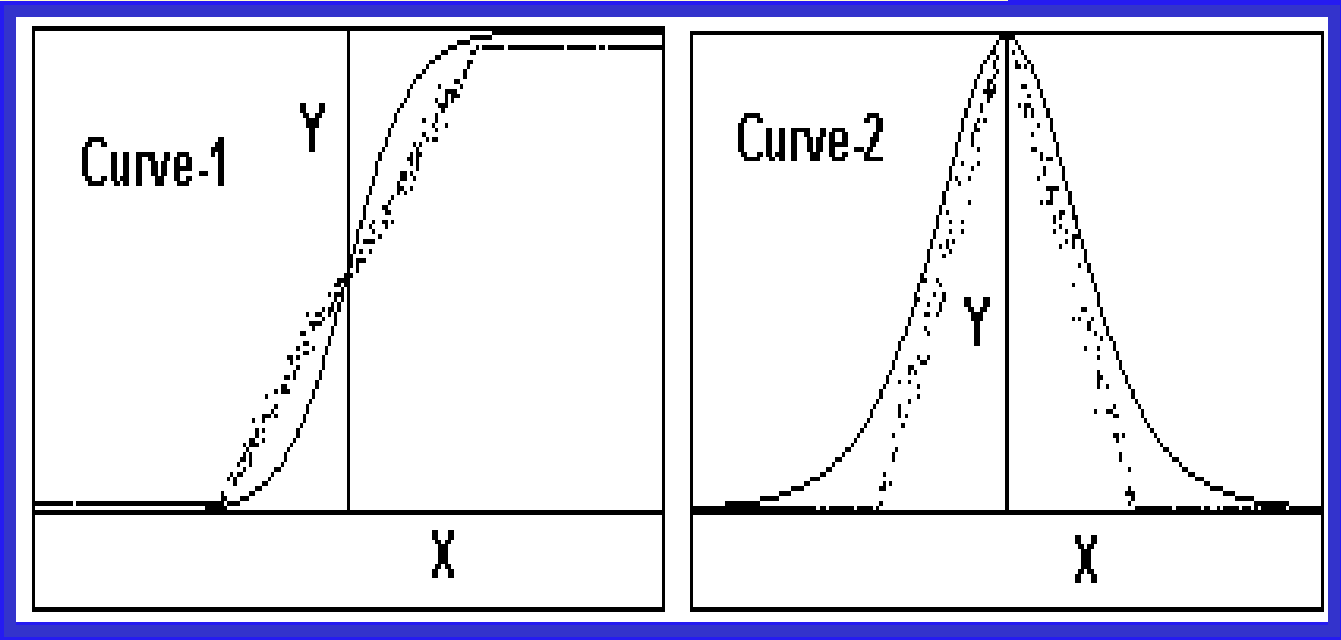


(1) Layer wise connected 2-8-1 network (2) Input and output image of the network

Mathematical Modeling using NN



Stochastic Neuron Activation Function

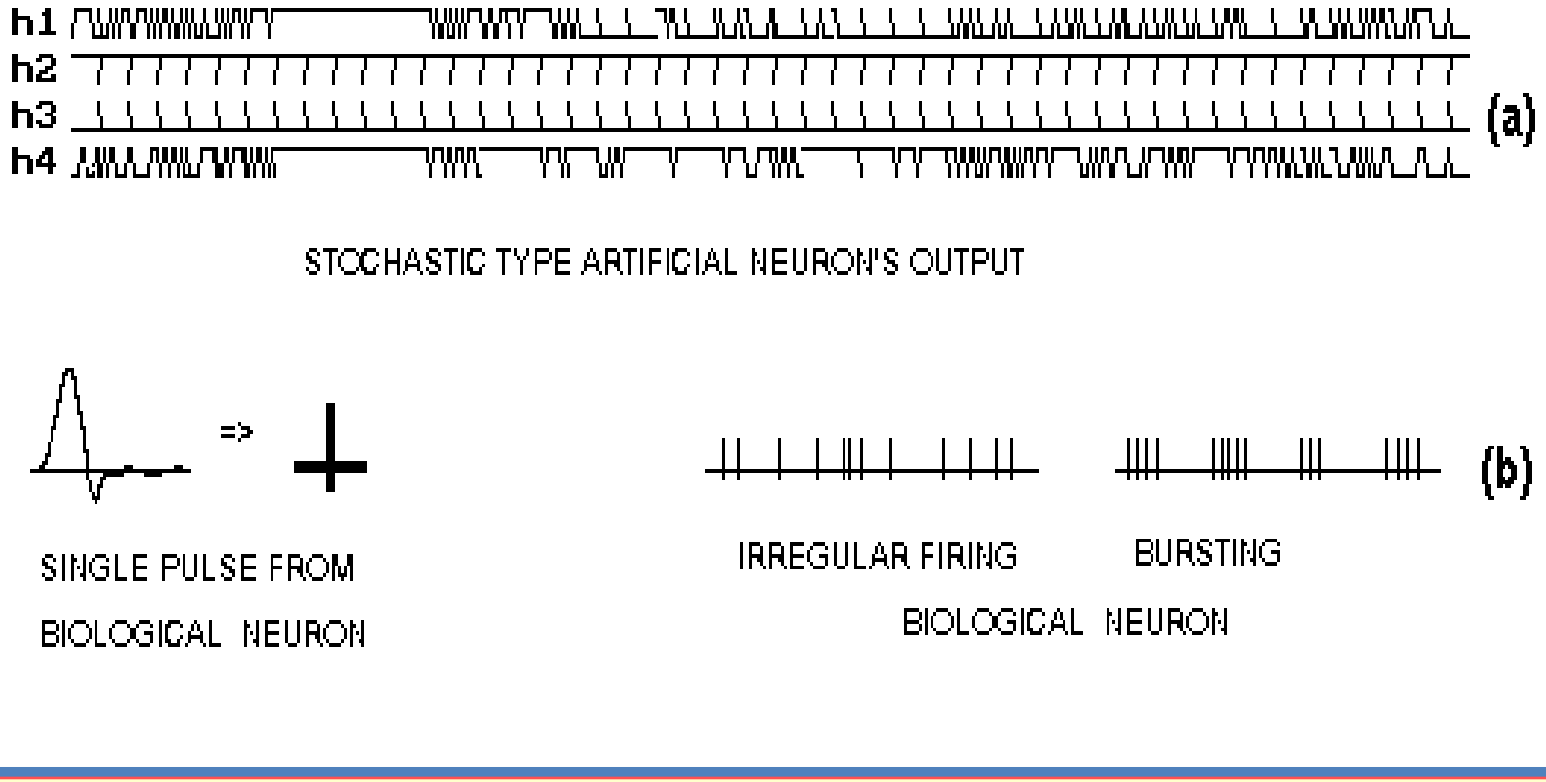


Curve-1 (dotted line)
*p=N-random(2*N+1)+X*
if p>0 then z=1 else z=0
Y=(Σ_s z_s)/S for S samples
Curve-1 (solid line)
Y = 1 / 1+ $e^{(-X)}$

Curve-2 (dotted line)
p=random(N)-abs(X),
f p>0 then z=1 else z=0
y=(Σ_s z_s)/S for S samples
Curve-2 (solid line)
Y= $e^{(-X)}$ /(1+ $e^{(-X)}$) ^{2}

Forward and reverse characteristics of the proposed stochastic function (dotted lines) along with exponential sigmoid function (solid lines).

Stochastic Neuron



Similarity between the stochastic and the biological neurons.

a) Output of stochastic type neurons. The curves h1, h2, h3 & h4 are hidden neuron's output during training for fixed input pattern.

b) Output of biological neurons. The X-axis represents iteration (@ 10 samples per iteration).

Forward Pass ()

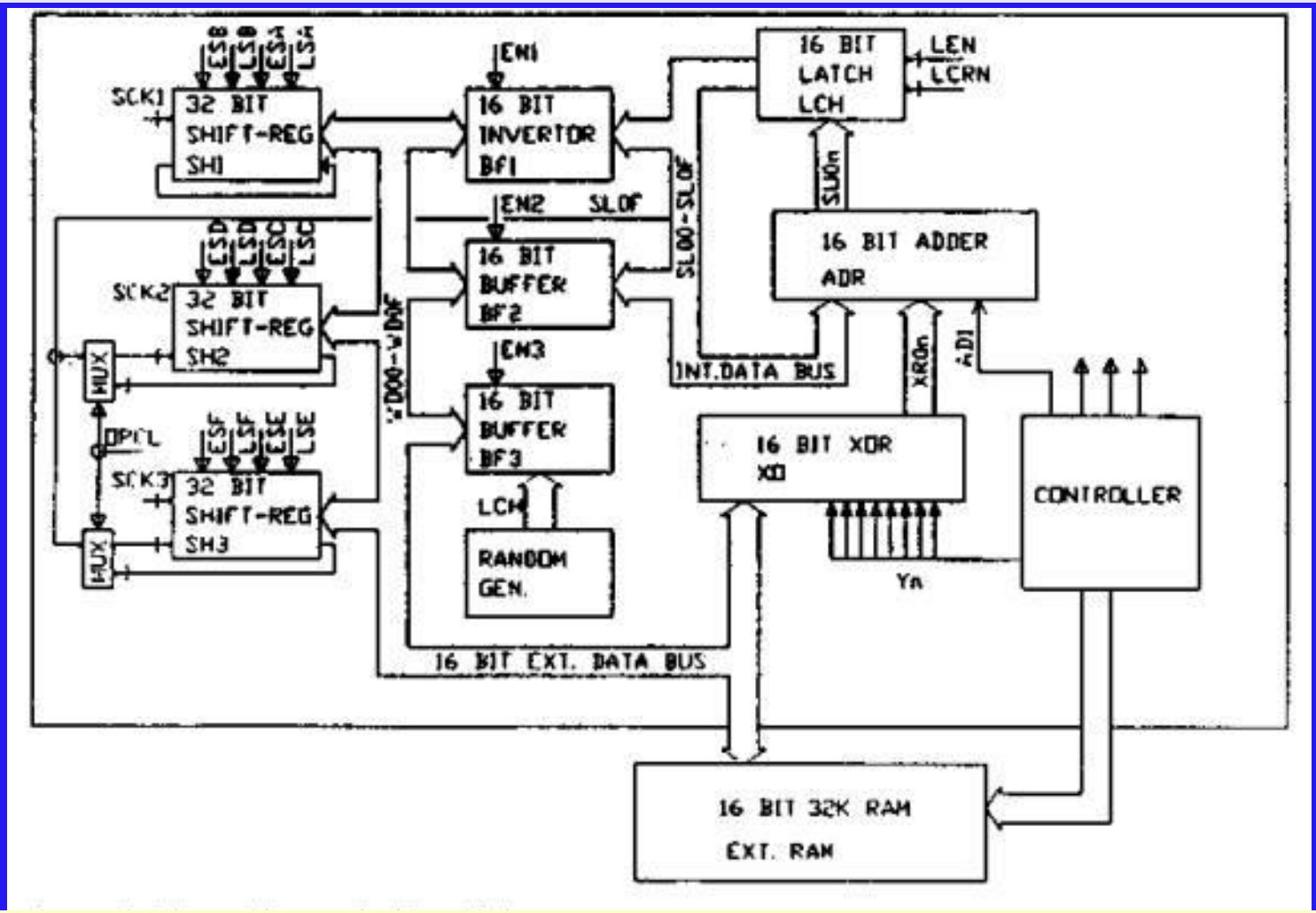
```
void ForwardPass()
{
   for(intj=0;j<jmax;j++){
      xj[j]=0;
    for(inti=0;i<=imax;i++){
     if(yi[i]>0) xj[j]=xj[j]+wji[j][i];
     if(xj[j]>random(N0)) yj[j]=1;
     else yj[j]=0;       }     }
   for(intk=0;k<kmax;k++){
      xk[k]=0;
   for(intj=0;j<=jmax;j++)
     if(yj[j]>0) xk[k]=xk[k]+wkj[k][j];
     if(xk[k]>random(N0))     yk[k]=1;
     else   yk[k]=0;}
}
```

Training Pass ()

```
void TrainingPass()
{
for(intj=0;j<=jmax;j++)
outj[j]=0;
for(intk=0;k<kmax;k++){
  if(abs(xk[k])>random(N1)) p=0;
  else p=1;
  d=out[k]-yk[k];
  if(d!=0)
  for(intj=0;j<=jmax;j++){
   if(yj[j]>0)
        wkj[k][j]=wkj[k][j]+d;
   else wkj[k][j]=wkj[k][j]-d;
  if(p>0)
  if(d>0)
   outj[j]=outj[j]+wkj[k][j]
  else
   outj[j]=outj[j]-wkj[k][j];}
        }
for(j=0;j<jmax;j++){
```

```
  if(abs(xj[j])>random(N2)) a=0;
  else  a=1;
  if(abs(outj[j])>random(N3)) b=1;
  else  b=0;
  d=a&b;
if(d!=0)
  if(outj[j]>0){
   for(inti=0;i<=imax;i++)
    if(yi[i]>0)
        wji[j][i]=wji[j][i]+d;
        else
        wji[j][i]=wji[j][i]-d;
  }
  else
   for(inti=0;i<=imax;i++)
   if(yi[i]>0)
        wji[j][i]=wji[j][i]-d;
   else wji[j][i]=wji[j][i]+d;
   }
}
```

VLSI Implementation of Multi-layer NN



Block diagram of VLSI implementation of multi-layer neural network for high-density high-speed update and learning

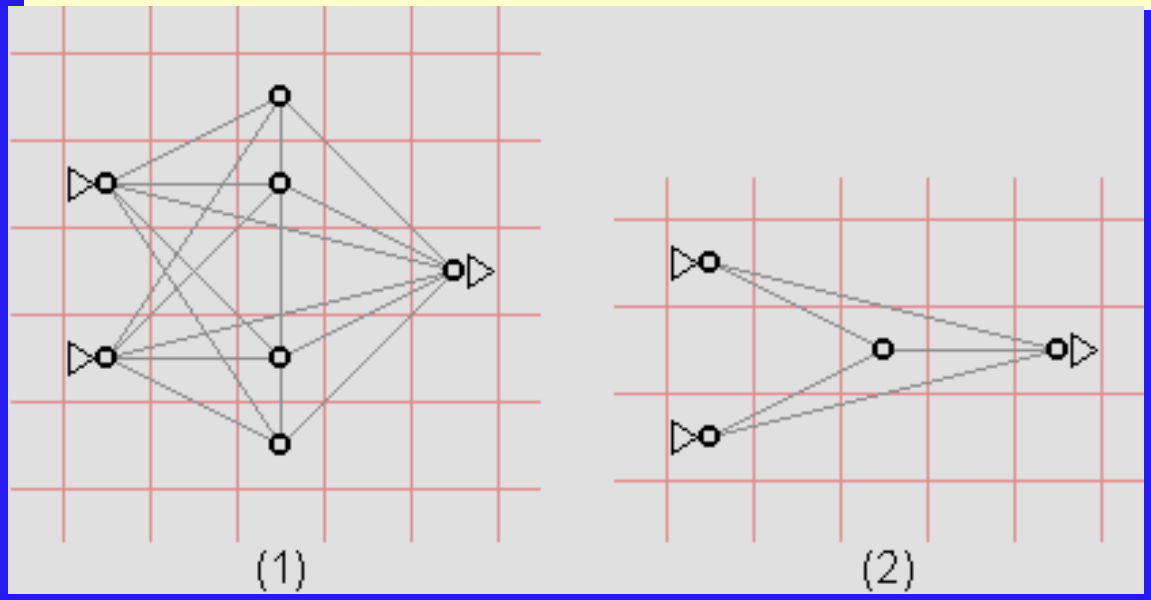
Results of Stochastic Type Algorithm

Exp no.	Real B.P.		Stochastic	
	Time (s)	Loops	Time (s)	Loops
1	740	283	440	115
2	1133	433	321	113
3	699	267	522	128
4	311	119	144	51
5	740	283	1056	367
6	1232	471	369	129
7	288	110	317	116
8	392	150	1074	374
9	900	344	261	93
10	196	75	232	83
11	411	157	243	87
12	251	96	165	59
13	178	68	282	101
Mean	574	219	417	139

Comparison of results of back- propagation and stochastic type algorithm.

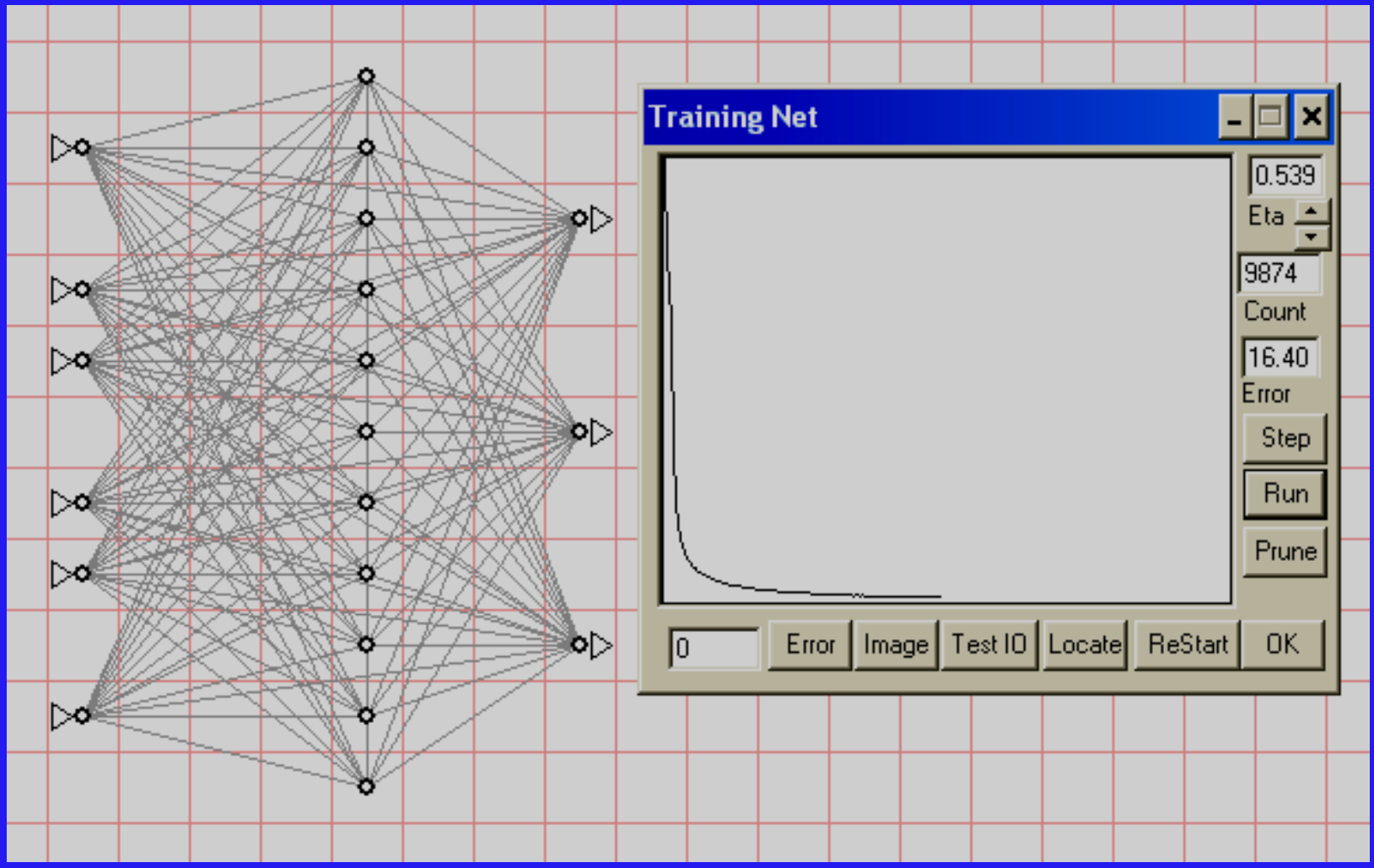
Visual Neural Net Designer (VNND)

VNND is a tool to design multi layered feed forward based neural net applications. VNND is an interactive tool to draw and edit neural network. It generates network parameters and C source code for the target system. VNND uses multi layered neural network (MLP) with gradient descent learning model. VNND can optimize the network for a given training set.



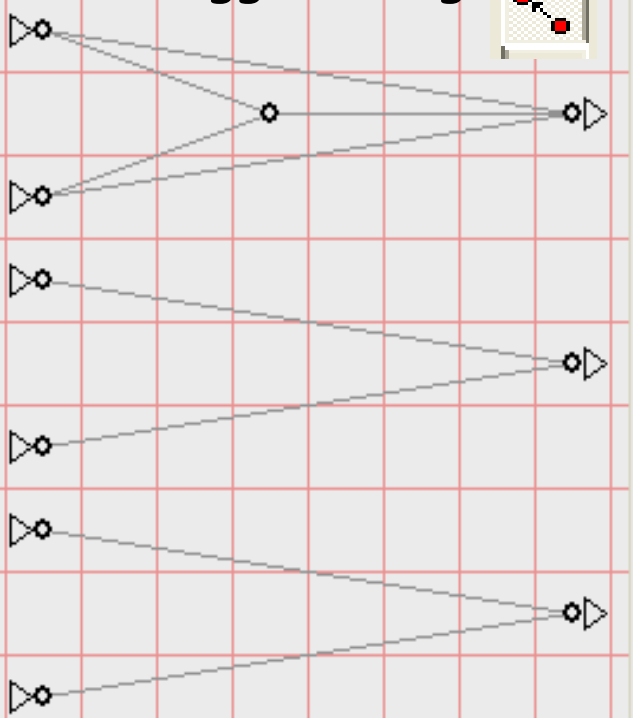
Example:
Exclusive OR problem,
(1) before and
(2) after
network optimization

Quick Training



View Input Output

Hidden neuron dragged using



View Input Output

In-1	In-2	Out-8	In-3	In-4	Out-9	In-
0.000000	1.000000	0.986577	0.000000	0.000000	0.000045	0.0
1.000000	0.000000	0.986626	1.000000	1.000000	0.986931	1.0
0.000000	0.000000	0.004208	1.000000	1.000000	0.986931	1.0
0.000000	0.000000	0.004208	0.000000	1.000000	0.013028	1.0
0.000000	1.000000	0.986577	1.000000	0.000000	0.012989	1.0
1.000000	0.000000	0.986626	1.000000	0.000000	0.012989	1.0
0.000000	0.000000	0.004208	0.000000	0.000000	0.000045	0.0
0.000000	1.000000	0.986577	0.000000	1.000000	0.013028	0.0
1.000000	0.000000	0.986626	0.000000	1.000000	0.013028	1.0
0.000000	1.000000	0.986577	1.000000	1.000000	0.986931	0.0
1.000000	0.000000	0.986626	0.000000	1.000000	0.013028	1.0
0.000000	0.000000	0.004208	1.000000	0.000000	0.012989	0.0
1.000000	1.000000	0.013920	1.000000	0.000000	0.012989	0.0
1.000000	1.000000	0.013920	0.000000	1.000000	0.013028	1.0
1.000000	1.000000	0.013920	0.000000	1.000000	0.013028	1.0

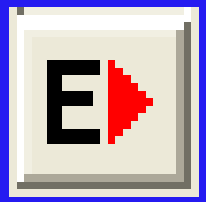
View OK

Input Output after training the Network (XOR, AND & OR)

```
/*
////////////////////////////////////////////////////////////////////////
// <XORANDOR.cpp>  Multi-Layer Neural Network CPP File
// Date:09-12-2002
// Time: 8:49:42
// H.S.Mazumdar
////////////////////////////////////////////////////////////////////////
*/
#include <stdlib.h>
#include <stdio.h>
#include <conio.h>
#include <math.h>
#include "XORANDOR.h"
#define       CFGFILE     "XORANDOR.cfg"
float pi=22.0F/7.0F;
/*................................*/
int  LoadNet(char *flnm)
{
FILE *fl;
int n;
fl=fopen(flnm,"rt");
if(fl==NULL) return 1;
fscanf(fl,"%d",&maxNeurons);            //Total no of neurons
fscanf(fl,"%d",&maxConnections);        //Total no of connections
fscanf(fl,"%d",&maxInputs);             //Total no of inputs
fscanf(fl,"%d",&maxOutputs);            //Total no of outputs
fscanf(fl,"%d",&maxioFun); //Total no of I/O functions
if(neuron==NULL) delete neuron;
neuron = new NEURON[maxNeurons];
if(conn!=NULL) delete conn;
conn = new CONNECTION[maxConnections];
if(inputs!=NULL) delete inputs;
inputs = new INOUT[maxInputs];
if(outputs!=NULL) delete outputs;
outputs = new INOUT[maxOutputs];
if(ioFun!=NULL) delete ioFun;
ioFun = new INOUTPROP[maxioFun];
for(n=0;n<maxNeurons;n++){
fscanf(fl,"%d",&neuron[n].sno);//serial number from input to output starting
at 1
fscanf(fl,"%d",&neuron[n].type);//in (128+64); out (128+32); hidden 128;
Activation Fun 0-31
fscanf(fl,"%d",&neuron[n].hlyr);//if more then 1 hidden layer then hlayer sno
form 1
fscanf(fl,"%d",&neuron[n].state);//temp verible for update state
fscanf(fl,"%f",&neuron[n].bias);//bias of neuron
}
```

cont...

Sample
'C'
Source
Output



Features of Feedback Neural Net Toolbox

Special features of Horizontally and Vertically Connected Feed Back type Neural Network Tool Box-

- Gray or Color Image storage and recall
- Interactive and user friendly Window based Application
- 48k neurons and 5 million connections
- 1 million connections per second while using 586 based PC
- Maximum binary image size (128 x 128 x 8)
- Partial and Optimized Connectivity
- Auto network building with optimize connections
- Recall with noisy, offset and tilted images
- Recall response in 1 sec. in 586 based PC
- All memory based data arrays

Connection Optimization Algorithm

1. Network is trained for several iterations till the error is minimized to a stable value.
2. Add one connection to the input of each neuron that has non-zero output error. Other side of the connection is terminated to a randomly chosen neuron's output.
3. Remove as much number of connections as much is added. Removing is done from zero error neurons
4. Repeat above steps at the end of each training cycle for each image.

3D Human face Reconstruction using multiple 2D images

Objective

- To reconstruct a 3D human face to develop a system that generates a 3D face from 2D input images.

- One of the objectives of this project is to use less number of images to generate 3D human face as compared to other algorithms and System as it need more than two images to generate 3D human face.

- Use of the existing simple framework for 3D development will reduce the time requirement of the system.
- Use less no of landmarks for 3d construction.

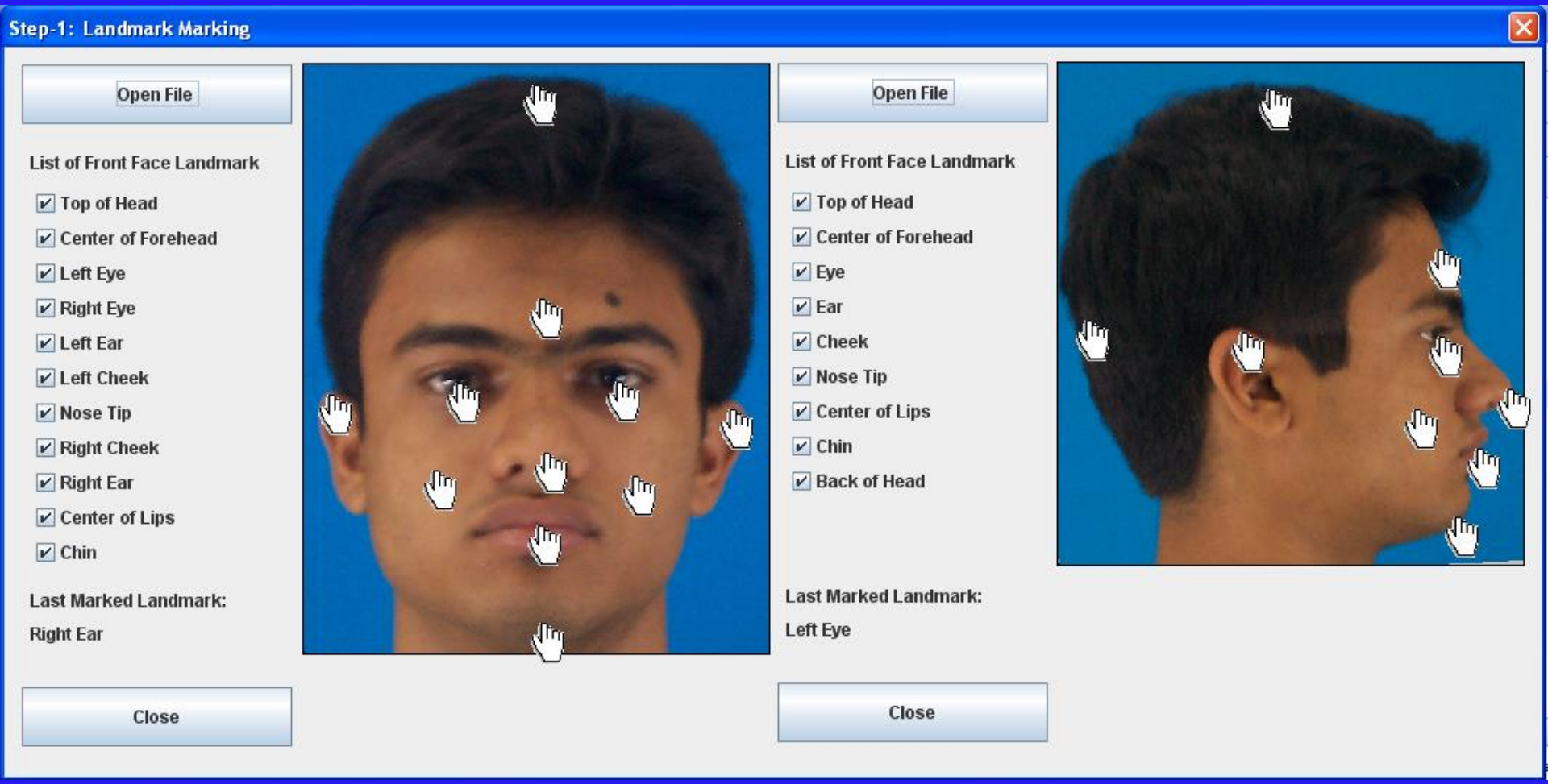
Algorithm for 3D Human Face Reconstruction

(an on going work)

Algorithm Steps:

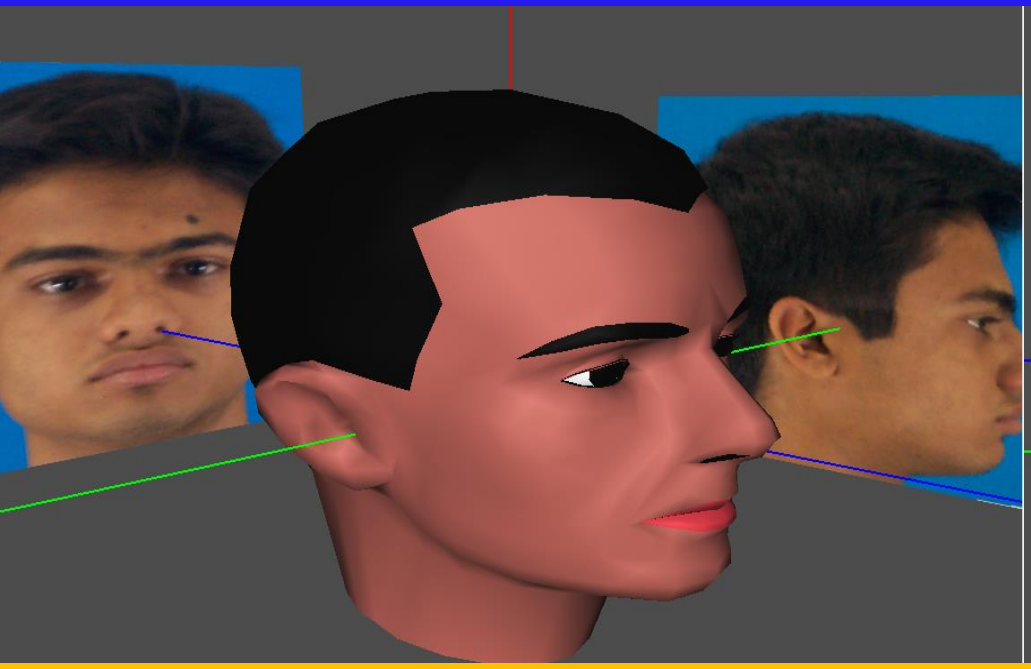
1. Take front face image and side face image.
2. Mark landmark features on the front and side images.
3. Construct 3D wireframe in OpenGL (Open Graphics Library).
4. Reshape the wireframe by minimizing the RMS error for landmark features.
5. The wireframe triangles will be marked automatically on both the images.
6. The area of each triangle will be calculated one by one automatically from both the images.
    1. Whichever has highest triangle area, will be taken particularly for the that triangle's texture mapping.
7. For some of the areas, the triangles are not visible in other image, so take the triangle from the current and only image.
8. Generate an output file which stores the list of triangle vertexes and the image no specifying from which image, the texture image has to be taken.

Application for Marking landmarks on the front and side images.



1.Front face and Side face Landmark marking on Mouse Click Event

Reshaping wireframe in 3D and matching it with front and side face

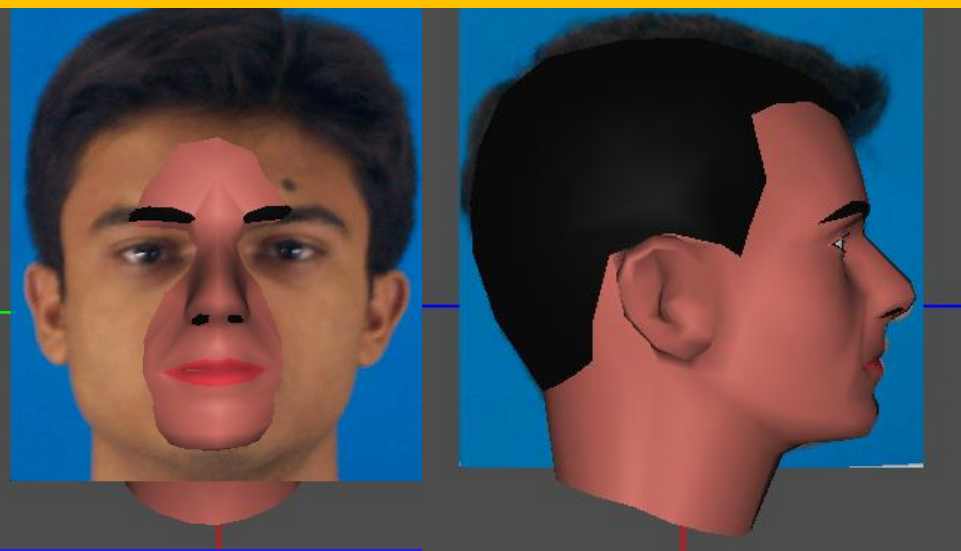




Before Reshape

After Reshape





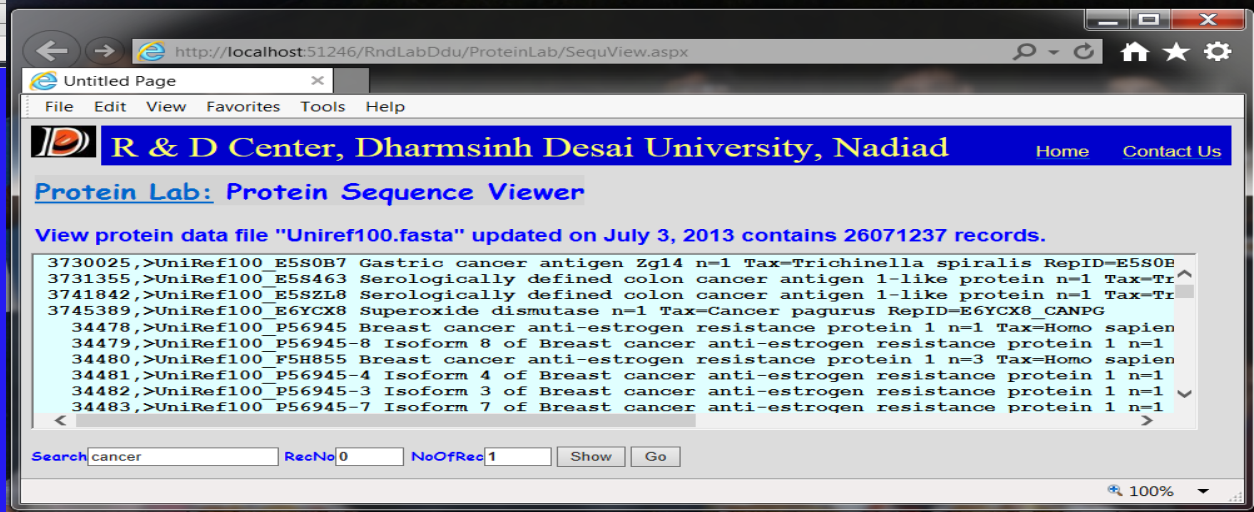
Big Data web based Protein Analysis Tools

Based on the algorithms developed under PhD research on Characterization of Bio-molecules an M.Tech research project was under taken and successfully completed to develop a web based bio-molecule characterization tool for public use. This web based tool is an intelligent search engine for 26,071,237 protein records.



Protein sequence viewer is an Intellisence based web search tool for protein big data. One can search protein data by entering keyword (e.g. Name of disease, Type of protein etc.) in search box.

The search output of desired keyword is retrieved as shown in above figure. This retrieves all the related headers as shown in right side figure .



Space Vector Modulation (SVM) algorithm for motor control

Motors are essential component of space missions, rovers and scientific experiments. Motors consume more power than other components and needs added reliability being electro mechanical component.
Space Vector Modulation (**SVM**) is new development which is used to increase the drive efficiency. Clark and Park transform is used to independently control Torque and Speed of motor to increase efficiency and save power.

Park's transformation is a well-known three-phase to two-phase transformation in synchronous machine analysis.
Clarke's Transformation converts balanced three phase quantities into balanced two phase quadrature quantities.

Objective of Overall Project

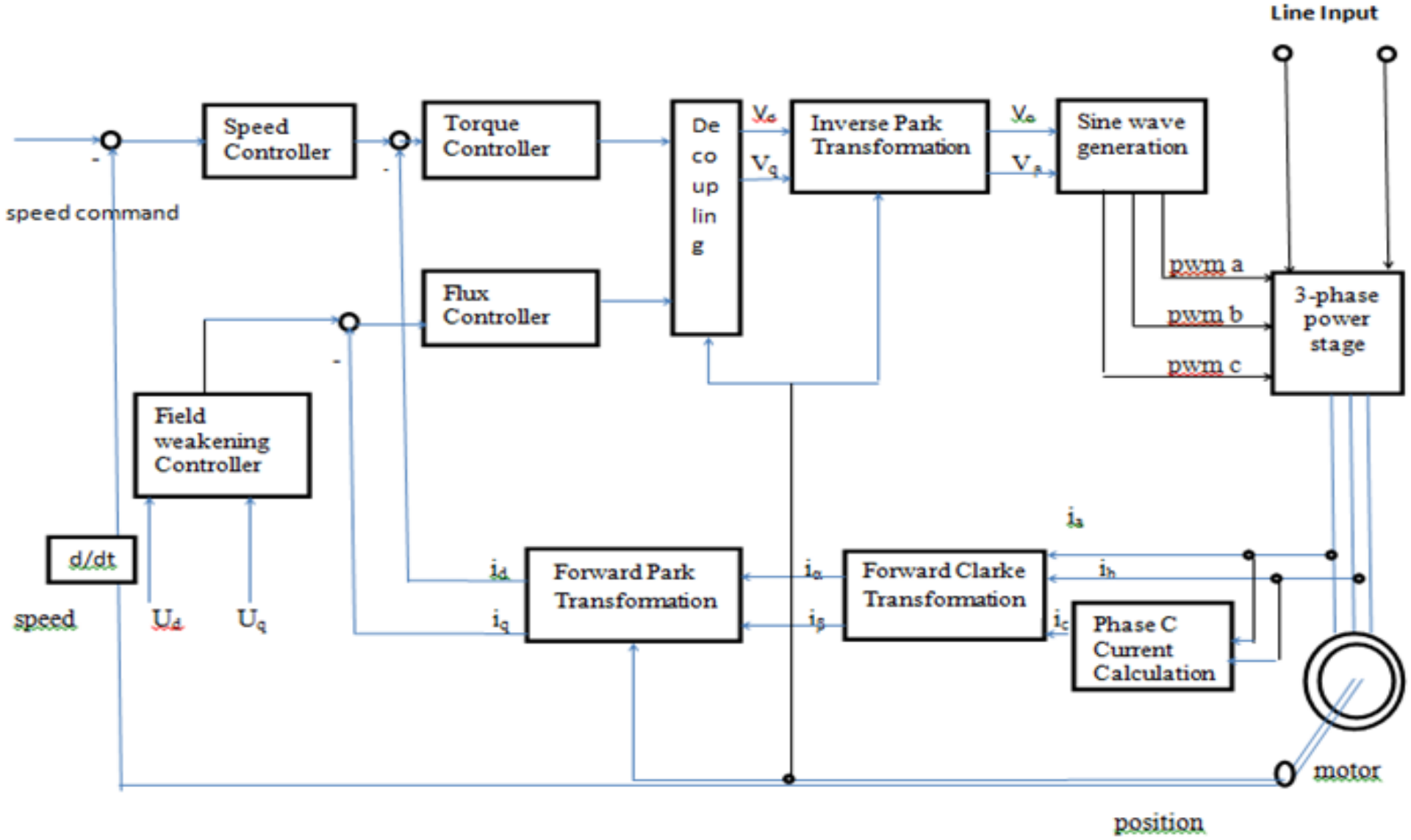
The focus of this project is on independent direct torque control and speed control. Accordingly, this dissertation deals with control of amplitude in terms of torque and control of frequency in terms of speed.

The dominant challenge of this research was independent control of torque and speed using Space Vector Modulation (SVM) techniques for AC Induction Motor (high voltage) and Permanent Magnet Synchronous Motor (low voltage).

Objective of Project

- Basic study and understanding of Permanent magnet Synchronous motor and its characteristics
- Study and understanding of Space Vector Modulation technique in descriptive manner and its mathematical interpretation and its linkage with theoretical aspects
- Detailed study of transformations and its mathematical analysis in Space Vector Modulation Technique
- Space Vector Modulation Technique implementation in software using .NET C# language in Visual studio 2008

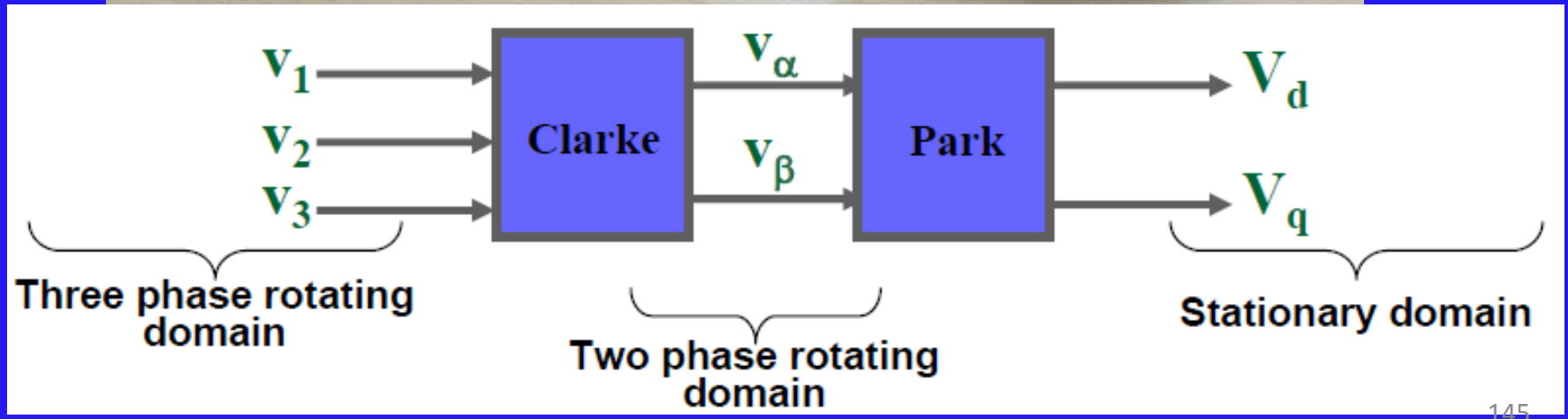
Block Diagram of Proposed System (FOC)



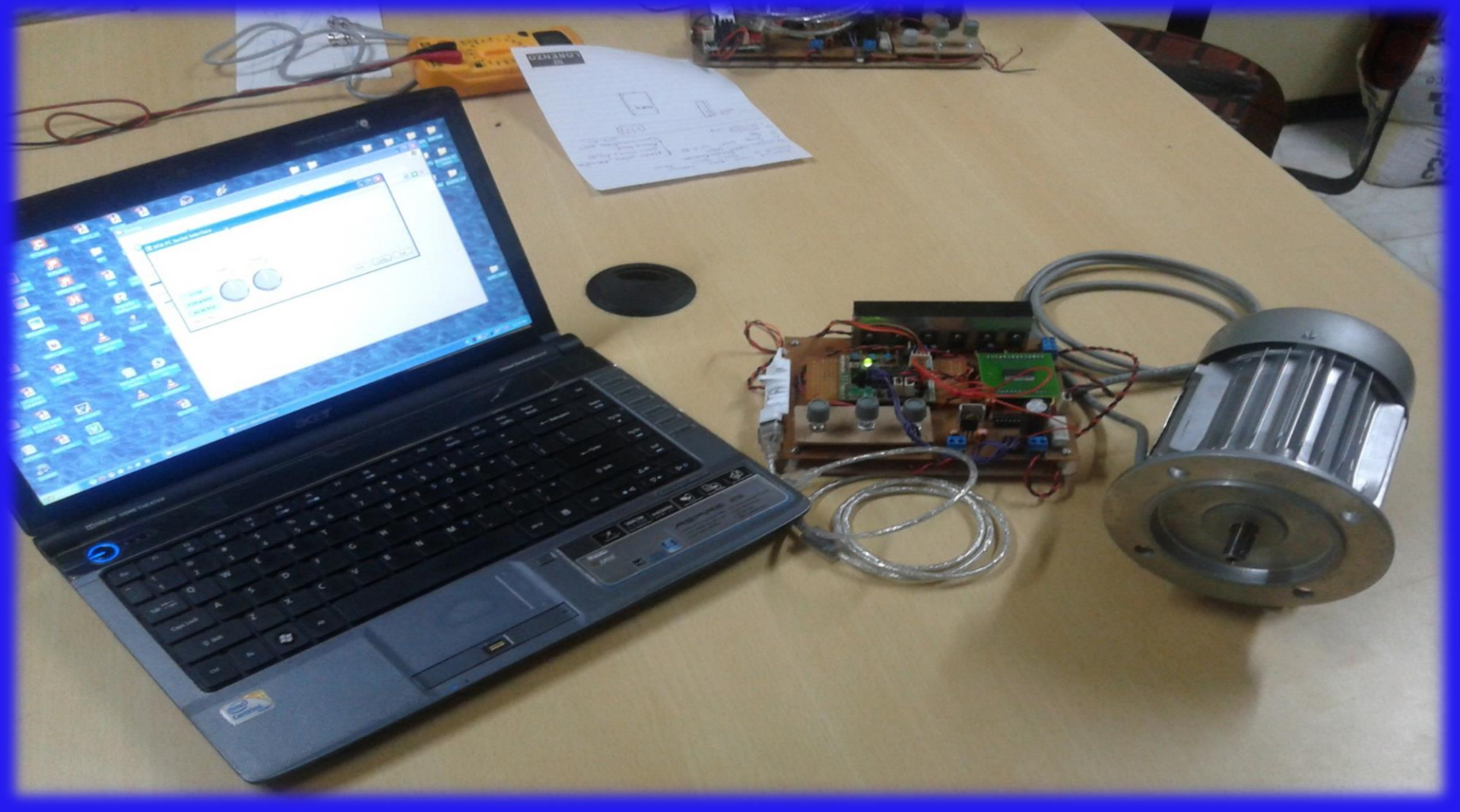
SVM Hardware



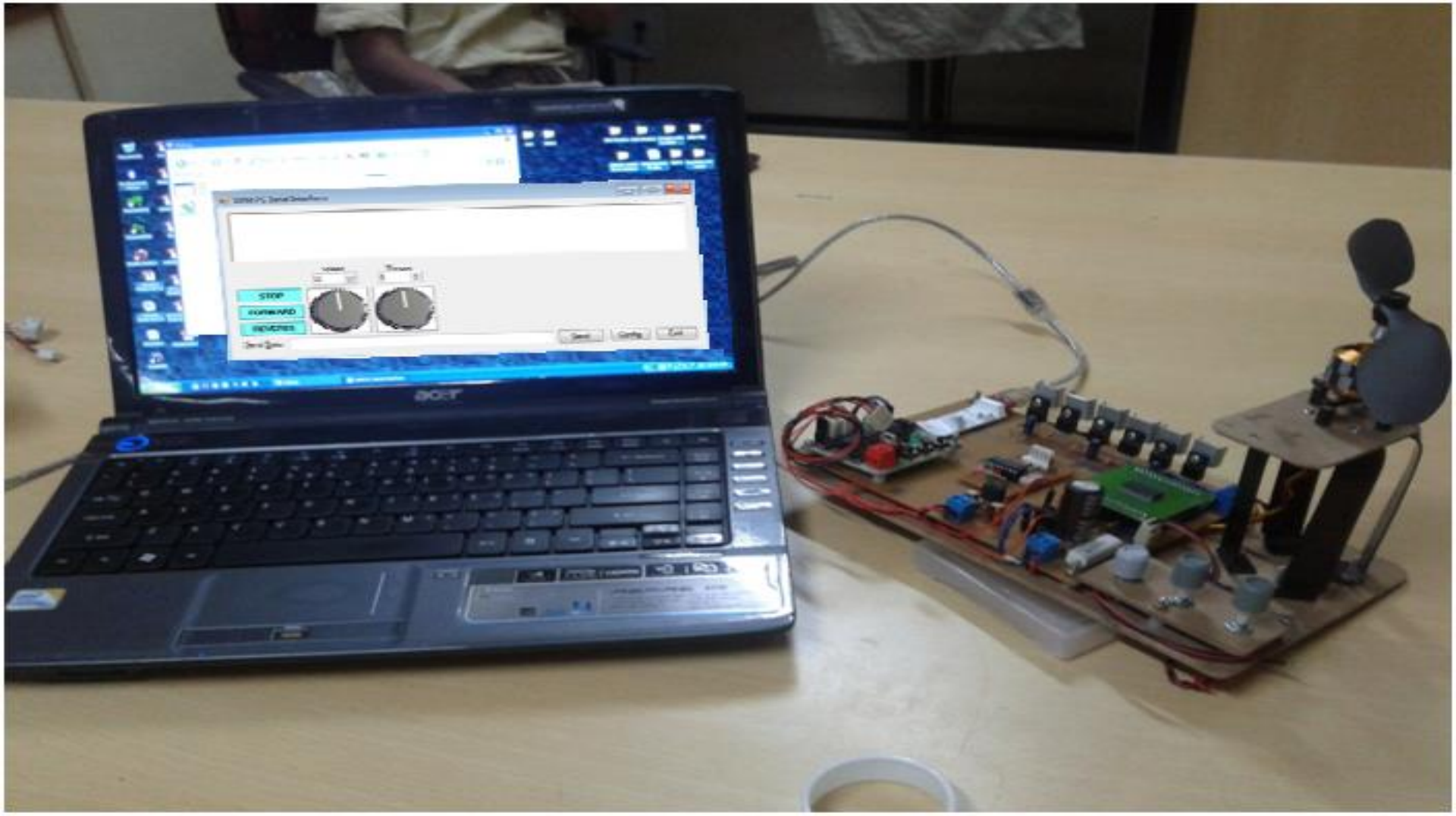
(Video)



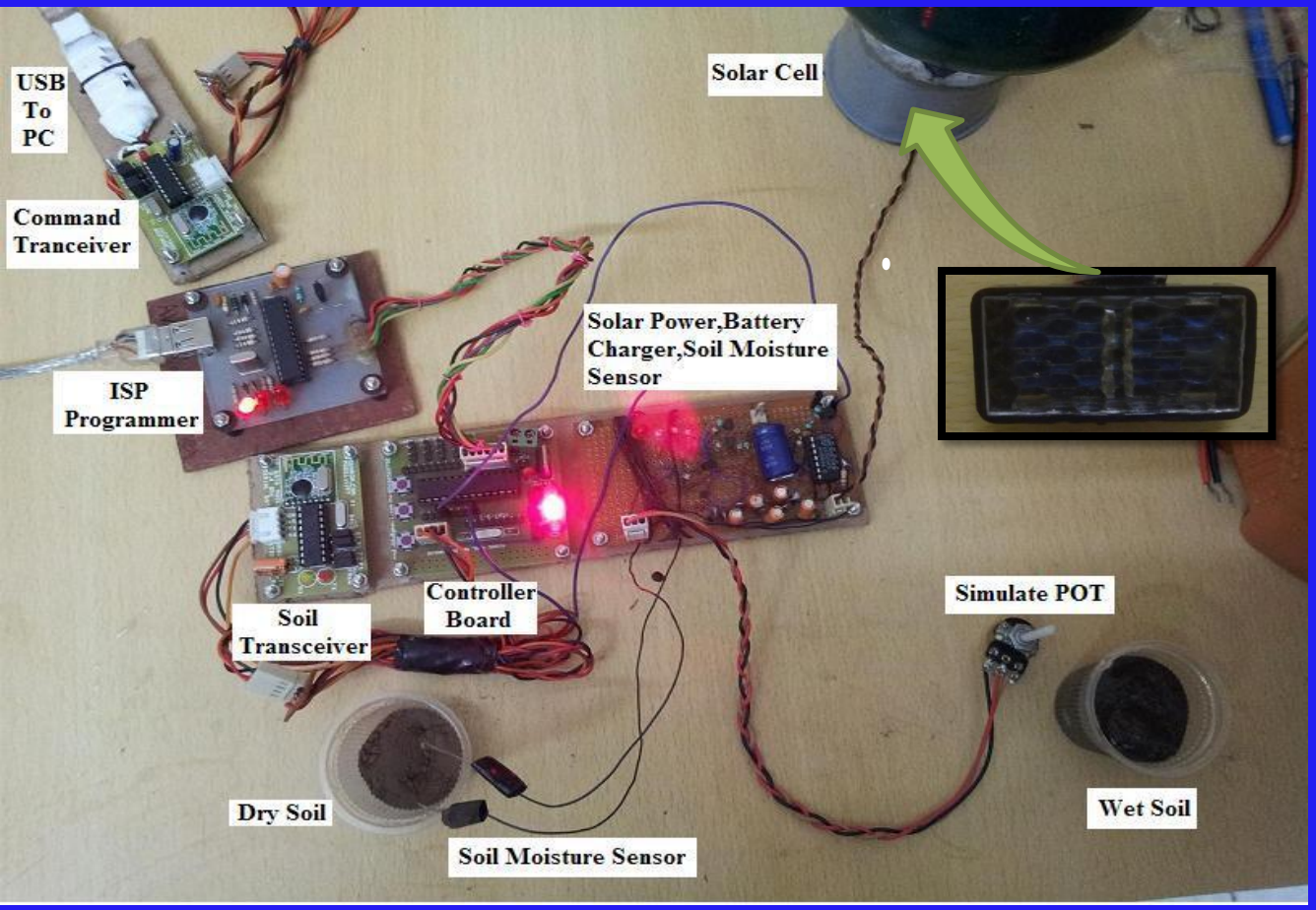
Serial Interface with Three Phase AC Induction motor



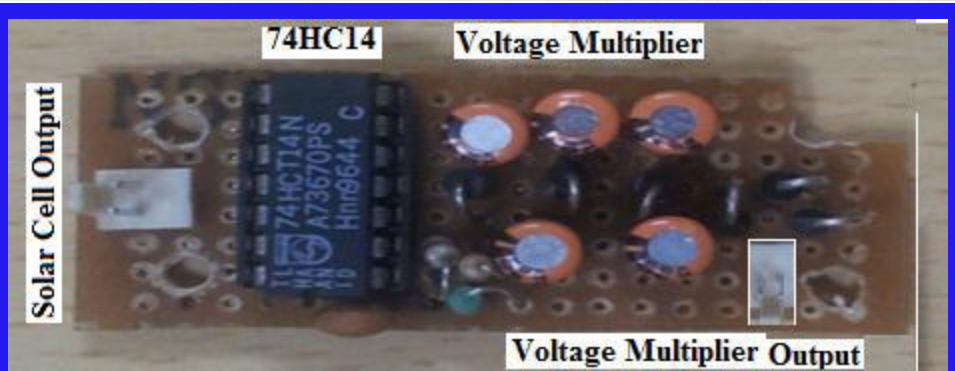
Serial Interface GUI with PMSM through PC



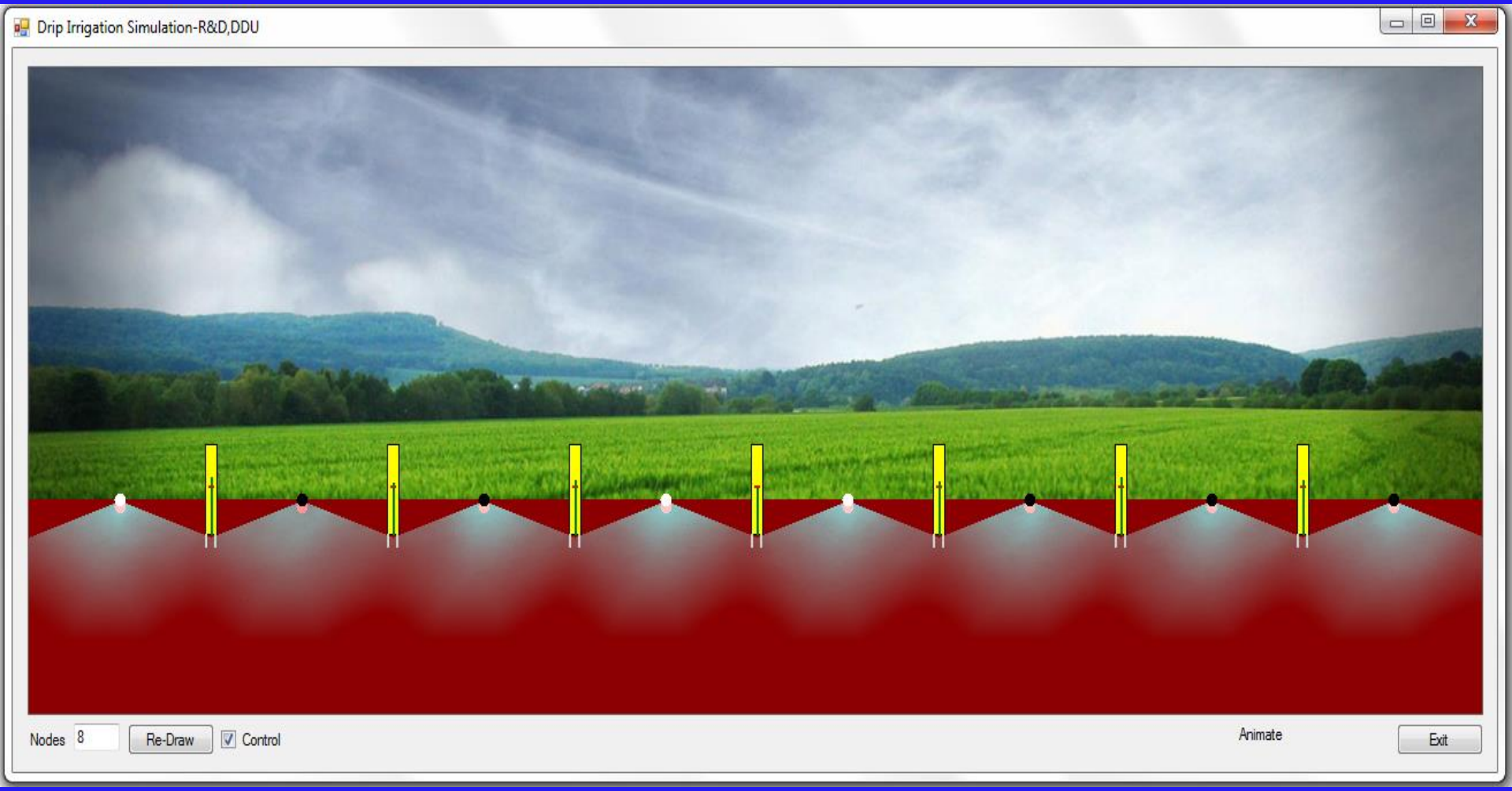
Solar powered sensor networking system



Objective of this project is to design, develop and test solar cell based voltage multiplier, charge accumulator and timer switch for RF burst communication network.
This application is used for Drip Irrigation project of IEDC

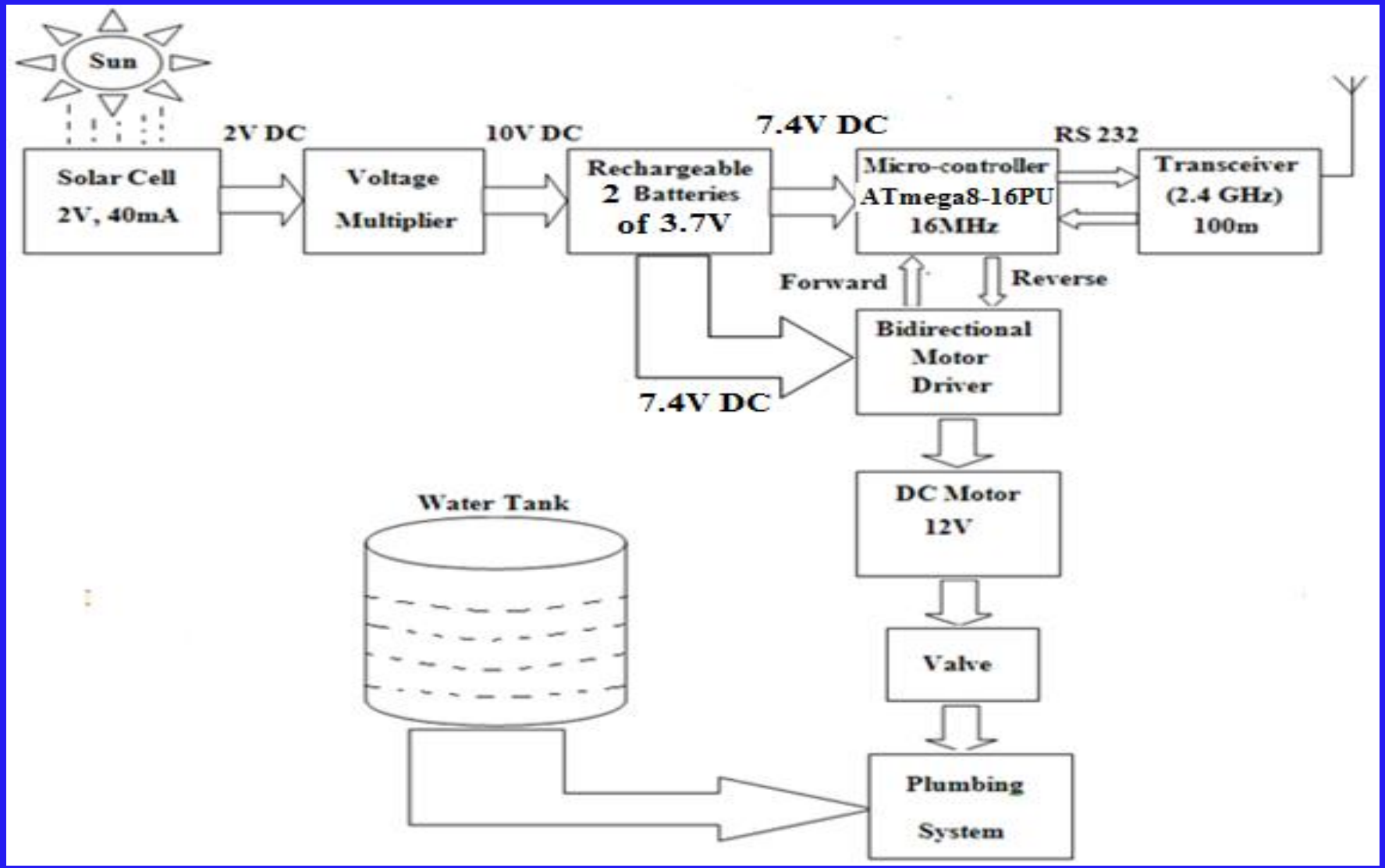


Simulation of DDU Drip Irrigation WSN



Screenshot of drip irrigation simulation software developed using C# .Net platform at R&D Center DDU.

❑ Block Diagram of Irrigation Valve:

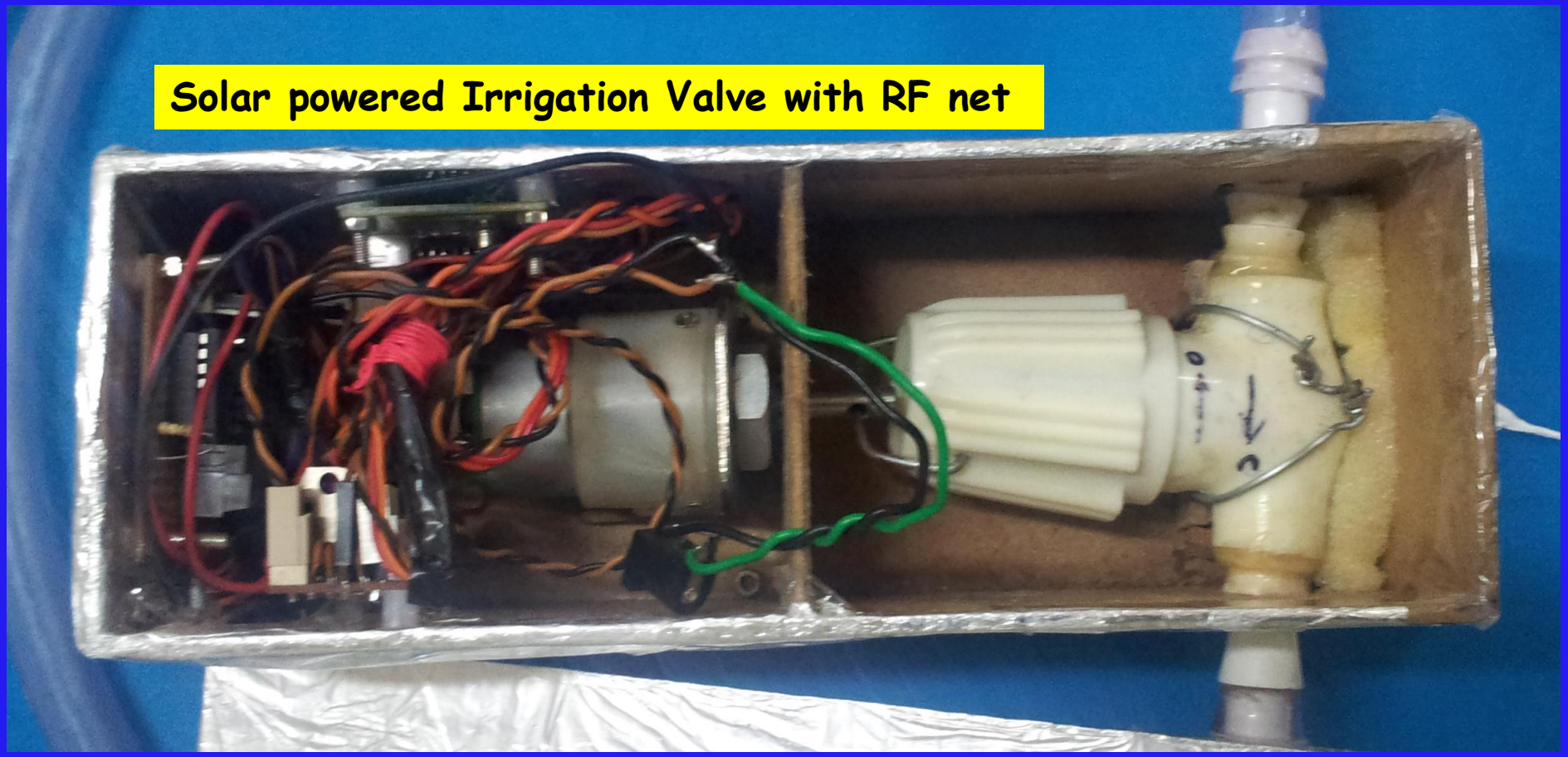


Working Model of Drip Irrigation System

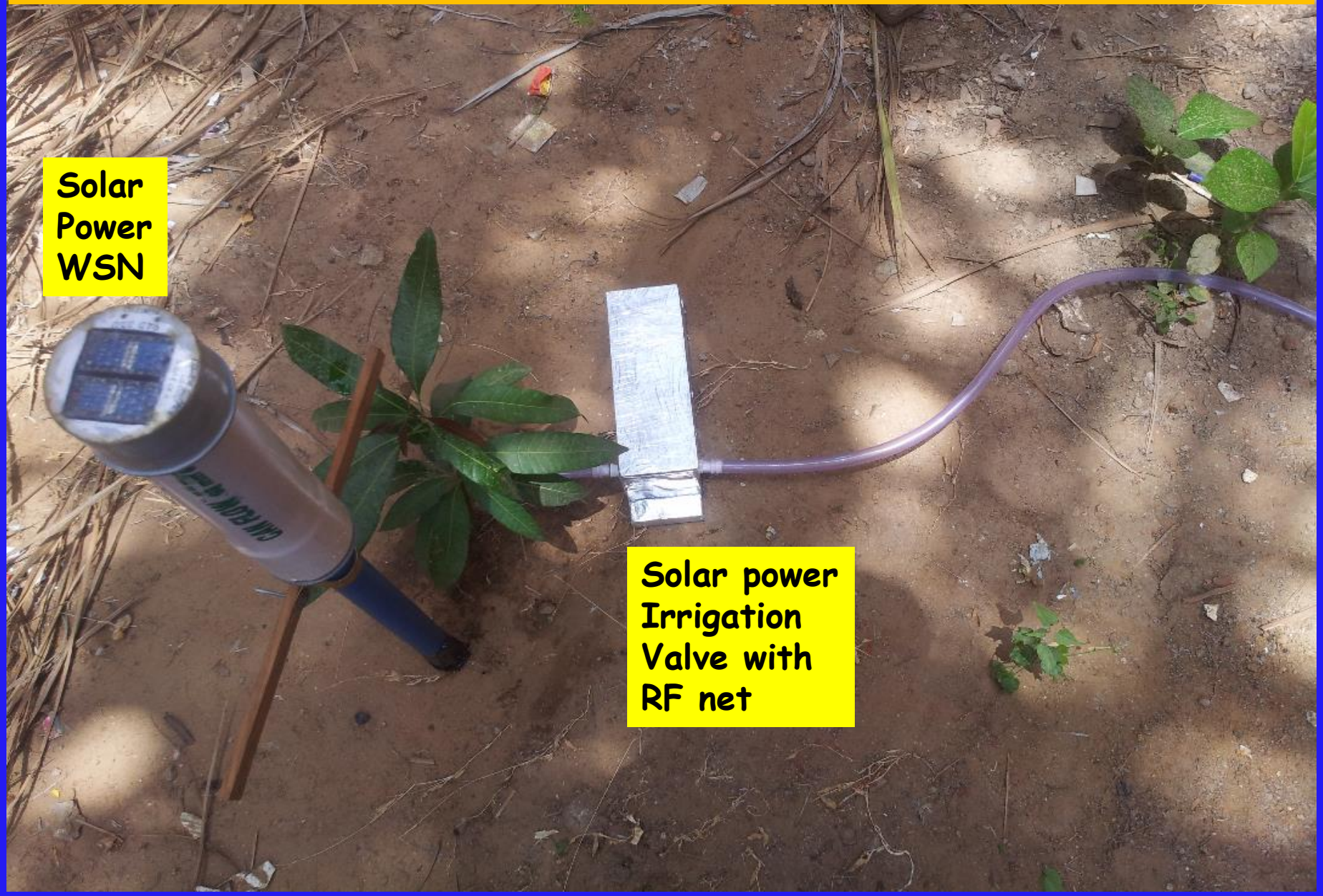
(IEDC,DST)(Designed and Developed at RND Center, DDU)



Irrigation Valve with Control Electronics

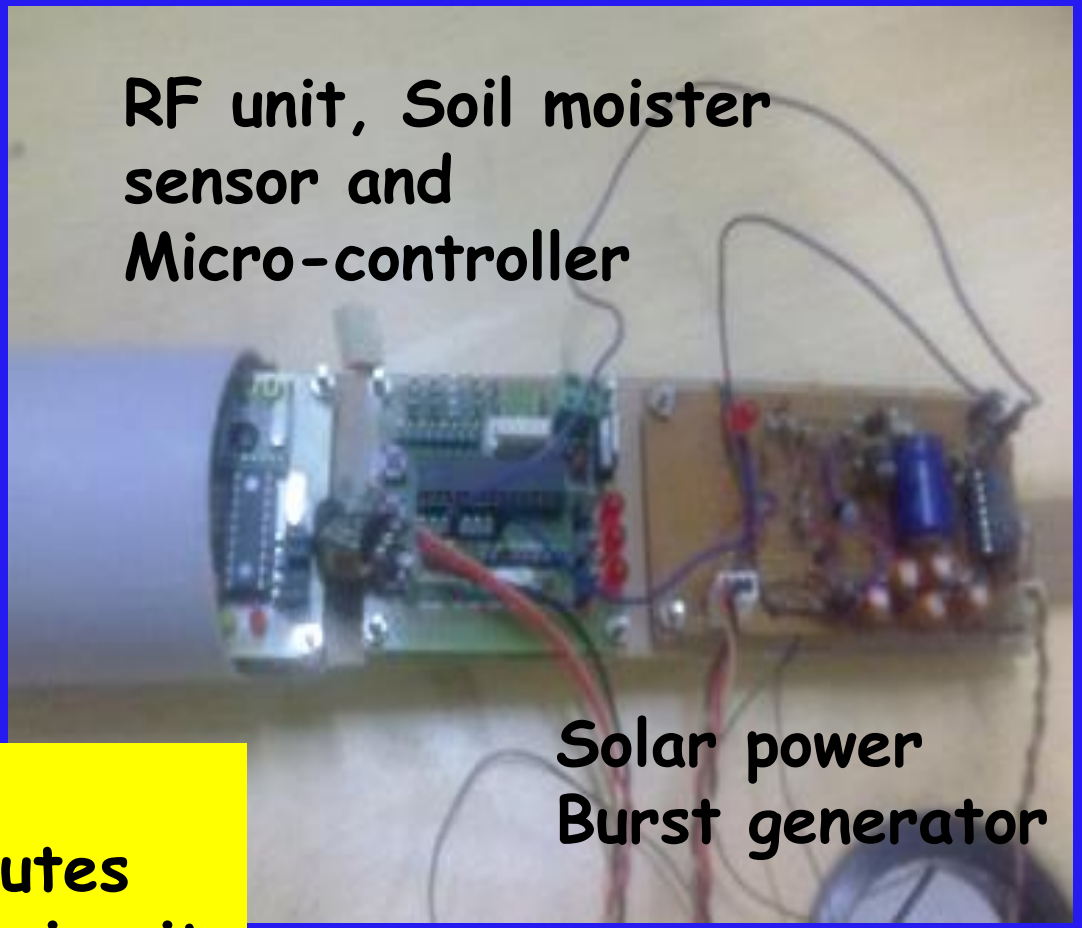


Drip Irrigation Local Loop Control Testing



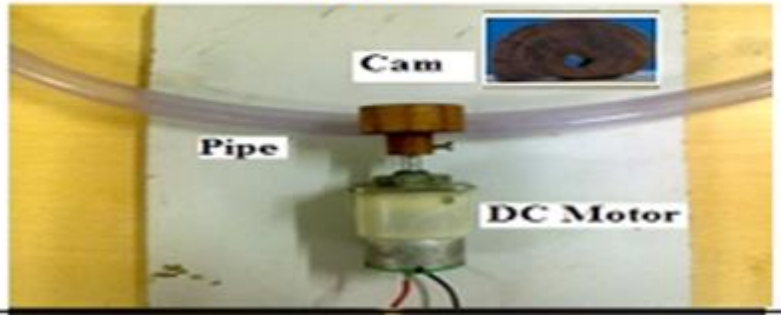
Integrated WSN Node Operating on Solar Power





Small solar cell charges
a capacitor for few minutes
and connected to WSN circuit
to transmit burst sensor data.

❑ Comparison:

NAME	IMAGE	POINTS
Cam Driven		• Needs higher torque. • Motor gate jams. • Leakage of water misalignment.
Thread Couple Pipe Loop		• Poor efficiency. • Thread gets loose or entangled. • Pipe life reduces.
Direct Couple Valve		• Needs accurate alignment. • Misalignment needs higher torque. • Manufacturing time is more.
Flexible Coupling		• Low friction. • High efficiency. • Best overall performance.

❑ Advantages:

- ✓ Waste of the water reduced
- ✓ Minimized fertilizer
- ✓ Maintains water within the plant's root zone where it is most needed
- ✓ Reduces soil erosion

❑ Disadvantages:

- ✓ Initially installation cost may be high
- ✓ The sun may affect the lifespan of the tubes used in the system
- ✓ Some times in farm some animal come they may damage the pipe and some component

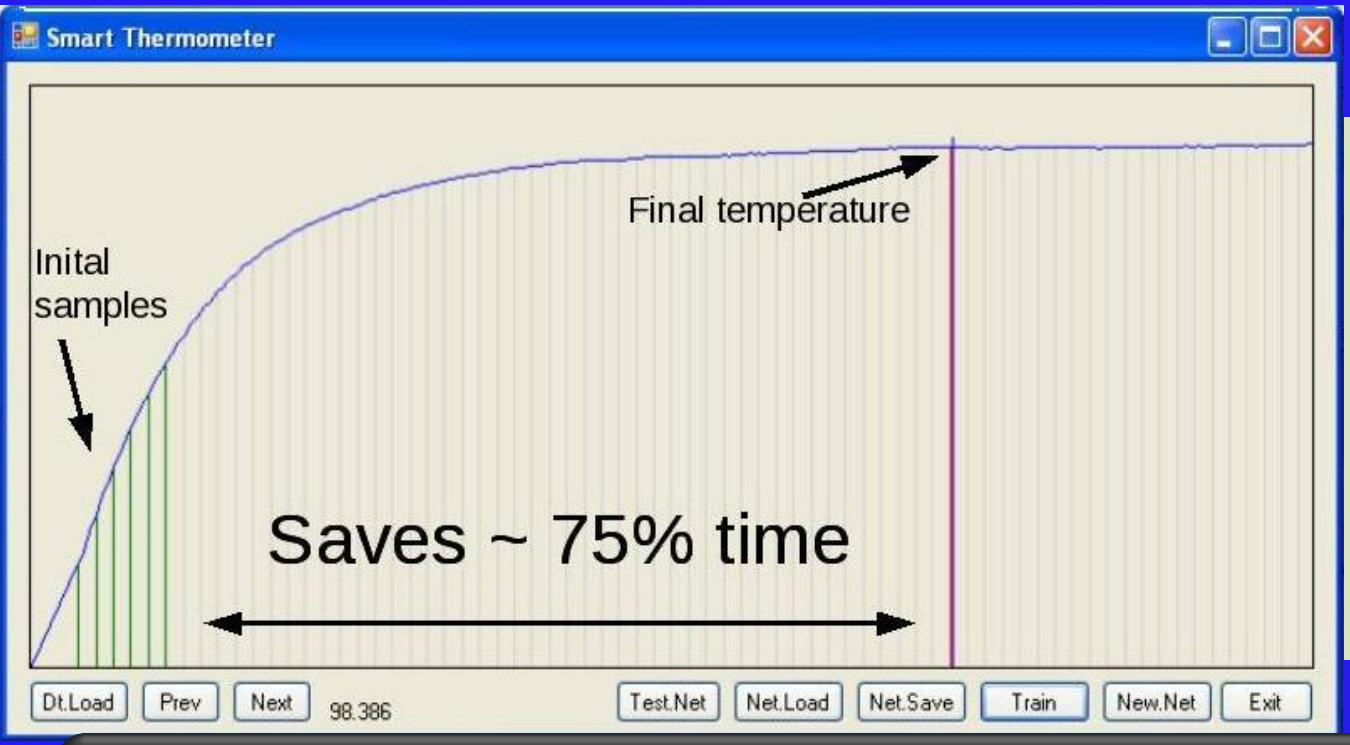
Smart Predicting Thermometer

Temperature stabilization time in an inertial mass is governed by complex heat flow equation of dynamic equilibration.

Objective of this project is to estimating the temperature equilibrium equation using neural network algorithm to save the time of measurement for different applications.

A neural network based algorithm is developed to predict the target temperature from early samples profile. It is demonstrated with experimental data of a digital thermometer that average 95% accurate temperature is estimated in less than 10% of the required time.

Result of Smart Predicting Thermometer



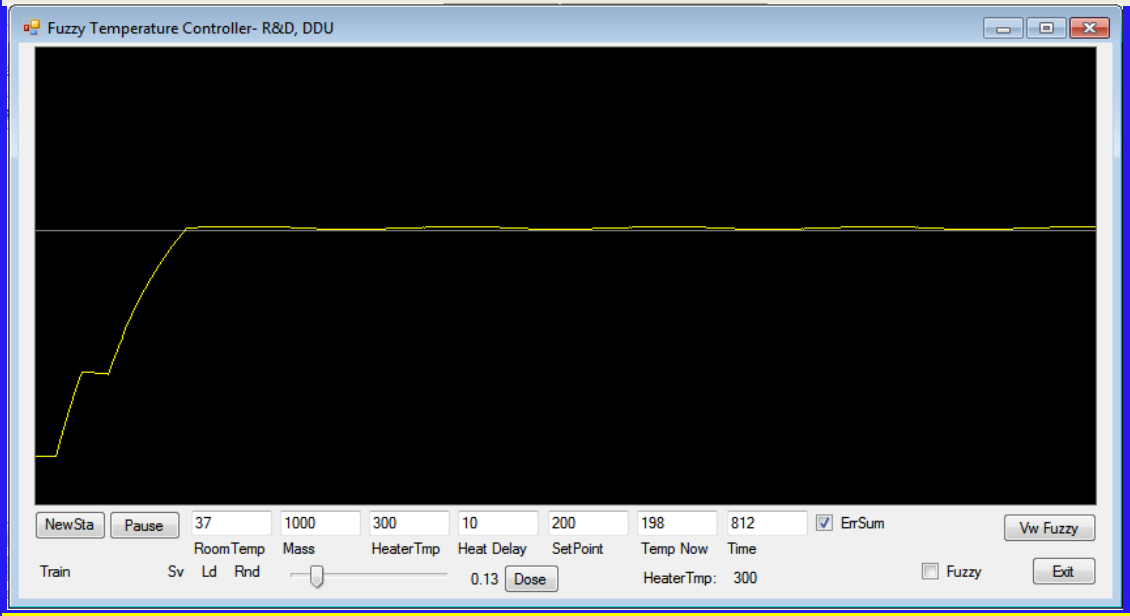
The curve above shows the final temperature (in red) of the system can be predicted based on a few initial measurements (in green), leading to about 75% saving in time.

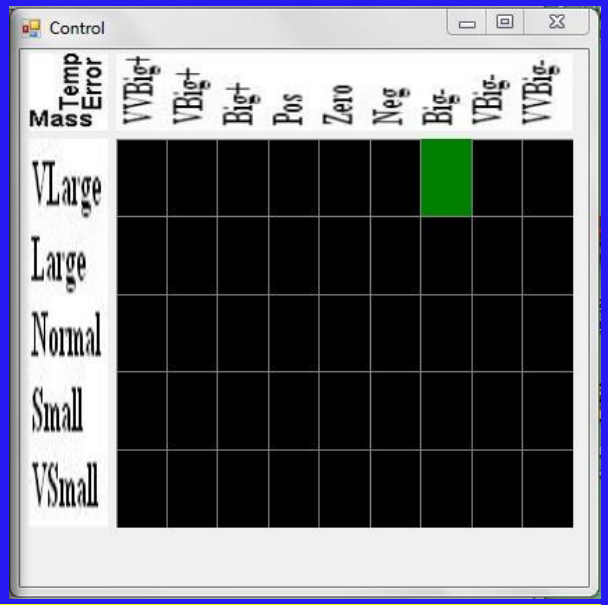
Measured final temperature(°C)	Predicted final temperature(°C)	Error (%)
68.1985	68.20058967	-3.68
85.2962	85.29708722	-2.02
76.1499	76.15671659	-2.67
68.0654	68.06808406	-3.87
93.296	93.2988449	-3.44

Table shows the actual and predicted values of temperature with percentage error.

Adoptive and Predictive Neuro-Fuzzy Temperature Controller

- A Neuro-Fuzzy controller with Genetic algorithm based De-Fuzzification method is developed.
- It is divided into three parts namely data acquisition, Control and Prediction. Back Propagation algorithm based neural network is used to predict the temperature while Fuzzy Logic technique is used to control the temperature. This project is supported under IEDC – DST as M.Tech dissertation project.

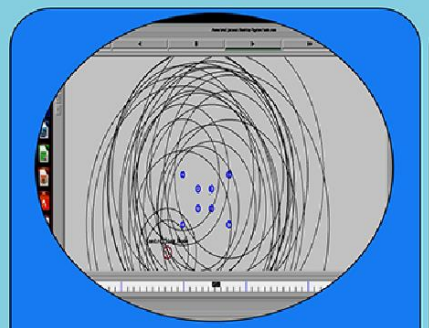




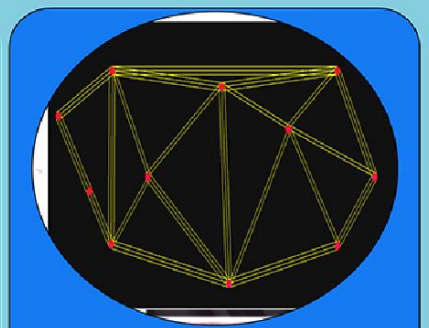
A computer simulation of Neuro-Fuzzy controller without predictive control

- Combined Neuro-Fuzzy technique is used to control the temperature.
- Neural network helps to predict the mass of the system.
- Fuzzy controller that consists of fuzzification, inference system and de-fuzzification is used for non- linear control of temperature

A novel hybrid wireless sensor network development for smart city (IEDC,DST)(Designed and Developed at RND Center, DDU)



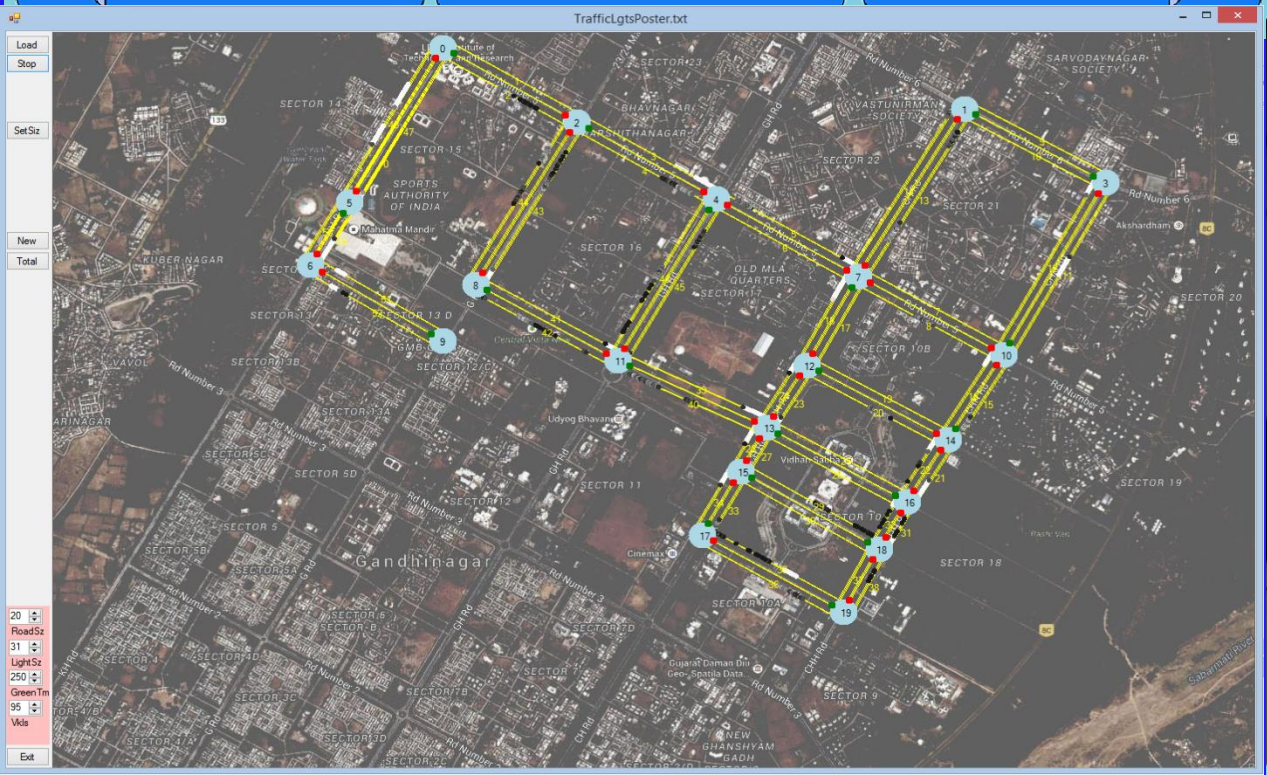
Network simulator

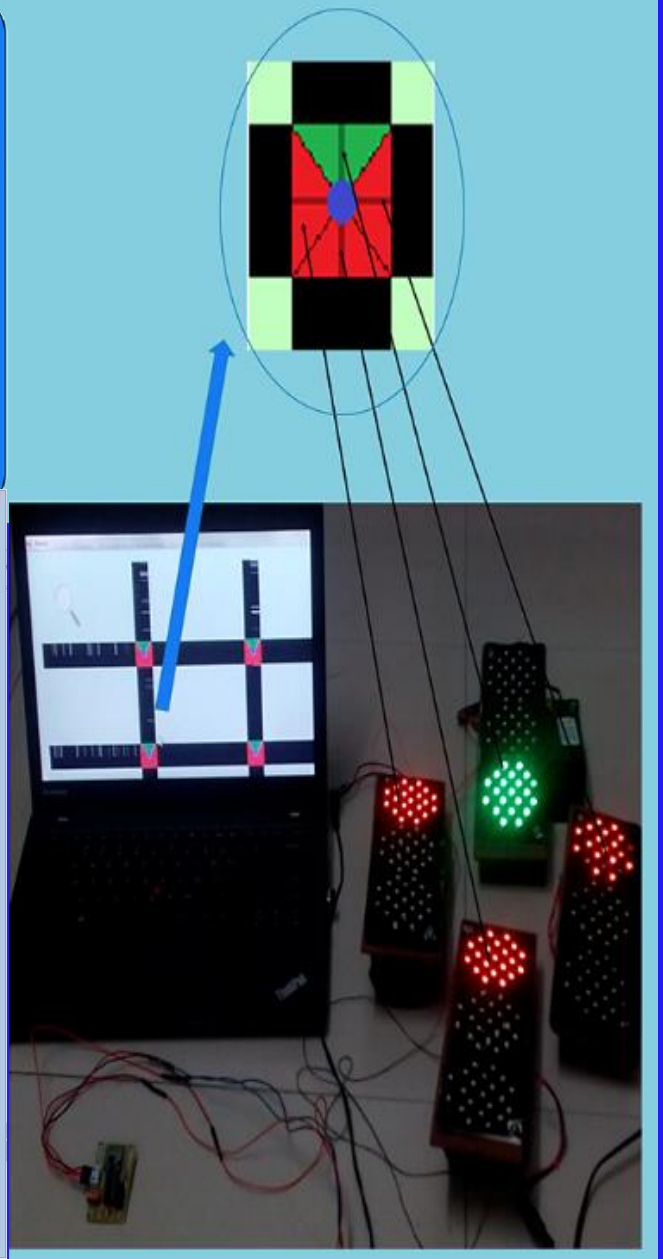


Vehicular Simulation Environment

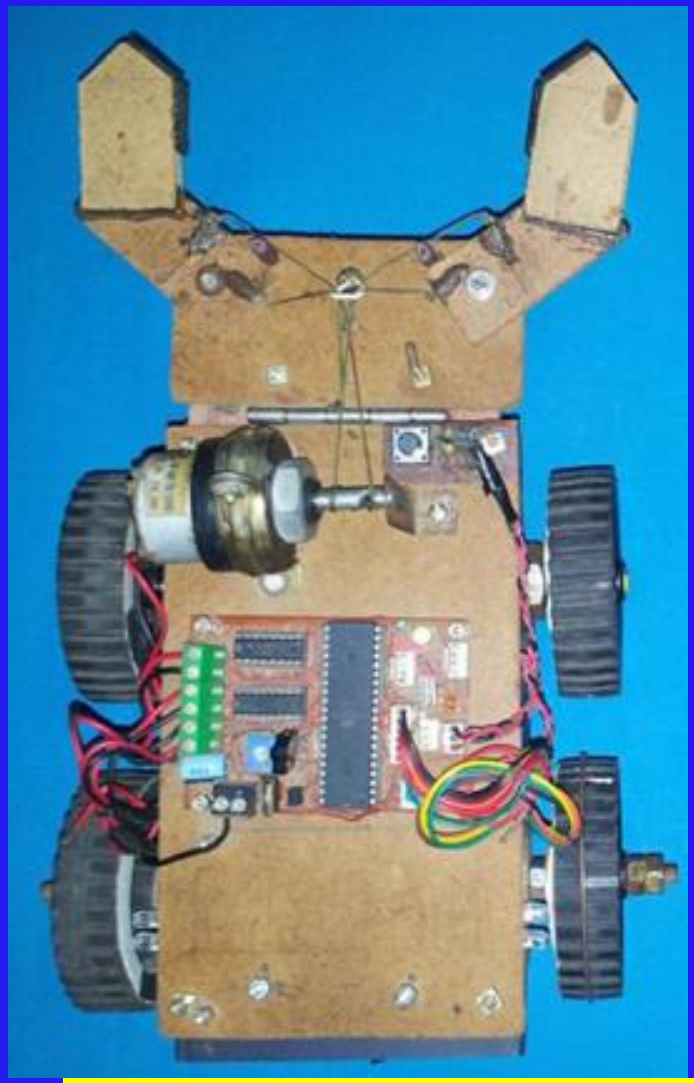


Real Hardware Nodes





DDU Robot with Gripper and Path Finder



Objective is to demonstrate a battery operated mobile robot with gripper arm which could be used for different applications. This project is undertaken in view of in-situ analysis of rock samples, security applications and training students.



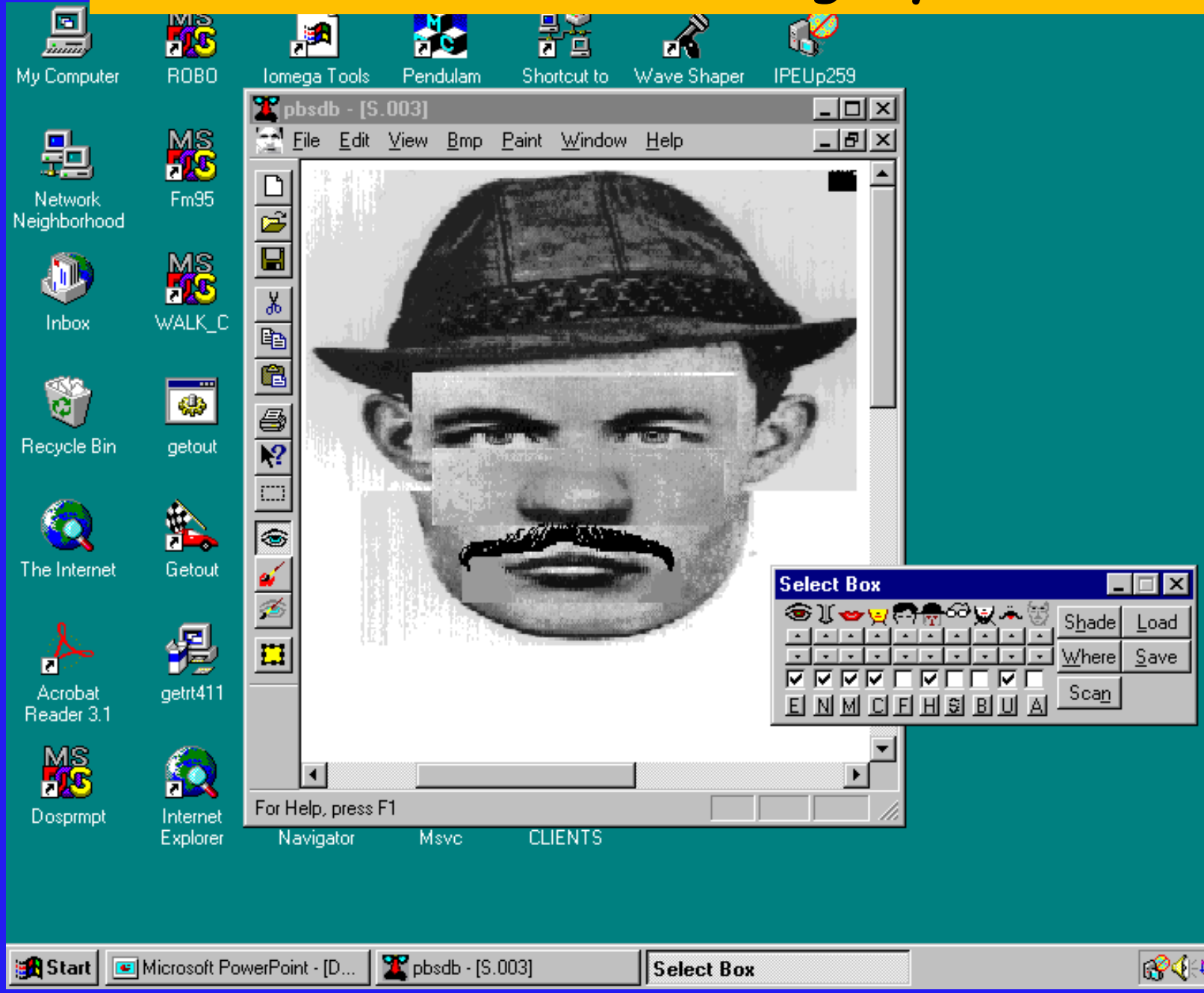
Line Tracker



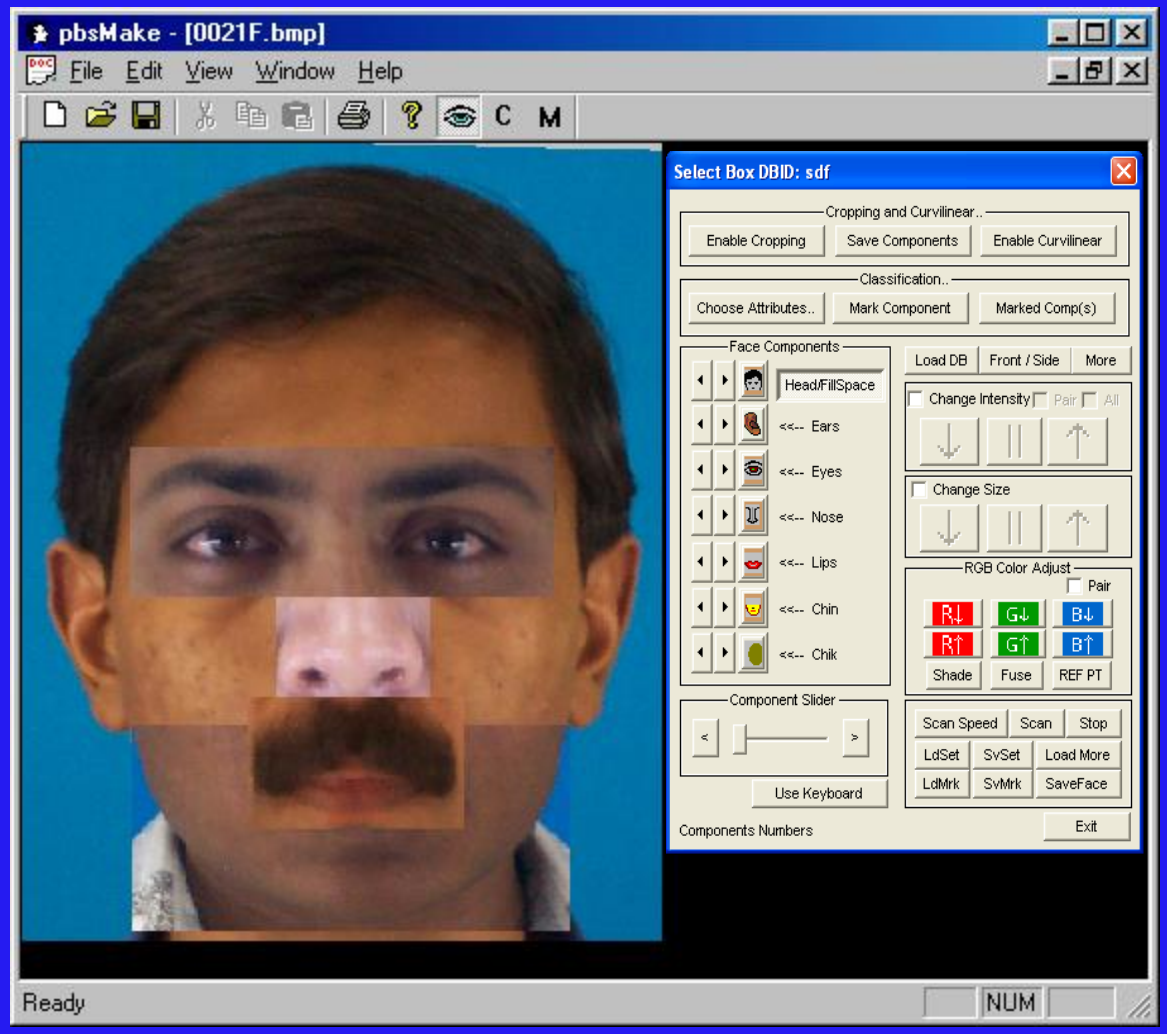
Gripper Robot

Figure shows a mobile four wheel robot with a gripper arm. It uses front two wheel drive with wheel encoder. The gripper arm is implemented using single motor to perform up, down, grip, un-grip, and auto-stop.

Portrait Building System



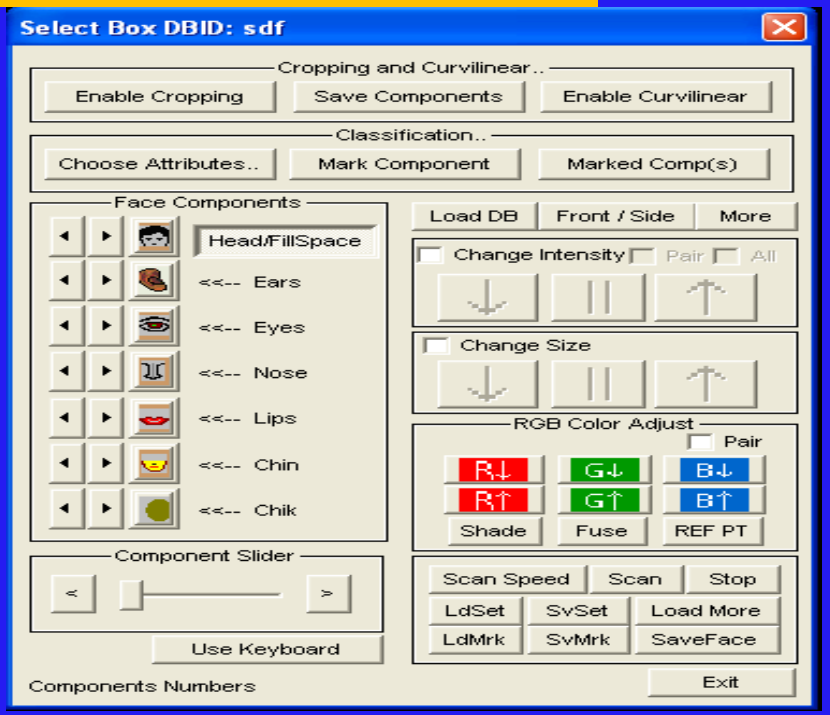
PBSMake



Press the [Eye], [Nose], [Lips] ,[Chin],[Ear] & [Chick] button. The components of first face from database will show up. Using corresponding [Next Arrow] or [Previous Arrow] buttons move through the database to select a desired components. The face would now appear as shown.

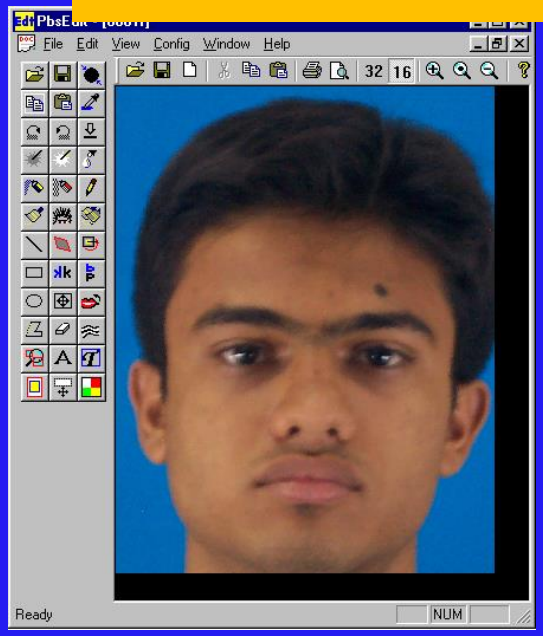
PBSMake

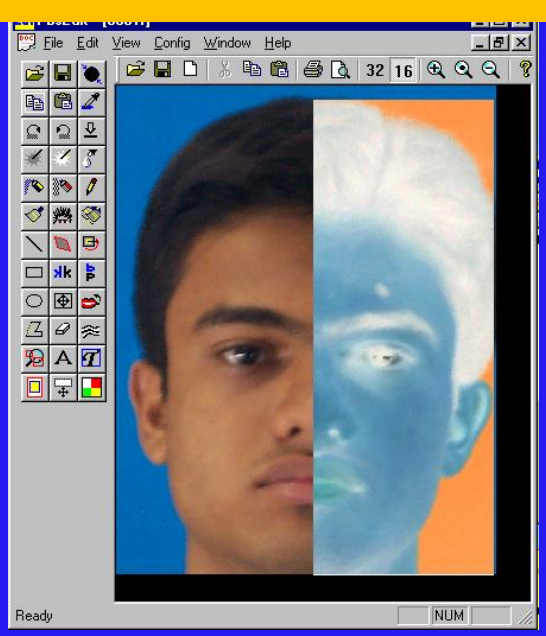


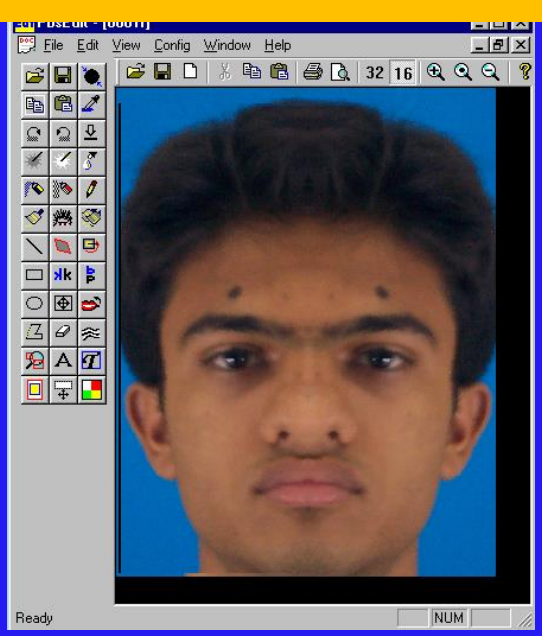


Select the More components (like hat, specs, mustache, beard etc) that have to be added by pressing their icon buttons. Select respective components of each in database using the [Next arrow] or [Previous arrow] button. Save the face using [Save Face].

PbsEdit

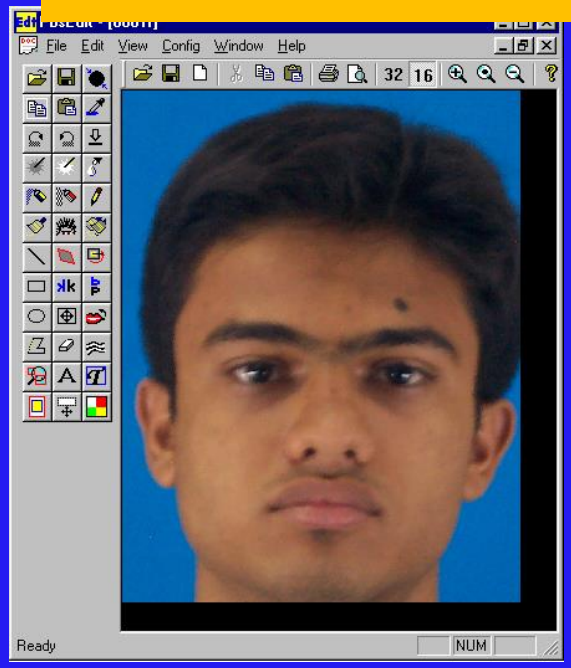


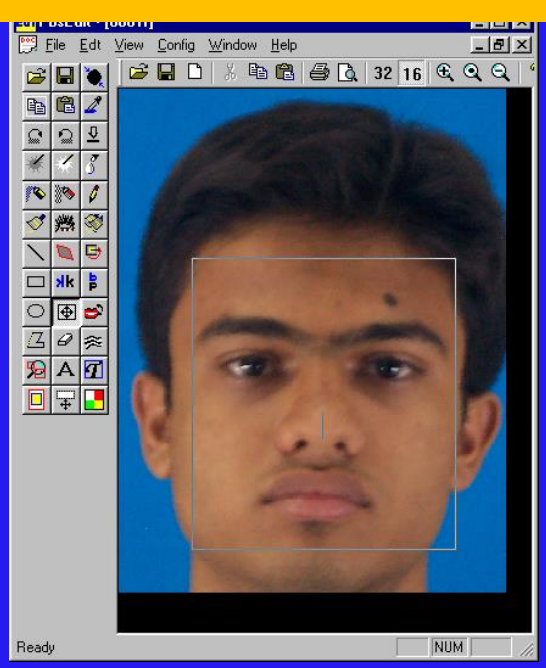


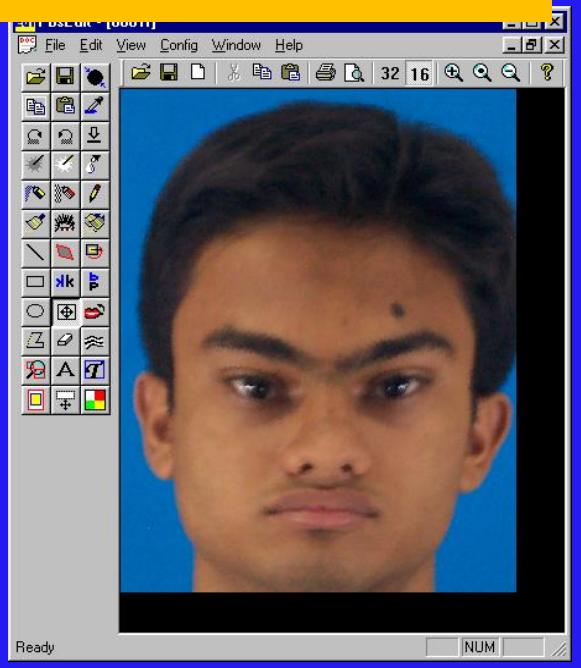


Press [MirrorH] button to select the mirror tool. Click anywhere on the image, a vertical reference will appear. Select a rectangular boundary around the portion of image starting from the reference line, to be Horizontal mirrored. With the release of Left Mouse Button the mirroring will start. The adjacent example shows Horizontal mirroring of right half of the face to the left half. Similarly you can select [MirrorV] Button for vertical mirroring.

PbsEdit

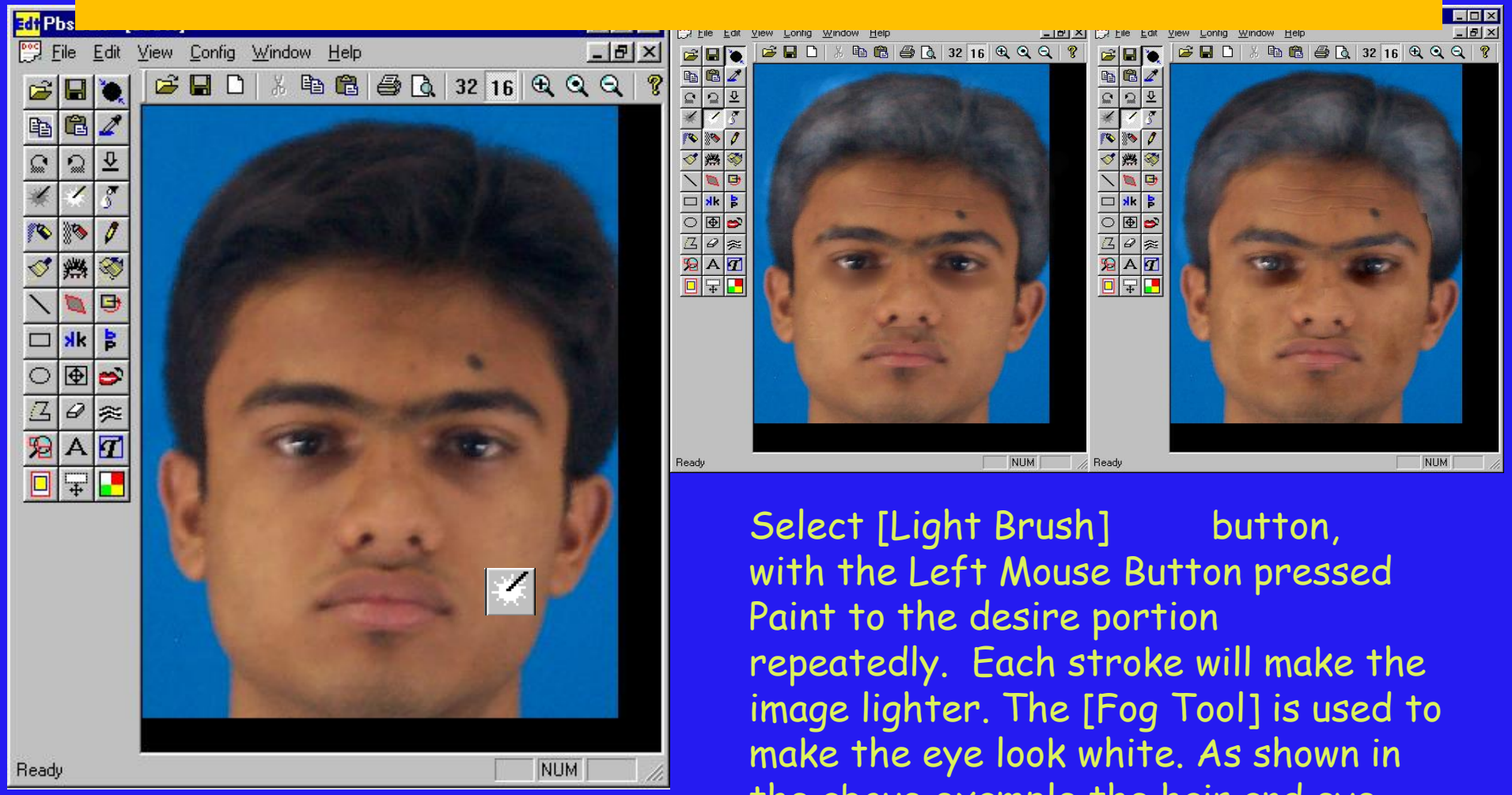






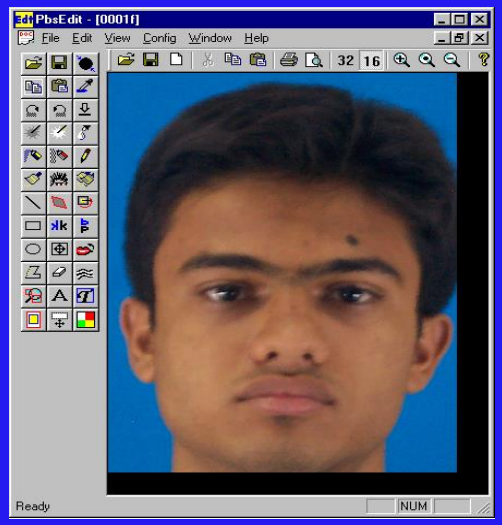
Press [ChangeShape2] button . Select a rectangular boundary around the portion of image to be changed. Anchor the mouse cursor to the point which you want to shift, now drag the cursor keeping the Left Mouse Button pressed and release to the desire point. In the above example lip portion is selected and the mouse cursor is anchored down.

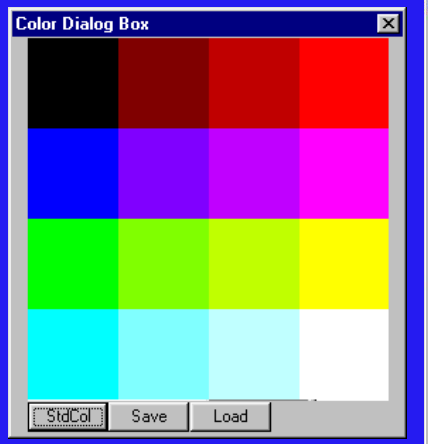
PbsEdit

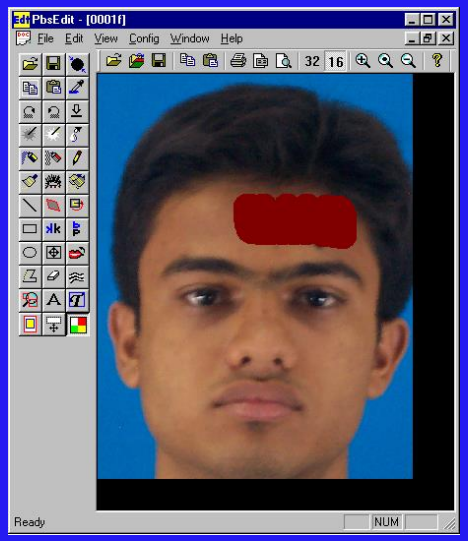


Select [Light Brush] button, with the Left Mouse Button pressed Paint to the desire portion repeatedly. Each stroke will make the image lighter. The [Fog Tool] is used to make the eye look white. As shown in the above example the hair and eye lashes are made white using the light brush. Similarly you can use dark brush.

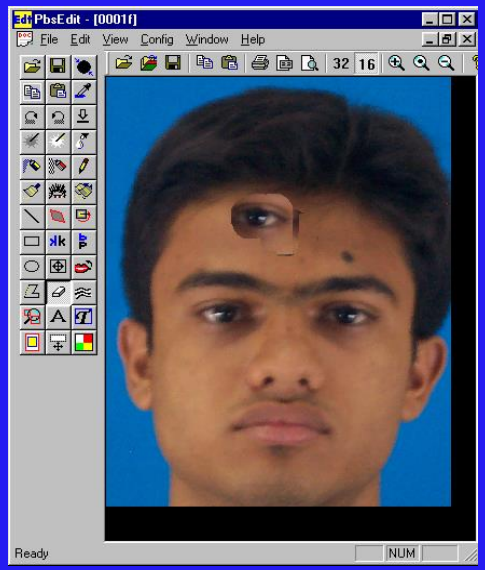
PbsEdit











Press [color palette] button to open "Color Dialog Box". Selecting any color from the dialog box allows you to paint the image with that color as shown in second image. If you want to store any part of the image in the "Color Dialog Box", right click on any color and then left click on any part of the image,that part will be loaded in the "Color Dialog Box" as shown in the fourth image, eye and lips are loaded in the dialogbox.Then the loaded part can be drawn on any image as shown in the fifth image.

14th PLANEX Workshop on "Instrumentation for Planetary Exploration "At R&D Center, DDU

- The 14th PLANEX Workshop was held during 6-10 January 2014 on the theme "Instrumentation for Planetary Exploration" at D.D. University, Nadiad, Gujarat.
- The Workshop was consisted of lectures by experts, group discussions, tutorials, team project work and presentations by participants. Thirty one students from all over India were selected on basis of merit.

Workshop offered seven projects to the participating students. Four projects of them were offered by this research center.
The projects undertaken are listed in table.

Workshop Project	Mentor
Mini Rover Design	**Dr. H.S.Mazumdar, DDU**
Rock Detection and Image Classification	**Prof.Y.K.Meghrajani, DDU**
Temp-Sensor with RF-Network	**Dr. H.S.Mazumdar, DDU** **Himanshu Purohit, DDU**
Low Power Motor Drive	**Prof. R.S.Chajjed, DDU**
Wireless Sensor Networks for Surface Exploration	Durga Prasad, PRL
X-Ray Detector and Frontend Instrumentation	Dr. Y.B.Acharya, PRL Shri M.Shanmugam, PRL
Crater Detection and Classification	Dr. S. Vijayan, PRL

14th PLANEX Workshop on "Instrumentation for Planetary Exploration "At R&D Center, DDU

Mini Rover Project

The objective was to assemble a mini rover robot with given specification and components and to design the necessary firmware for the rover controller.



Specification:

Approximate size:
Length: 300mm Width: 200mm Height: 125mm
Weight: *1.5 Kg*
Four Wheels of 70mm diameter
Two 60 rpm DC Motor drive with Gear
Interface with IR remote (RC5) for motion control.
Maximum Speed: *400mm/sec*
Speed control 10mm/sec to 400mm/sec

14th PLANEX Workshop on "Instrumentation for Planetary Exploration "At R&D Center, DDU

Rock Detection and Image Classification

The objective was to develop an algorithm for the identification of rock type using microscopic color images of different rock samples and to suggest improvements in the existing rock identification program



Specification:

Image format: *JPEG*
Resolution: *1600X1200*
Parameter used: *Hue value of grain*
Imaging Sensor: *100X USB Digital Hand-Held Microscope*

14th PLANEX Workshop on "Instrumentation for Planetary Exploration "At R&D Center, DDU

Temperature Sensor with RF-network Design

The objective was to assemble a solid state temperature sensor with a microcontroller and RF trans-receiver with given specifications and components and to design the necessary firmware for the sensor network node micro controller.



Specification:

Temperature Nodes:

Temperature range -25°C to 125°C for each node
Maximum Sampling rate 0.2 samples per second for each node
Power supply 5 Amp-Hr, 10V, Li Ion for each node
Battery charging using 12V solar cell.
Communication frequency 2.4 GHz
Data baud rate: 192000 Hz
Identification: Unique Node-ID and Long Integer Message-ID
Message passing: relay the message of other nodes with no repeat of message ID.

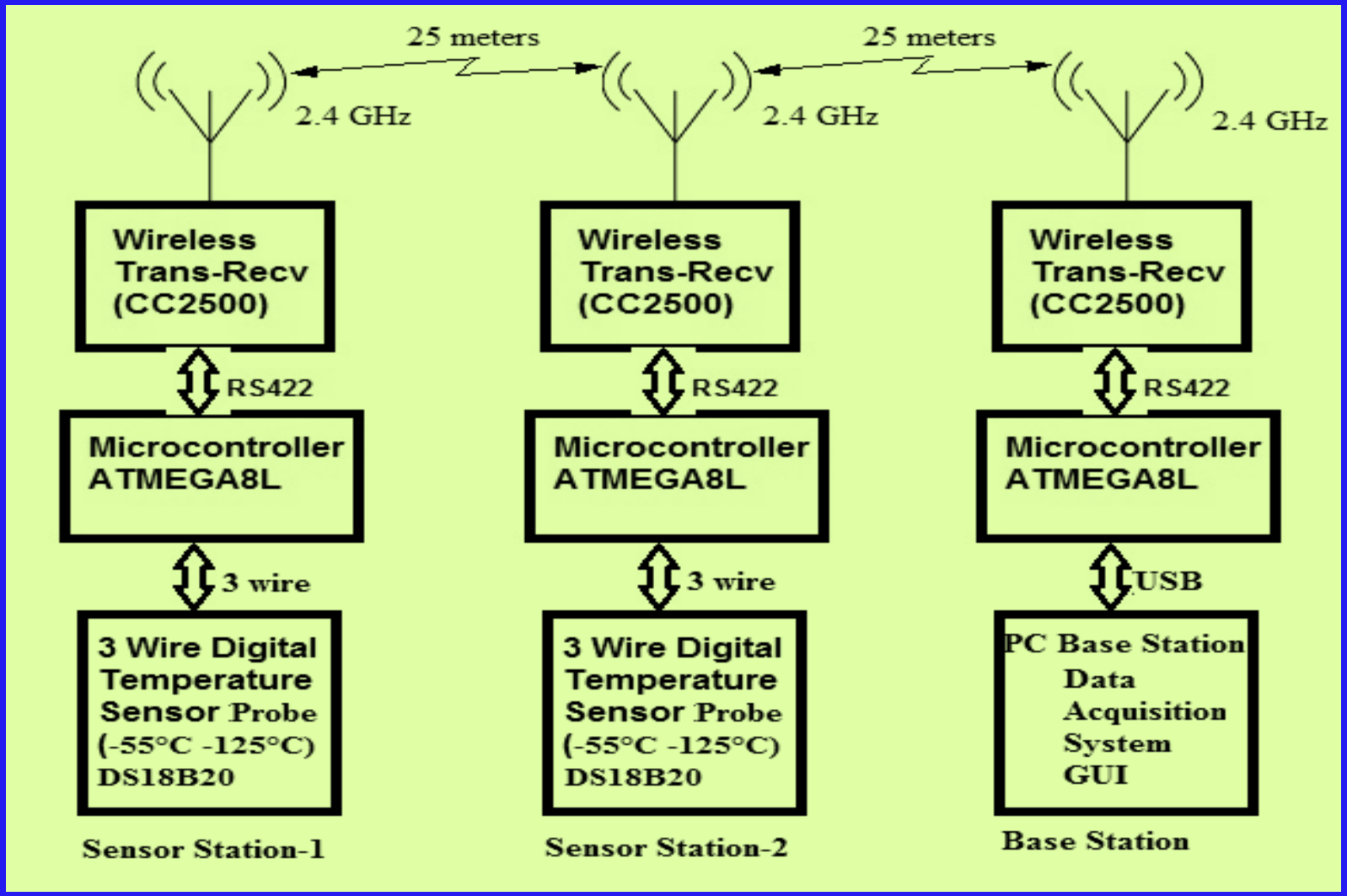
Base Station:

Mode: Master (in Master Slave protocol)
Identification: Unique Node-ID and Long Integer Message-ID
Message passing: relay the message of other nodes with no repeat of message ID.
GUI for command and temperature display

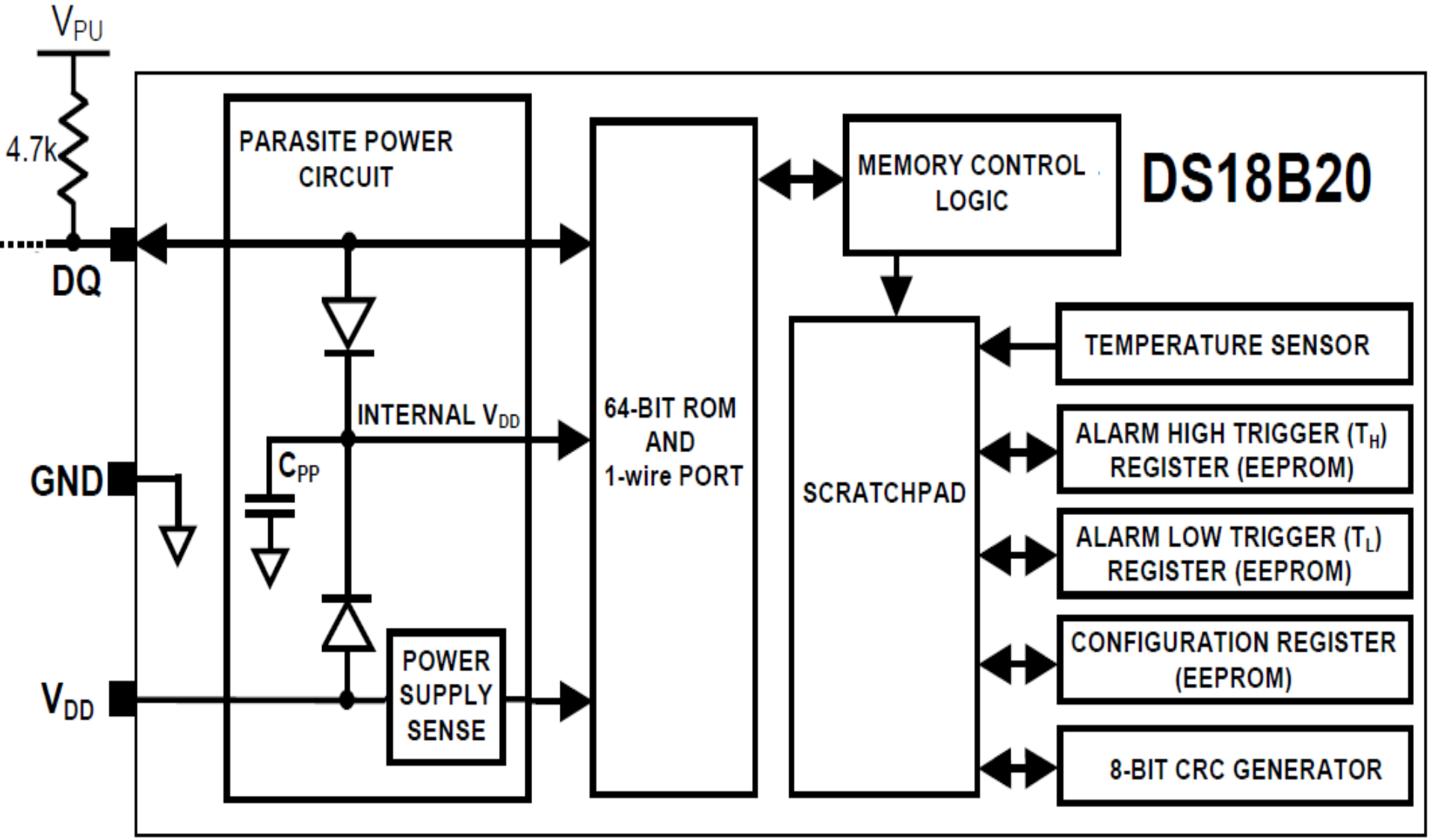
Objective

- To assemble a solid state temperature sensor IC with a microcontroller and RF trans-receiver with given specifications and components.
- Design the necessary firmware for the sensor network node micro controller. This design need not include actual coding but should have detailed specification and description of different modules and technologies.
- Prepare a short design and application report. This temperature sensor network is scalable and your application proposal need not limit to its current parameters like temperature and distance range.
- You may suggest other implementable add-ons to enhance the performance and functions of the sensor network.

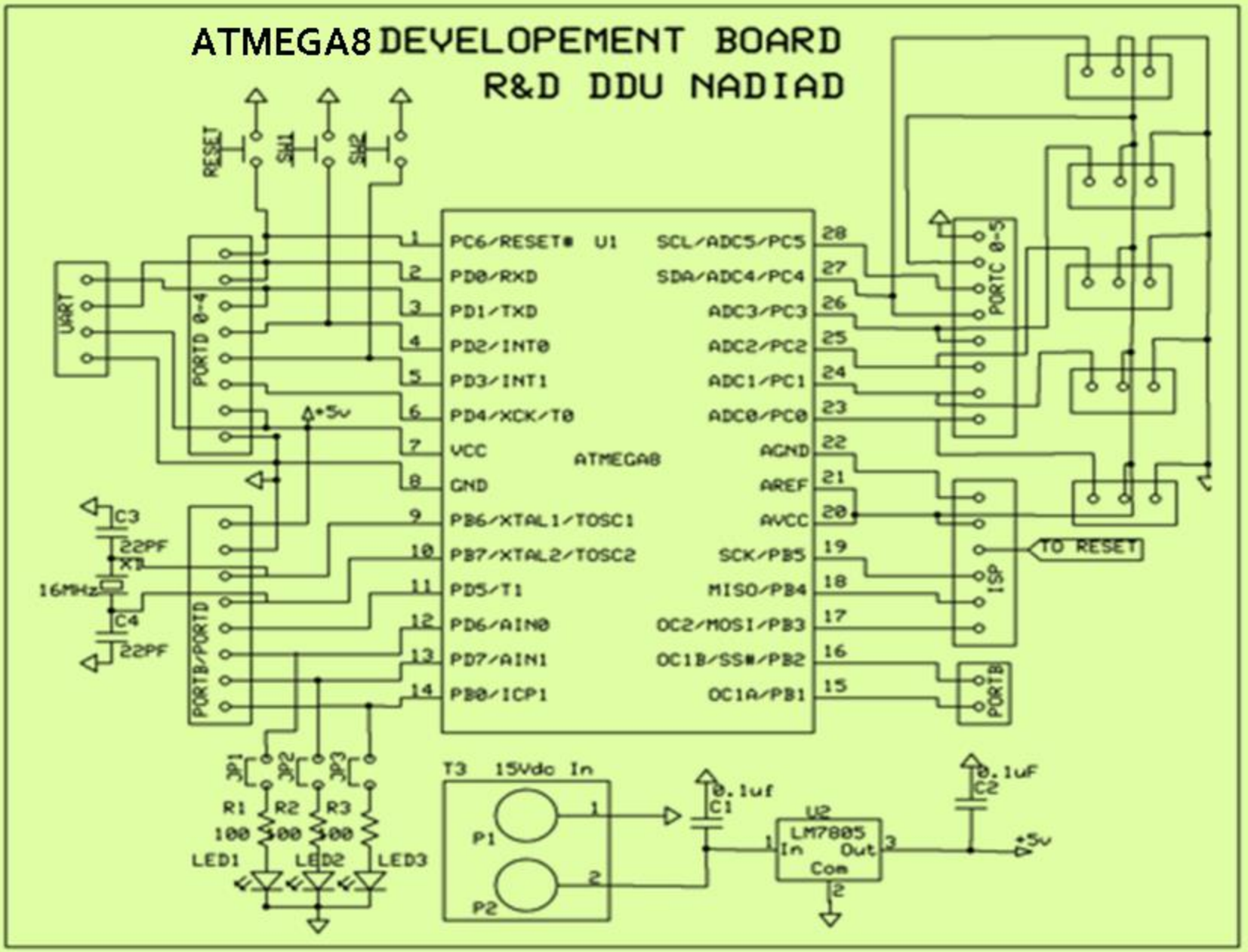
Block diagram of Temperature Sensor Network



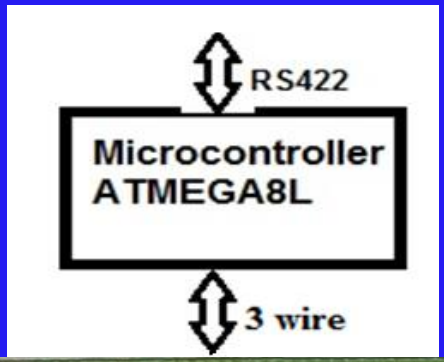
Digital Temperature Sensor-Block Diagram

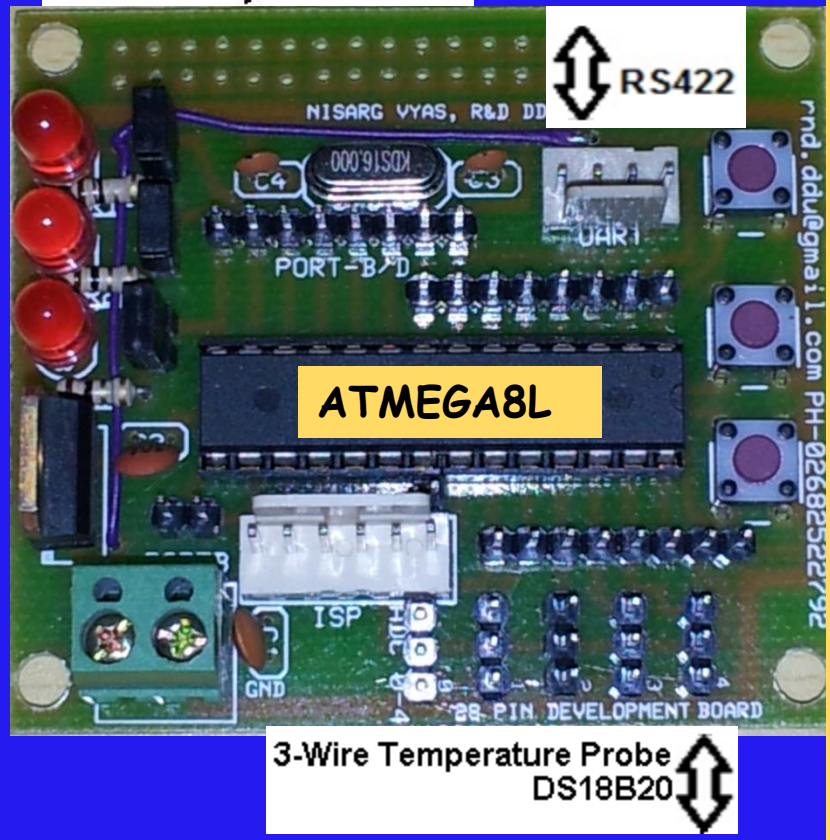


Circuit Diagram of Microcontroller Board



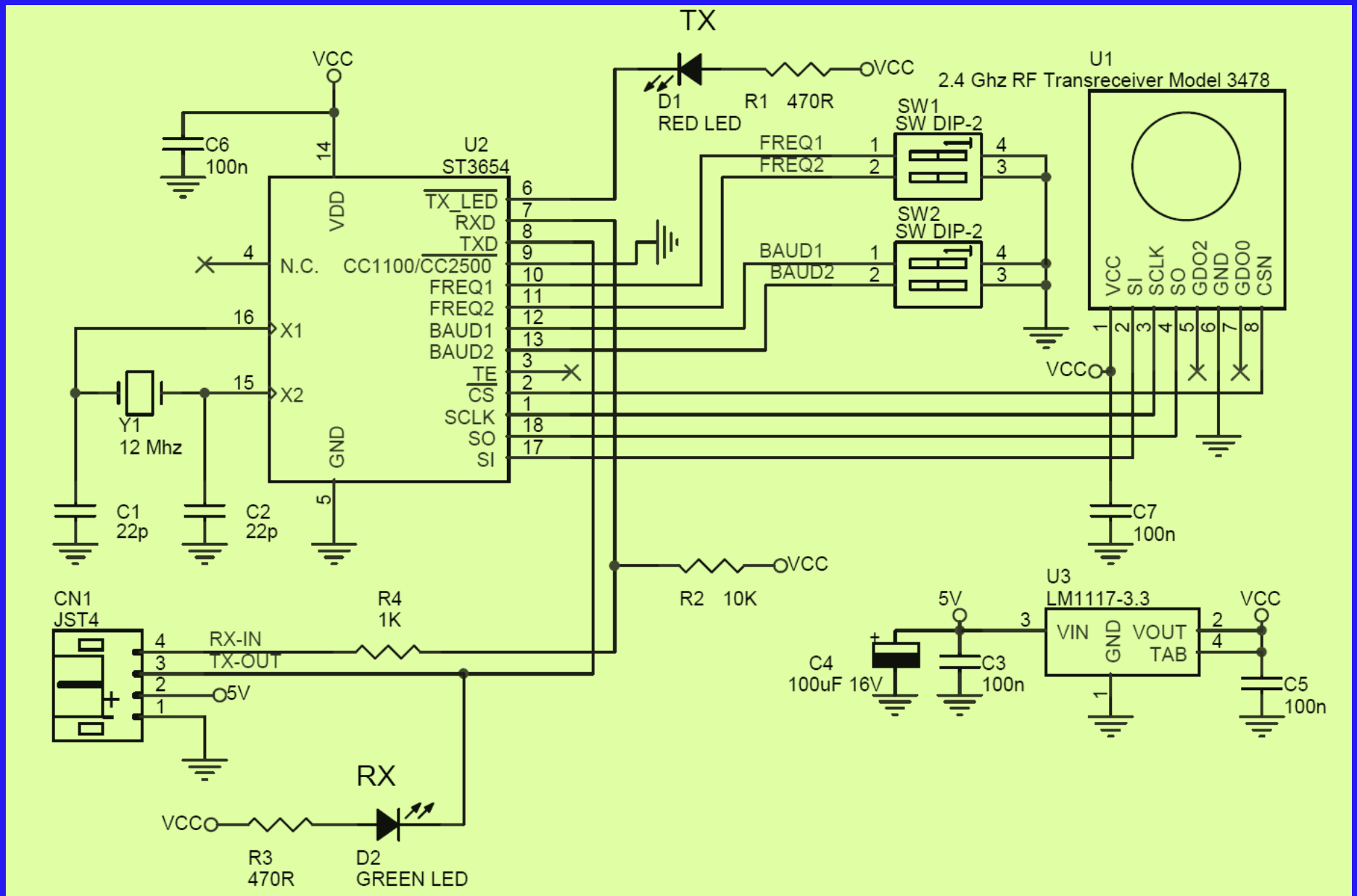
Microcontroller Card ATMEGA8 -1



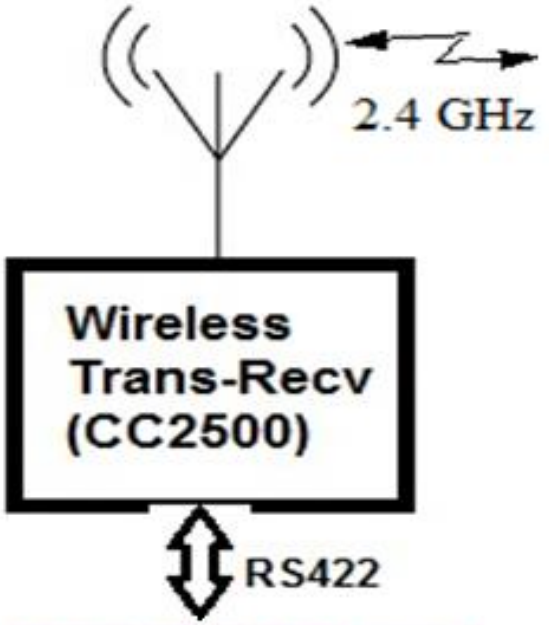


- ATMega8 microcontroller @ 16 MHz
- Serial communication linkRS422 @ 192000 baud
- 8K Bytes of Flash program memory
- 512 Bytes EEPROM
- 1K Byte Internal SRAM
- 6-channel ADC of 10-bit Accuracy
- Operating Voltages 5V
- 23 Programmable I/O Lines
- 2 Switches + 1 Reset Switch
- 3 Indicator LEDs
- SPI interface for programming

Circuit Diagram of Wireless Trans-Receiver Module



Wireless Trans-Receiver Module-1







RF Trans-receiver
Freq: 2.4 GHz
Range: 30 meters
Antenna: Onboard

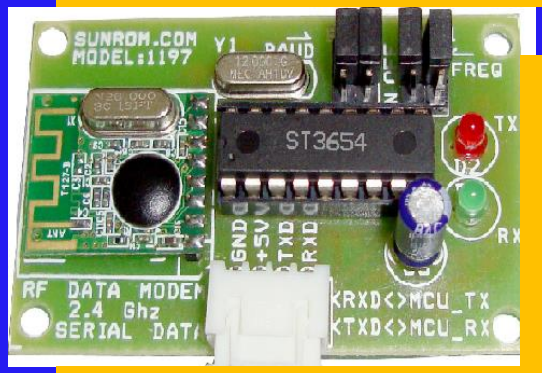
Serial Interface board with RF Trans-Receiver CC2500

Microcontroller Card ATMEGA8-2



- Small Size : 55 x 51 mm
- Can be easily power from an DC source or Battery
- 3 Indicator LEDs
- LED select through jumpers JP1, JP2, JP3.
- Onboard power regulation and filter circuit
- Included AVR Serial Port Programmer for programming the Microcontroller.
- 3 Switches including 1 Reset Switch
- Included PC-MCU serial link for communication with PC
- Provided with standard .1 header pins to be used with other circuits.
- Can be used as any autonomous Robots board.
- Programmer, Serial port and Power Supply are provided externally which helps keeping the board size small.
- Includes ATMega8 microcontroller.

Wireless Trans-Receiver Module-2



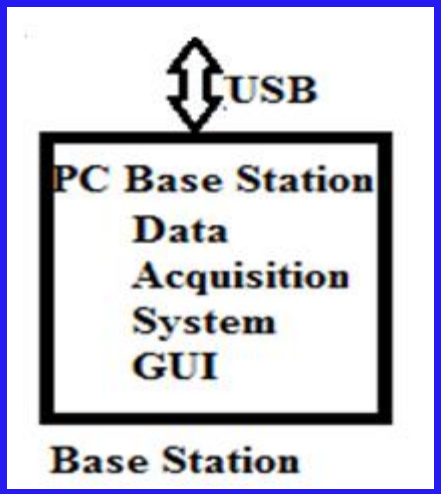
- Very reliable, small size, easier mounting
- No tuning required, PLL based self tuned
- Adjustable baud rate setting of 9600, 4800, 38400 and 19200
- Automatic switching between TX and RX mode with LED indication
- Frequency Channel can be set to operating multiple pairs in same area
- FSK technology, half duplex mode, robust interference
- Protocol translation is self controlled, easy to use
- High sensitivity, optimized transmission range.
- Standard UART interface, TTL(3-5V) logic level with any microcontroller
- Error checking(CRC) to prevent corrupted data output at receiver

Technologies to be used for Temperature Sensor Network

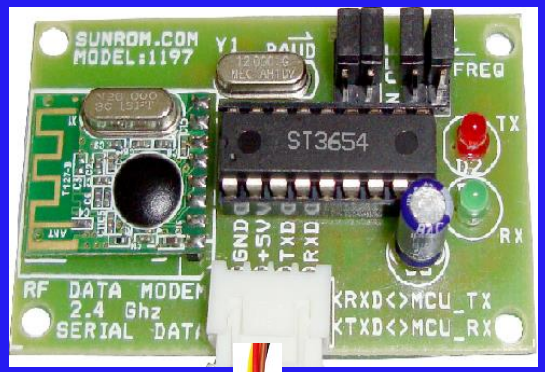
Technologies to be used:

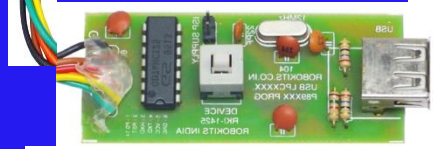
- ATMEL ATMEGA series Microcontroller- ATMEGA8 / ATMEGA8L
- DS18B20 digital thermometer
- CC2500 Low-Power 2.4 GHz RF Transceiver
- Visual Studio IDE with C#
- USB Programmer for ATMEGA series microcontroller using Code Vision AVR
- AVR 'C' cross compiler

Temperature RF Network Base Station



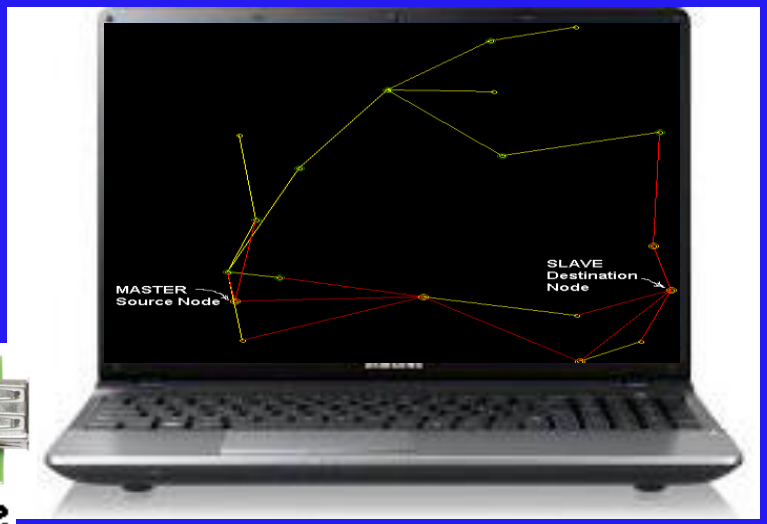
Wireless Trans-Receiver



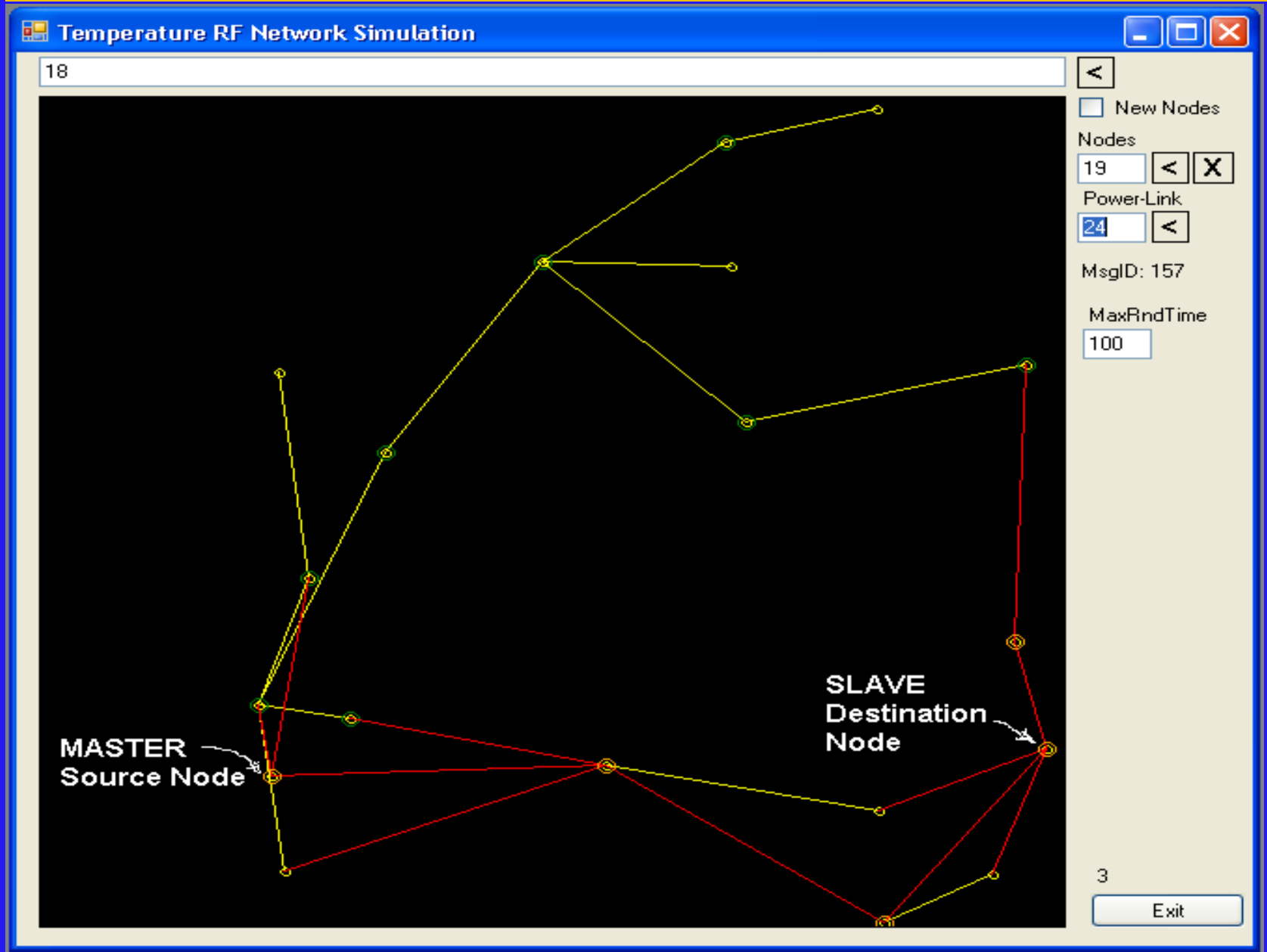


Serial Interface

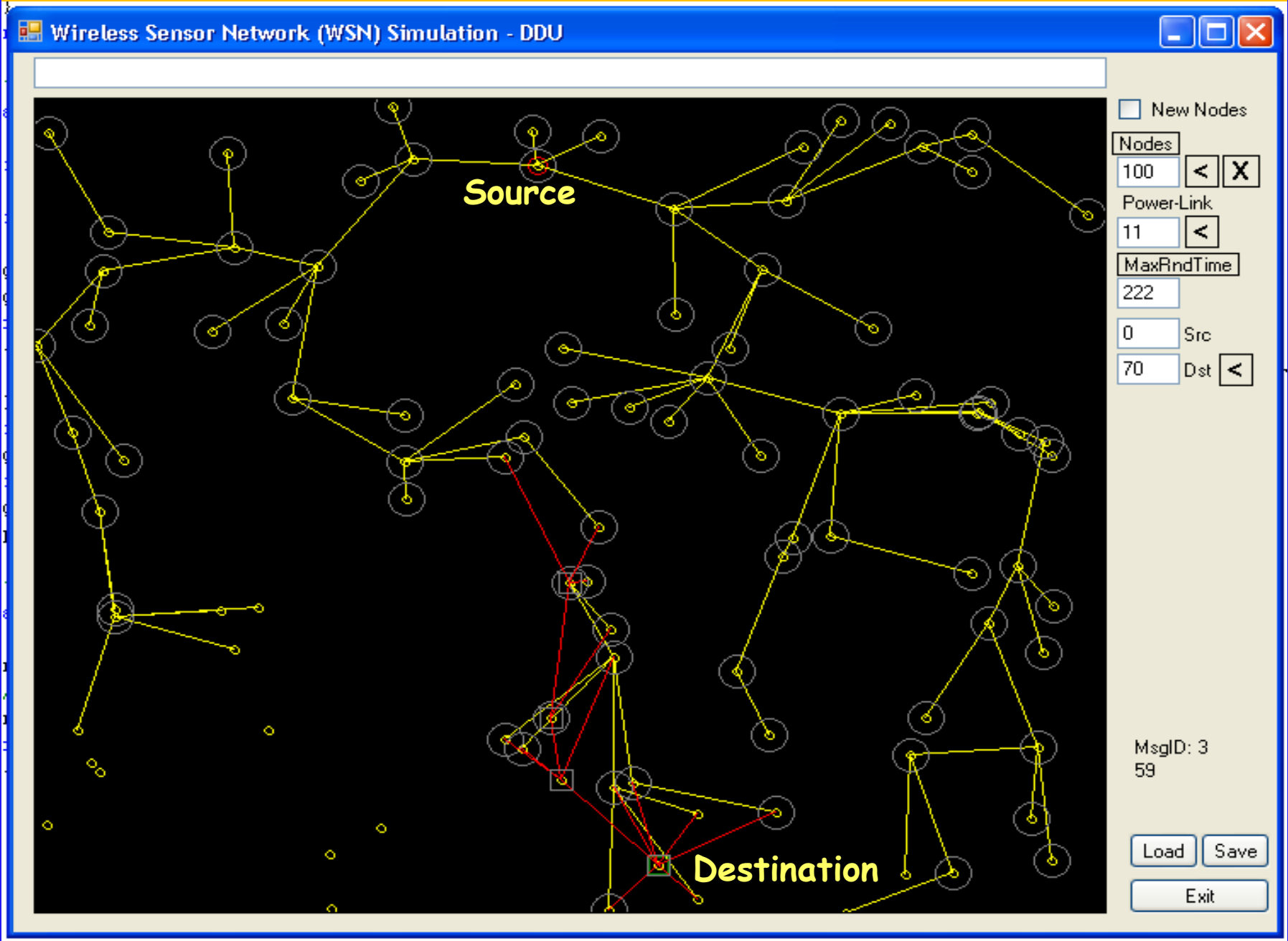
Host PC



Simulation of Temperature RF Network



Simulation of Wireless Sensor Network



Application of Wireless Sensor Network in Farming and Irrigation



14th PLANEX Workshop on "Instrumentation for Planetary Exploration "At R&D Center, DDU

Low Power Motor Drive Project

The objective was to design the necessary firmware for the DC / Stepper Motor controller to reduce the power requirement, Interfacing DC and Stepper Motor with microcontroller with given specification and components



Specification:

Approximate size Length: *300mm,* ***Width:*** *200mm,*
Height: *125mm*
Weight: *1.5 Kg*
Four Wheels of 70mm diameter.
Two 60 rpm DC Motor drive with Gear.
Interface with IR remote (RC5) for motion control.
Maximum Speed: *400mm/sec.*
Speed control: *10mm/sec to 400mm/sec.*
Direction control: *Left, Right, Forward, Reveres, Start, Stop*
Each wheel rotation counter using IR sensor

List of Publications

Journal Papers

[1] Seema Mahajan, "Modeling and Prediction of Rainfall – India", International Journal of Computer Science and Knowledge Engineering,(ISSN:0973-6735), vol-7, Jan-Jun-13 Serial Publication Pvt. Ltd.

[2] Seema Mahajan and Dr. Himanshu Mazumdar, "A Regenerative Prediction Algorithm for Indian Rainfall Prediction", International journal of Engineering Science & technology (ISSN: 0975 -5462) Volume 5 Issue 12 - December 2013, Engg. Journals Publication, Singapore.

[3] Seema Mahajan and Dr. Himanshu Mazumdar, "Rainfall Prediction Using Neural Net Based Frequency Analysis Approach", International Journal of computer Application (ISSN: 0975 – 8887) Volume 84 – No 9, December 2013, USA.

[4] Seema Mahajan and Dr. Himanshu Mazumdar, "A Fast Learning Algorithm for Rainfall Prediction", International Journal of computer Application (ISSN: 0975 – 8887) Volume 85 – No 15, January 2014, USA

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List of Publications (Contd..)

Journal Papers

[5] Pratik V Patel and Dr.Himanshu S Mazumdar, "Earth rock classification using Neural Network", Journal of Research in Technology and Management Vol.1, No.1, Jan-Jun 2013, pp: 1-4; ISSN 2278 – 3121.
[6] Maulika S Patel and Himanshu S Mazumdar, "Data mining for Proteomic tasks", Journal of Research in Technology and Management Vol.1, No.1, Jan-Jun 2013, pp: 1-4; ISSN 2278 – 3121.
[7] Maulika S Patel and Himanshu S Mazumdar, "Knowledge Base and Neural Network Approach for Protein Secondary Structure Prediction", under review for the international journal of theoretical biology, Elsevier publication.
[8] Maulika S Patel and Himanshu S Mazumdar, "Extracting Database Properties for Sequence Alignment and Secondary Structure Prediction", International Journal of Pune and Applied Bioscience, 2014, ISSN: 2320-7051.

Technical Reports

Technical Reports by Desserting Students at R & D Center

[1] Ankita C Baravaliya, Dr. Himanshu S Mazumdar and Maulika S Patel, "Keyword Based Iterative Approach to Multiple Sequence Alignment" (In progress)

[2] Divya J Nimavat, Dr. Himanshu S Mazumdar and Marichi P Patel, "3D Video Streaming for Virtual Exploration of Planet Surface" (In progress)

[3] Priyank Y Chauhan, Dr. Himanshu S Mazumdar, "Reconstruct 3D Human Face Using Two Orthogonal Images" (In progress)

[4] Sagar K Soni, Dr. Himanshu S Mazumdar and Pratik V Patel, "Rock Classification Using Computational Intelligence" (In progress)

[5] Hasmukh A. Bheda, Nirav T Patel, Rahul V Karelia and Dr. Himanshu S Mazumdar "Neuro-Fuzzy Controller with Genetic Algorithm Based De-Fuzzification Methods" (In progress)

Invited Talks and Lectures

[1] "Big Data in Life Science"

[2] "Development of Electronic Systems for Planetary Missions and job opportunities".

[3] "Intelligent Wireless Sensor Network"

[4] "Miniaturization of Payloads"

[5] "Competing Globally – A Race for Survival"

[6] "Electronics, Robotics, Artificial Neural Network and Biological Connections"

Details

Workshops, Seminars and Training Courses

[1] 14th PLANEX Workshop on **"Instrumentation for Planetary Exploration"** was successfully hosted by this research group from 6th to 10th January, 2014 at DDU. The workshop consisted of lectures conducted by experts from PRL, ISRO centers and DDU to 31 participants. Projects offered to the participants by this group are Mini-Rover Design, Adoptive RF Temperature Sensor Network, Rock Classification and Low Power Motor Drive.

[2] One day seminar on "Highlights on Indian Planetary Exploration Missions" organized at DDU on 10th September, 2013.

[3] Offered short course on "Detection and classification of craters" and "Browsing planet surface using stereo projection" during STP-2013 workshop for ISRO engineers at PRL, Ahmedabad.

[4] Helped PLANEX, PRL to review and monitor progress of Chandrayaan-II and Mars Payloads.

Details

Team Members of Planetary Exploration Technology Research-DDU



Dharmesh Rabari
Mechanical Technician



Harish Rabari
Peon



Himanshu Mazumdar
Software Hardware Developer



Himanshu Purohit
Software Hardware Developer



Marichi Patel
Software Developer



Maulika Patel
PhD Scholar



Nisarg Vyas
Electronic Technician



Pratik Patel
PhD Scholar



Seema Mahajan
PhD Scholar



Vitul Patel
Resource Management



Yogesh Meghrajani
PhD Scholar

HELLO to ALL from R&D DDU


DHARMSINH DESAI UNIVERSITY
Thank You