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A-VIEW Phase II

Kamal Bijlani
Amrita University
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• Phase II Objectives

• Phase II Budget & Deliverables
A-VIEW Usage – 10,000 Institutions

- J & K: 31
- Punjab: 64
- Haryana: 45
- UP: 229
- Bihar: 78
- Jharkhand: 51
- MP: 372
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- Orissa: 61
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- Meghalaya: 14
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- Assam: 15
- New Delhi: 137
- Sikkim: 11
- Uttarakhand: 182
- Chandigarh: 15
A-VIEW Phase II

**Phase II**
- Crores benefited
- 25,000 Institutions (Higher Edu)
- Large Scale: Schools, Skill Training

**Phase I**
- Lakhs benefited
- 10,000+ Institutions (Higher Edu)
- Pilots: Schools, Skill Training
A-VIEW Phase II Vision: Crores of Users

Massively Scalable Live Interactive Collaborative E-Learning Platform
शिक्षकों के लिए बनेगा प्रौद्योगिकी ट्रेनिंग सेंटर

हद्दनारी में संगठन का आयोजित कार्यक्रम में वित्त मंत्री इंदिरा इद्रेश्य और अन्य।

इंदिरा बोली, एक-दो दिन में होगा मंग्रिंदल विस्तार

हद्दनारी। वित्त मंत्री डॉ. इंदिरा इद्रेश्य ने कहा कि राज्य मंत्रिमंडल में नवीनता दिया कि एक-दो दिन में पर स्थिर रहा। उन्होंने दिया कि उत्तराखंड में जीवनस्तंभ की व्यवस्था ने लागू किया जाएगा। इसके लिए राज्य के अधिकारियों की तैयारी के लिए किया गया है।

मुंबई की ओर से तैयार किए गए माइक्रोफोन और साउंडसीमिनर को लग इन आईडी महाविद्यालयों को दी गई। महाविद्यालयों की तरफ से उन्होंने दिया कि हमें अपना विकास करना है।
A-VIEW Phase II

A-VIEW
Huge Synchronous Classroom

- Free & Open
- 1 Lakh Synchronous Students
- Easy to Adopt
- Minimum Setup cost
- Maximum Reach
- Plug n Play API

Crores of Users
Ring Architecture
Mobile Device
On Premise Server
Cloud WiFi Satellite
Lakhs of Users

2015
2018

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- Cloud/National servers – free for everyone; supported by MHRD
  - e.g. Baadal Cloud, Data centers

- VPN servers at Universities
  - Provides better performance
  - e.g. within NKN VPN network

- LAN servers at colleges/schools
  - Provides accessibility to all students; without internet
  - More content security
  - e.g. within any institution campus
Overview

• Single sign-on
• Upload content from other platform
• Get audit data
• Get attendance report
• Synchronize user data
• Synchronize course/class scheduling
A-VIEW Integrated with IITM QEEE
NO AGE. NO BOUNDARIES. NOW NO MORE LIMITATIONS.

Learning made easy with SWAYAM,
An MHRD initiative
• Architecture Discussions with Microsoft under-way

• Roadmap Overview
  – Single Sign-On
  – Live Doubt Clearance Sessions
  – Live Classroom Monitoring
  – Teacher Self-Recording of Lectures
  – Seamless Web Integration
A-VIEW on ISRO Satellite Network

• Remote Areas

• Testing ongoing with ISRO Dehradun & Ahmedabad
A-VIEW Phase II

A-VIEW
Huge Synchronous Classroom

- Crores of Users
- Ring Architecture
- Mobile Device
- On Premise Server
- Cloud WiFi Satellite
- Lakhs of Users

- Free & Open
- 1 Lakh Synchronous Students
- Easy to Adopt
- Minimum Setup cost
- Maximum Reach
- Plug n Play API

2015 → 2018

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A-VIEW Maintenance

• Continue A-VIEW Support for Major Stakeholders

• Complete partial features requested by Customers
  – FOSS for institutions using it locally on their own
  – Mobile App (70% completed)
  – Satellite (80% completed)

• Scale A-VIEW Deployment to Crores of users
A-VIEW Interoperability

- Requested by DEC Connectivity (HRD Ministry)
  - Interoperate with MCU’s and other Video Conferencing Equipment
  - Integrate with Campus Wi-Fi initiative
- Increase Wi-Fi/Internet utilization
- Mobile A-VIEW adoption on Campus Wi-Fi
Phase II – Modules

M1: Huge Virtual Synchronous Classrooms
M2: Classroom Monitoring & Attention Analysis
M3: Adaptive Plug and Play Devices
M4: Open Source Server Components
M5: Major Requests From Stakeholders
M6: Synchronous Tutoring Groups
M7: A-VIEW Using Low End Mobiles
M8: Local Synchronous Producer And Player
M9: Automation Testing & System Integration
M10: Implementation For One Crore Users
M1: Huge Virtual Synchronous Classrooms
User Interface for each Role Type

- **Teacher**: Content
- **Teaching Assistant**: Content, Forum, Interaction
- **System Admin**: Troubleshooting
- **Monitor**: Supervision, Analytics
M2: Classroom Monitoring and Attention Analysis
Summary: Plug and Play Devices
Support for wide-variety of certified audio and video devices.

Overview:
• Automatic Device Recognition
• Seamless reconfiguration
• Cloud-based Profiles and Roaming
• Device Certification
• Quality Lab
M5: Major Requests From Stakeholders

- UI Improvements
- Centralized Analytics
- Ease of Admin
- User Requested Enhancements
M6: Synchronous Tutoring Groups

- Classroom Chat
- Student Group Chat
- TA / Student Private Chat
- Breakout Rooms
- Open APIs
- Contact Lists
A-VIEW On Mobile
Immediate Feedback Mechanism
Which is the longest river in India?

- Ganga
- Yamuna
- Kaveri
Live Poll

Poll
What Impact Has Social Media Truly Had On Society

Revealing personal information on social sites can make users vulnerable to crimes like identity theft, stalking, etc.

- Agree
- Disagree

SUBMIT

Session: Introduction to Social Media Impact
Blended Doubt Clearance

Live Class

Live Interaction

Questions

Recordings

Mooc Forum

Questions

Recordings

Synchronous Tutoring Group
• Automation Testing
  • Server / Cloud Validation
  • Client Automation
  • Load Testing
    • Satellite
    • IP Multicast

• Tools for Deployment Validation
  • Private Cloud Deployments
  • Self-Check Tools for Admins
M10: Implementation for 1 Crore Users

• **Deploy to 1 Crore Learners and Teachers**
  • Divide the Country into Regions
  • Regional Phased Deployments
  • Bi-Annual Managed Refresh

• **Regional Support Coordinator**
  • Regional Implementation Plan
  • Dedicated Trainings in Selected Cities
  • Minimize Travel Budget for Admins
Implementation for 1 Crore Users

• **Central Deployment Team**
  • Assisted Remote Deployments
  • Regular Online Trainings

• **24x7 Technical Support**
  • Phone / Chat / Email Support
  • Prioritized Ticketing System

• **24x7 IT Support**
  • On-Call System Admins
  • Network Alerting, Escalation
Implementation for 1 Crore Users

• Training & Documentation
  • A-VIEW II Setup & Management
  • A-VIEW II – Configuring and Managing Users
  • A-VIEW II User Guide
  • Videos showing how to use A-VIEW II
  • Mobile App User Guide
  • Videos showing how to use the Mobile App
  • Multi-Language Documentation
  • Multi-Language Trainings
A-VIEW 5.0 Features

Client:
Mobile & Tablet
Easy MP4 Recording
Self-Recording Producer
Audio-Video

System/Server:
Open Source A-VIEW
License-Free National A-VIEW Server
Red 5 Server
Internet & Satellite
## Phase 1 – Funding Summary

<table>
<thead>
<tr>
<th>No.</th>
<th>Financial Year</th>
<th>Amount</th>
<th>Team Size</th>
<th>Institutions using A-VIEW</th>
<th>Comments</th>
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<tbody>
<tr>
<td>1</td>
<td>2010-11</td>
<td>1034</td>
<td>100</td>
<td>20</td>
<td>Main Project Started</td>
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<tr>
<td>2</td>
<td>2011-12</td>
<td>200</td>
<td>140</td>
<td>127</td>
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<td>3</td>
<td>2012-13</td>
<td>593.7</td>
<td>160</td>
<td>693</td>
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<td>4</td>
<td>2013-14</td>
<td>768</td>
<td>165</td>
<td>2,762</td>
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<tr>
<td>6</td>
<td>2014-15</td>
<td>400</td>
<td>150</td>
<td>4,207</td>
<td>Funds exhausted in September 2014</td>
</tr>
<tr>
<td>7</td>
<td>2015-16</td>
<td>0</td>
<td>120</td>
<td>8,426</td>
<td>No funds received in 2015; 5 crore Advance from Amrita University</td>
</tr>
<tr>
<td>8</td>
<td>2016-17</td>
<td>450</td>
<td>74</td>
<td>10,141</td>
<td>450 Lakhs received, paid back to Amrita Univ.</td>
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**Total Phase I** | 3446  

---

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# Phase II – Original Total Budget

<table>
<thead>
<tr>
<th>#</th>
<th>Line Items</th>
<th>Amount (in lakhs)</th>
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<tbody>
<tr>
<td>A</td>
<td>Total original budget</td>
<td>1484.47</td>
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<tr>
<td></td>
<td>(A = B + C)</td>
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<tr>
<td>B</td>
<td>Budget for Maintenance Items</td>
<td>1179.92</td>
</tr>
<tr>
<td>C</td>
<td>Budget for New features</td>
<td>304.55</td>
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<tr>
<td></td>
<td>(C = D + E) (Swayam Breakup)</td>
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<tr>
<td>D</td>
<td>New Features (some overlap with Swayam)</td>
<td>49.23</td>
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<tr>
<td>E</td>
<td>New Features (not part of Swayam)</td>
<td>255.32</td>
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<tr>
<td></td>
<td>New Requirement (Module 11)</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>A-VIEW Interoperability*</td>
<td>179.61</td>
</tr>
</tbody>
</table>

**Maintenance Budget**

- 1179.92

**New Modules not overlapping with Swayam**

- 255.32

**New Module: A-VIEW MCU Inter-Operability**

- 179.61

**Revised Total Budget (in lakhs)**

- 1614.85
<table>
<thead>
<tr>
<th>Item</th>
<th>Module Name</th>
<th>Maintenance Items</th>
<th>New Features</th>
<th>Total To-Do Items</th>
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<td>Module 1</td>
<td>Huge Virtual Synchronous Classrooms</td>
<td>23</td>
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<td>Module 2</td>
<td>Classroom Monitoring and Attention Analysis</td>
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<td>Module 3</td>
<td>Adaptive Plug and Play Devices</td>
<td>35</td>
<td>7</td>
<td>42</td>
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<td>Module 4</td>
<td>Open Source Server Components</td>
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<td>Module 5</td>
<td>Major Requests from Stakeholders</td>
<td>41</td>
<td>12</td>
<td>53</td>
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<td>Module 6</td>
<td>Synchronous Tutoring Groups</td>
<td>16</td>
<td>10</td>
<td>26</td>
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<tr>
<td>Module 7</td>
<td>A-VIEW using Low End Mobiles</td>
<td>11</td>
<td>7</td>
<td>18</td>
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<td>Module 8</td>
<td>Local Synchronous Producer and Player</td>
<td>11</td>
<td>8</td>
<td>19</td>
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<tr>
<td>Module 9</td>
<td>Automation Testing and System Integration</td>
<td>100%</td>
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<tr>
<td>Module 10</td>
<td>Implementation of A-VIEW for Crores of Users</td>
<td>100%</td>
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<tr>
<td></td>
<td>Maintenance</td>
<td>184</td>
<td>73</td>
<td>257</td>
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<td></td>
<td>Total</td>
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</table>
## Budget Breakdown by Module

<table>
<thead>
<tr>
<th>Module #</th>
<th>Functional Description</th>
<th>Total Budget</th>
<th>Total No. of Items</th>
<th># of Maintenance Items</th>
<th>Maintenace Budget</th>
<th># of New Features Items</th>
<th>New Features Budget</th>
</tr>
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<tbody>
<tr>
<td>Module 1</td>
<td>Huge Virtual Synchronous Classrooms</td>
<td>169.98</td>
<td>32</td>
<td>23</td>
<td>122.17</td>
<td>9</td>
<td>47.81</td>
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<td>Module 2</td>
<td>Classroom Monitoring and Attention Analysis</td>
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<td>45</td>
<td>30</td>
<td>86.93</td>
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<td>43.47</td>
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<td>Module 3</td>
<td>Adaptive Plug and Play Devices</td>
<td>99.74</td>
<td>42</td>
<td>35</td>
<td>83.12</td>
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<td>16.62</td>
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<td>Module 4</td>
<td>Open Source Server Components</td>
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<td>41</td>
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<td>16</td>
<td>79.97</td>
<td>10</td>
<td>49.98</td>
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<tr>
<td>Module 7</td>
<td>A-VIEW using Low End Mobiles</td>
<td>143.31</td>
<td>18</td>
<td>11</td>
<td>87.58</td>
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<td>55.73</td>
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<td>Module 8</td>
<td>Local Synchronous Producer and Player</td>
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<td>11</td>
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<td>32.91</td>
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<td>Module 9</td>
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<tr>
<td>Module 10</td>
<td>Implementation of A-VIEW for Crores of Users</td>
<td>338.95</td>
<td>100%</td>
<td>100%</td>
<td>338.95</td>
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| Total                                             | 1484.47      | 257               | 184                    | 1179.92           | 73                      | 304.55              |
## Phase II - Maintenance Budget

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<tr>
<th>Expense Head</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
<th>Total (3 yr)</th>
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<tbody>
<tr>
<td><strong>Total In Lakhs</strong></td>
<td></td>
<td></td>
<td></td>
<td>1179.81</td>
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<tr>
<td><strong>Non Recurring</strong></td>
<td></td>
<td></td>
<td></td>
<td>1039.22</td>
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<tr>
<td>Equipment</td>
<td>81.22</td>
<td>47.90</td>
<td>0.00</td>
<td>129.12</td>
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<tr>
<td>Total Salary</td>
<td>325.45</td>
<td>285.67</td>
<td>298.98</td>
<td>910.10</td>
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<tr>
<td><strong>Recurring</strong></td>
<td></td>
<td></td>
<td></td>
<td>140.59</td>
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<tr>
<td>Contingency</td>
<td>3.42</td>
<td>6.20</td>
<td>7.58</td>
<td>17.20</td>
</tr>
<tr>
<td>Consumables &amp; Supplies</td>
<td>3.34</td>
<td>6.02</td>
<td>7.34</td>
<td>16.70</td>
</tr>
<tr>
<td>Internet for Servers &amp; Development</td>
<td>3.10</td>
<td>7.45</td>
<td>9.11</td>
<td>19.66</td>
</tr>
<tr>
<td>Mobile &amp; Internet</td>
<td>4.44</td>
<td>9.36</td>
<td>11.33</td>
<td>25.13</td>
</tr>
<tr>
<td>Regional Support &amp; Training</td>
<td>6.5</td>
<td>15.3</td>
<td>18.7</td>
<td>40.5</td>
</tr>
<tr>
<td>Travel &amp; Stay</td>
<td>4.8</td>
<td>7.4</td>
<td>9.2</td>
<td>21.4</td>
</tr>
<tr>
<td><strong>Total (Rec + Non Rec)</strong></td>
<td>432.27</td>
<td>385.30</td>
<td>362.24</td>
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• Thank you
## Year 1 Expenditure

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Staff Salary</td>
<td>248.73</td>
<td>76.72</td>
<td>Incurred Expenses; Salary for 3 months</td>
</tr>
<tr>
<td>Hardware: A-VIEW Load Testing, Implementation</td>
<td>58.29</td>
<td>20.9</td>
<td>Hardware: A-VIEW Load testing for simultaneous large number of users</td>
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<tr>
<td>Hardware Maintenance</td>
<td>1.5</td>
<td>0.53</td>
<td>Minor Hardware maintenance</td>
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<tr>
<td>Consumables and Contingencies</td>
<td>16.5</td>
<td>4.3</td>
<td>Bandwidth costs for A-VIEW test servers; Data Cards; Other Support costs</td>
</tr>
<tr>
<td>Travel &amp; Implementation Expenses</td>
<td>3.6</td>
<td>1.2</td>
<td>Travel and expenses for implementation engineers</td>
</tr>
<tr>
<td>Total</td>
<td><strong>328.62</strong></td>
<td><strong>103.65</strong></td>
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</table>

**Total: 432.27 Lakhs**
<table>
<thead>
<tr>
<th>A-VIEW Testing Hardware</th>
<th>Count</th>
<th>Unit Cost in Lakhs</th>
<th>Completed in Lakhs</th>
<th>Pending</th>
</tr>
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<tbody>
<tr>
<td>Video Conf Equip for testing - Student grade</td>
<td>10</td>
<td>0.10</td>
<td>1.0</td>
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<tr>
<td>Projector (for testing)</td>
<td>4</td>
<td>0.60</td>
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<td>Video Conf Equip for testing - Classroom grade</td>
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<td>0.25</td>
<td>2.5</td>
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<tr>
<td>30 TB NAS Desktop Storage (Lacie)</td>
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<td>3.50</td>
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<td>High end Machine for /Testing/Server</td>
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<td>1.20</td>
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<td>Mobile for Implementation - Category 5</td>
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<td>1.6</td>
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<tr>
<td>Support Laptops - Category 1</td>
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<td>Workstations For Implementation</td>
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<td>0.45</td>
<td>6.3</td>
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<td>Video Streaming Server (Development and Test)</td>
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<td>3.00</td>
<td>6.0</td>
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<tr>
<td>SAN Server (10 TB Storage Capacity)</td>
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<td>Software for Server, Computers</td>
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<td>2.00</td>
<td>4.0</td>
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<tr>
<td>Displays - TVs/Monitors</td>
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<td>0.60</td>
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<td>Laptops For Testing - Category 2</td>
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<td>Workstations For Test / Dev</td>
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<td>Mobiles - Category 1 (for testing)</td>
<td>6</td>
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<tr>
<td>Mobiles - Category 2 (for testing)</td>
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<td>0.15</td>
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<td>Mobiles - Category 3 (for testing)</td>
<td>9</td>
<td>0.2</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Mobiles - Category 4 (for testing)</td>
<td>6</td>
<td>0.3</td>
<td>1.8</td>
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<td>Tablets - Category 1 (for Testing)</td>
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<tr>
<td>Tablets - Category 2 (for Testing)</td>
<td>4</td>
<td>0.3</td>
<td>1.2</td>
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<td>Handy Cam - for testing</td>
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<td>1.2</td>
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<td><strong>Total</strong></td>
<td><strong>58.29</strong></td>
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<tr>
<td>A-VIEW Testing Hardware</td>
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<td>Unit Cost in Lakhs</td>
<td>Pending</td>
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<tr>
<td>----------------------------------------------------------</td>
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<td>---------</td>
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<td>30 TB NAS Desktop Storage (Lacie)</td>
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<td>High end Machine for /Testing/Server</td>
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<td>Workstations For Implementation</td>
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<td>Video Streaming Server (Development and Test)</td>
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<tr>
<td>Software for Server, Computers</td>
<td>4</td>
<td>2.00</td>
<td>8.0</td>
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<tr>
<td>Displays - TVs/Monitors</td>
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<tr>
<td>Laptops For Testing - Category 2</td>
<td>10</td>
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<td>Workstations For Test / Dev</td>
<td>27</td>
<td>0.72</td>
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</table>

**Total**: 47.94
# Module Teams Breakdown

<table>
<thead>
<tr>
<th>#</th>
<th>Item</th>
<th>Module Name</th>
<th>Team</th>
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<tbody>
<tr>
<td>1</td>
<td>Module 1</td>
<td>Huge Virtual Synchronous Classrooms</td>
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<tr>
<td>2</td>
<td>Module 2</td>
<td>Classroom Monitoring and Attention Analysis</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Module 3</td>
<td>Adaptive Plug and Play Devices</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Module 4</td>
<td>Open Source Server Components</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Module 5</td>
<td>Major Requests from Stakeholders</td>
<td>5</td>
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<tr>
<td>6</td>
<td>Module 6</td>
<td>Synchronous Tutoring Groups</td>
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<td>7</td>
<td>Module 7</td>
<td>A-VIEW using Low End Mobiles</td>
<td>6</td>
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<td>8</td>
<td>Module 8</td>
<td>Local Synchronous Producer and Player</td>
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<tr>
<td>9</td>
<td>Module 9</td>
<td>Automation Testing and System Integration</td>
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<tr>
<td>10</td>
<td>Module 10</td>
<td>Implementation of A-VIEW for Crores of Users</td>
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<table>
<thead>
<tr>
<th></th>
<th>Team</th>
</tr>
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<tbody>
<tr>
<td><strong>Total</strong></td>
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# Implementation Team - Breakdown

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<thead>
<tr>
<th>Sl.No</th>
<th>Item</th>
<th>Qty</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Deployment Manager</td>
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<td>2</td>
<td>Regional Support</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Trainers</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Support Staff</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Helpdesk Analyst</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Technical Analyst</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>System Admin (24 Hour Service)</td>
<td>5</td>
</tr>
<tr>
<td>Row Labels</td>
<td>Sum of 5.x</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>Adaptive Plug &amp; Play Video</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>A-VIEW using Low-End Mobiles</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Classroom Monitoring &amp; Attention Analysis</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Huge Virtual Synchronous Classrooms</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Local Synchronous Producer &amp; Player</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Major Requests from Stakeholders</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Open Source Server Components</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Synchronous Tutoring Groups</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>43</strong></td>
<td></td>
</tr>
<tr>
<td>Module</td>
<td>5.0/5.1 Features Committed</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>-----------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Adaptive Plug &amp; Play Video</td>
<td>Improved Pre-testing, Network Self-Testing, Automatic Mixer/Local Echo Detection</td>
<td></td>
</tr>
<tr>
<td>A-VIEW using Low-End Mobiles</td>
<td>HTML5 Client – Poll, Quiz, User List</td>
<td></td>
</tr>
<tr>
<td>Classroom Monitoring &amp; Attention Analysis</td>
<td>Dedicated Monitoring Role, Functionality for Monitors</td>
<td></td>
</tr>
<tr>
<td>Huge Virtual Synchronous Classrooms</td>
<td>A-VIEW on Satellite, Multicast</td>
<td></td>
</tr>
<tr>
<td>Local Synchronous Producer &amp; Player</td>
<td>MP4 Recording, Local Recorder</td>
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</tr>
<tr>
<td>Major Requests from Stakeholders</td>
<td>Analytics &amp; UI improvements</td>
<td></td>
</tr>
<tr>
<td>Open Source Server Components</td>
<td>Open Content Server, Bulk Admin Activities</td>
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## A-VIEW Interop Module Budget

### A-VIEW Interop Module Budget with MCUs

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Item</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non Recurring Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Equipment</td>
<td>49.30</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>Module Dev Salary</td>
<td>36.00</td>
<td>39.60</td>
<td>43.56</td>
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<tr>
<td></td>
<td>TOTAL (Non Recurring Cost)</td>
<td>85.30</td>
<td>39.60</td>
<td>43.56</td>
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<tr>
<td></td>
<td>Recurring Cost</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Contingency</td>
<td>0.60</td>
<td>0.70</td>
<td>0.80</td>
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<tr>
<td>2</td>
<td>Consumables &amp; Supplies</td>
<td>0.60</td>
<td>0.75</td>
<td>1.00</td>
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<tr>
<td>3</td>
<td>Internet for Servers &amp; Development</td>
<td>0.50</td>
<td>0.75</td>
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<tr>
<td>4</td>
<td>Mobile &amp; Internet</td>
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<td>0.75</td>
<td>1.00</td>
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<tr>
<td>5</td>
<td>Travel &amp; Stay</td>
<td>0.80</td>
<td>1.00</td>
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<td>TOTAL (Recurring Cost)</td>
<td>3.00</td>
<td>3.90</td>
<td>4.80</td>
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<td>Total (Non Recurring + Recurring)</td>
<td>88.30</td>
<td>43.50</td>
<td>48.36</td>
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<td></td>
<td>Grand Total (Lakhs of Rs)</td>
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<td>180.16</td>
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### Module Dev Fees and Module Support, Maintenance Details

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Item</th>
<th>Qty</th>
<th>Rate (in Lakhs)</th>
<th>Budget (in Lakh)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Sr. Technical Manager</td>
<td>1</td>
<td>8.4</td>
<td>8.4</td>
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<tr>
<td>2</td>
<td>Lead Software Engineer</td>
<td>2</td>
<td>6.6</td>
<td>13.2</td>
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<tr>
<td>3</td>
<td>Software Engineer</td>
<td>2</td>
<td>4.8</td>
<td>9.6</td>
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<tr>
<td>4</td>
<td>Jr Test Engineer</td>
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<td>2.4</td>
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<tr>
<td></td>
<td>Total (Lakhs of Rs)</td>
<td>7</td>
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<td>36</td>
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</table>

### Equipment (In lakhs)

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Item</th>
<th>Qty</th>
<th>Rate (in Lakhs)</th>
<th>Budget (in Lakh)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Server Machine for development/testing</td>
<td>2</td>
<td>1.3</td>
<td>2.6</td>
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<tr>
<td>2</td>
<td>Workstations (for Development, Server)</td>
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<tr>
<td>3</td>
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<td>1.95</td>
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<td>4</td>
<td>Polycom MCU Testing Equipment</td>
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<td>5</td>
<td>Displays - TVs/Monitors</td>
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<td>0.6</td>
<td>3</td>
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<tr>
<td>6</td>
<td>Polycom HDX 7000</td>
<td>2</td>
<td>8</td>
<td>16</td>
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<tr>
<td>7</td>
<td>Polycom RealPresence Software</td>
<td>5</td>
<td>0.2</td>
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<tr>
<td></td>
<td>Total (Lakhs of Rs)</td>
<td></td>
<td></td>
<td>49.3</td>
</tr>
</tbody>
</table>
Current Status – Year 1 Completed

• Year 1 expense of Rs. 432.27 Lakhs
  • On-Loan from Amrita University since Sep 2015
  • Pending salary Arrears of Rs. 35 Lakhs
  • Many senior staff on voluntary moratorium on salary raises / partial salaries – Rs. 23.58 Lakhs
Current Status – Year 1

- Worked on Year 1 Deliverables since Oct 2015
- Version 5.0 to be released soon
- 5.0 Beta Given to IIT Bombay – Working on feedback
- 5.0 Beta running on Production Server for QEEE Program @ IIT Madras
Development of National Digital Library of India
Towards Building a National Asset

A PILOT PROJECT
Project Brief: 07-SEP-2016
Domain Expert Committee on e-Content, Pedagogy & Related Activities

Presented by
Prof. PARTHA PRATIM DAS
ppd@cse.iitkgp.ernet.in
Joint PI, NDL Project, NME-ICT, MHRD
Indian Institute of Technology, Kharagpur
Agenda

- Scope, Status & Progress
- HRM Review
- PRSG Review
- Fund Requirements
Scope
NDL – A Pilot Project: Scope

- NDL is a pilot project of 3-year duration
- Start: April, 2015
- Scope of the pilot project
  - Creation of a 24X7-enabled Infrastructure suitable for 10,000 Concurrent Users
  - Harvesting IDR (Institutional Digital Repository) of 100 Contributing Institutes
  - Integrate contents from eLearning repositories like INFLIBNET, NPTEL, NCERT, DLI, NMEICT projects
  - Participatory adoption by 100 Participating Institutes
  - Host 1000 LMS Courseware
Portal Status

**NDL Portal** ([https://ndl.iitkgp.ac.in](https://ndl.iitkgp.ac.in)) gone live in Feb’16

- 24X7 infrastructure
  - Partial server capacity (about 30% of planned)
  - Partial access bandwidth (about 50% of planned)
- English and Vernacular (Hindi & Bengali) User Interface
- 15 lakh+ content
- 70 Harvested IDR from Contributing Institutes
- Contents of INFLIBNET, NPTEL, NCERT, DLI, a few NMEICT projects, Librivox (Audio Books), OECD, IIT-JEE Question Papers & Answers & Satyajit Ray Redbook archive
- Contents of couple of international publishers
- Got users from about 325 Participating Institutes registered

**Portal Screenshots**
Content Pipeline

- Another 6 IDRs harvested and ready to go Live
- Karnataka Board Text Books, Question Papers, Solutions, Teachers’ Manual ready to go Live
- Joint Admission Test for M.Sc. (JAM) Question Papers (10 years) ready to go Live
- South Asia Archive ready to go Live
- World e-Book Library (WeL) (about 50%: 20 lakh) ready to go Live
- IEEE Publications (about 25%: 9 lakh) ready to go Live
- PubMed Publications (about 25%: 7 lakh) ready to go Live
Metadata Standard

- Ver-1 of NDL Metadata Schema Manual published
  (www.ndlproject.iitkgp.ac.in/)
Systems Status

- 2nd lot of servers received and installation and setup configuration are in advanced stage
- Disaster Recovery system
  - Server Room Infrastructure (A/C, UPS, Fire Alarm & Protection, Security Surveillance, Server Racks) Tender Evaluation completed and Order is being placed
  - Server sizing and tender document preparation started
  - Access bandwidth request initiated
- Sizing and tender document preparation for 3rd lot of servers initiated
Awareness Drive & Events

8 Workshops on NDL familiarization and IDR setup conducted across the country

Contributing & Participating Institute support
- Hand-holding Contributing Institutes to set up IDR and making IDR harvestable
- Hand-holding users of Participating Institutes
  - Registration
  - Usage
  - Query response
Awareness Drive & Events

- Workshop @ INDEST Meet @ Mohali, 29/30-Apr-15
- National IDR WS @ IIT Kharagpur, 15/17-June-15
- Regional (North-East-I) IDR WS @ IIT Guwahati, 04/05-July-15
- National Seminar on “Emerging Trends in Academic Libraries” @ IIT Kharagpur, 21-Aug-15
- Regional (North-I) IDR WS @ IIT Roorkee, 24/25-Aug-15
- ETD 2015 India @ JNU New Delhi, 05/06-Nov-15
- 4th NKN Annual WS @ JNTU Hyderabad, 21/22-Jan-16
- Regional (West-I) IDR WS @ M S University, 28/29-Jan-16
- National VC Address over NKN, 03-Feb-16
- Regional (South-I) IDR WS @ IIT Madras, 25/26-Mar-16
- Regional (South-II) IDR WS @ IISc, Bangalore, 20/21-May-16
- National Workshop for Open-Source Software for Library Management (OSSLM 2016) @ IIT Kharagpur, 13/18-Jun-16
- Regional (South-III) IDR WS @ IIIT, Hyderabad, 01/02-Jul-16
- Regional (North-II) IDR WS @ JNU, New Delhi, 01/02-Sep-16
- Regional (North East-II) IDR WS @ NIT Meghalaya, Shillong 23/24-Sep-16
- Regional (West-II) IDR WS @ IISER Pune, 05/06-Oct-16
- National (Medical) IDR WS @ AIIMS New Delhi, 20/21-Oct-16
- Regional (Central-I) IDR WS @ NIT Raipur, 18/19-Nov-16
- National (Law) IDR WS @ WB-NUJS Kolkata, 09/10-Dec-16

IIT, Kharagpur 07-Sep-16
User Registration

- Registered Users: 2.45 Lakh
- Active Users: 70K
- Controlled registration to ensure
  - Gradual build up of load on the system
  - Security issues, if any, gets addressed with a smaller user base
  - Limited to CFTIs and institutes in NDL Workshops and VC
- Self-registration for selective domains
  - ernet, ac, res, nic, gov
  - Many users don’t have e-mail id in these domains
- In addition to CFTIs, UGC & AICTE approved Institutes have been approached to send user list for bulk registration
- Institutional Registration Process Planned
Popularization Drives

- Regular update through Facebook (https://www.facebook.com/NDLIndia/)
- Promo video being hosted in YouTube
- PR Agency being appointed for promotion
- Mobile App under development; to be launched in near future
- Google Indexing of NDL site
Hon’ble HRM Review

- Prof. P. P. Chakrabarti, PI-NDL Project & Director IIT Kharagpur, made a presentation on NDL to Hon’ble HRM on 26-Jul-16
- Hon’ble HRM reviewed the project and following actions were identified:
  - HRM desires that Botanical Survey of India (BSI) and Zoological Survey of India (ZSI) materials to be linked to NDL
  - User feedback and action taken on these feedbacks to be presented to Hon’ble HRM
  - No. of users registered with NDL very low compared to GER of Higher Education. Necessary steps to be initiated to advertise through social media like LinkedIn, Facebook etc. And also Akashwani (FM) may be approached for publicity purpose
  - A video clip about NDL to be made available and hosted on YouTube
  - Students of UGC and AICTE colleges to be asked to register on the NDL portal through suitable notification by UGC and AICTE
HRM desires that the Botanical Survey of India (BSI) and Zoological Survey of India (ZSI) materials have to be linked to NDL

- AS (TE) wrote to Secretary, Ministry of Environment
- NDL team had been in touch with BSI for sometime and had the last meeting with BSI Director on 13-Aug-16 wherein followings were agreed:
  - BSI & NDL will work on a broader collaboration; an MoU will be worked out in this respect
  - A plan for migration of data from BSI metadata schema to NDL metadata schema will be made
  - NDL will help BSI in their IDR and Herbarium setup on technical points such as machine selection, software developer identification and NKN connection
  - Both will work on a vision to make a Portal of Biological Sciences with GIS
NDL team met ZSI Director on 20-Aug-16 wherein followings were agreed:

- An MoU for the collaboration will be made
- ZSI will collate user data of all its Scientists and Staff and send it to NDL for registration in NDL
- ZSI will nominate Nodal Official(s), to coordinate with NDL
- NDL, with the help of ZSI, will work out revisions required in its metadata schema to represent fauna related digital resources in NDL and corresponding mapping
- NDL will share its IDR Workshop schedule with ZSI so that ZSI can send their representatives to attend these workshops
User feedback and action taken on these feedbacks to be presented to Hon’ble HRM

- 5216 feedback have been received till 18-Aug-16
- 20% are positive feedback: No action required
- Feedbacks on which actions required, classified in 2 categories:
  - Interface & Search results related
  - Content related
- Interface related
  - Graphics design of the Landing page modified and its software implementation is in advanced stage
  - Different sources have different page design. To provide uniform look and feel to users while accessing content from different sources, a transcoding system has been designed and tried out in pilot mode. Deployment of the same in Live system will be taken once the new lot servers are operational
Search results related

- Search engine (Solr) parameter tuning done to improve ranking of search results.
- To address user frustration of content (full-text) not being accessible for some sources after clicking the search result, search result will display content status as one of the following:
  - “Open” (accessible from anywhere)
  - “Selectively subscribed” (accessible from institutional network who have subscribed to the source)
  - “Subscription/purchase required”
  - “Registration with the source institute required”
  - “Author to be approached”

New field has been introduced in metadata schema for this. Implementation started with sources currently in curation process. Will be made operational progressively, especially for sources which are already Live.
Content related

- Some users requesting to include a specific content which he/she is looking for
- No specific pattern has yet been observed for such request
- Whenever any specific pattern or prominent source will be noticed, necessary harvesting or inclusion action will be taken
ATR of HRM Review: User Registration & Publicity

• No. of users registered with NDL very low compared to GER of Higher Education. Necessary steps to be initiated to advertise through social media like LinkedIn, Facebook etc. And also Akashwani (FM) may be approached for publicity purpose
  - NDL account in Facebook operational for sometime (https://www.facebook.com/NDLIndia/) through which regular updates and events of NDL propagated
  - PR agency being appointed to draw up a comprehensive plan and take actions related to Publicity, Marketing and Branding
• Video clip about NDL to be made available and hosted on YouTube
  ○ Video clip made; being hosted on YouTube

• Students of UGC and AICTE colleges to be asked to register on NDL portal through suitable notification by UGC and AICTE
  ○ Notification sent to UGC and AICTE
  ○ UGC requested its institutes to get in touch with NDL directly
  ○ Institutes have started contacting NDL who are being asked to send their user data to NDL
  ○ A few institutes already sent data and these users registered in NDL
  ○ AICTE sent a list of Heads of 50 institutes to NDL. NDL has asked these Heads to send their user data to NDL
  ○ AICTE is preparing a list of Heads of another 150 institutes and will send the same to NDL soon to get their user data
OBSERVATIONS & RECOMMENDATIONS
2nd PRSG Meeting held on 10-Jun-16 at IIT Center, Kolkata

Attended by:
- Prof. H. P. Khincha, IISc Bangalore: PRSG Member & Chairman
- Dr. Jagdish Arora, Director, INFLIBNET: PRSG Member
- Prof. Uma Kanjilal: IGNOU: PRSG Member
- Prof. T. V. Prabhakar, IIT Kanpur
- Prof. Swapan K. Chakravorty: Kabiguru Rabindranath Tagore Distinguished Professor in the Humanities, Presidency University: Member Invitee

Followings attended over VC:
- Prof. Pushpak Bhattacharya, Director IIT Patna: Member Invitee
- Dr. Neena Pahuja: Director General, ERNET: Member Invitee

Prof. P. S. Mukhopadhyay attended as Invited Library Science Expert
2nd PRSG Recommendations

- Organize a contest to select a name of the Portal: In progress
- Make landing page more informative containing some specific link to contents: Under implementation
- Display in Portal “What’s New” & “Source-wise Last update Status”: Under implementation
- Implement in Advanced Search “Range”, “Boolean”, “Relational” & “Positional Search”
- Implement “Saved Search”, “Search History” & “Context-driven help”
- Make Publicity, Marketing & Branding Plan: PR Agency being appointed
- Make appropriate document for Phase-wise Visualization of the project
- A few other documents for future reference
2nd PRSG Recommendations

- Re-appropriation of budget heads (without change of total budget) was discussed and approved
- Release of Rs. 9.71 cr for the current year was recommended
### SUMMARY (All figures in Rs. Crore)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Items</th>
<th>Original Approval</th>
<th>Proposed Re-appropriation</th>
<th>Budget from 07-Jun-16 to 31-Mar-17</th>
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<td>13.25</td>
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<td>2</td>
<td>Manpower and Consultant</td>
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<td>Subscription /Procurement of e-Resources (Support to Institutes to make e-Resources usable by NDL)</td>
<td>15.00</td>
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<td>5</td>
<td>Travel</td>
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<td>6</td>
<td>Consumables</td>
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<td>1.50</td>
<td>0.70</td>
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<tr>
<td>7</td>
<td>Contingency</td>
<td>0.50</td>
<td>0.50</td>
<td>0.20</td>
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<td></td>
<td><strong>GRAND TOTAL</strong></td>
<td><strong>39.81</strong></td>
<td><strong>39.81</strong></td>
<td><strong>15.74</strong></td>
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<td></td>
<td><strong>UNSPENT BALANCE (07-Jun-16)</strong></td>
<td></td>
<td></td>
<td><strong>6.03</strong></td>
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<tr>
<td></td>
<td><strong>FUND REQUIREMENT</strong></td>
<td></td>
<td></td>
<td><strong>9.71</strong></td>
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</tbody>
</table>
# Utilization Certificate

**SPONSORED RESEARCH AND INDUSTRIAL CONSULTANCY**

**INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR**

**CONSOLIDATED STATEMENT OF ACCOUNTS**

(RECEIPTS & PAYMENTS ACCOUNT FOR THE PERIOD 26/03/2015 TO 06/09/2016)

**Title of the Research**  
“Development of National Digital Library of India, towards Building a National Asset (BNA)”

**Sponsoring Agency:** MHRD, New Delhi

**Name of the Investigator-in-Charge:** Prof. Partha P. Chakrabarti & Prof. Partha Pratim Das  
**Department:** Central Library

**Date of Commencement:** 26/03/2015  
**Date of Termination:** 25/03/2018

<table>
<thead>
<tr>
<th>Year</th>
<th>Grant</th>
<th>Total</th>
<th>Salary/Manpower/ Honorarium</th>
<th>Travel</th>
<th>Consumables</th>
<th>Contingency</th>
<th>Equipment</th>
<th>Misc. Expenditure/Others</th>
<th>Total</th>
<th>Closing Balance</th>
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<td>014-15*</td>
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<td>69700000</td>
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<td>84729</td>
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<td>1135046</td>
<td>60920242</td>
<td>2537124</td>
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<td><strong>Total</strong></td>
<td><strong>119400000</strong></td>
<td><strong>119400000</strong></td>
<td><strong>34670155</strong></td>
<td><strong>1761705</strong></td>
<td><strong>1281753</strong></td>
<td><strong>2472463</strong></td>
<td><strong>69480348</strong></td>
<td><strong>2196452</strong></td>
<td><strong>111862876</strong></td>
<td><strong>7537124</strong></td>
</tr>
</tbody>
</table>

Grants sanctioned for the FY 2014-15 received on next financial year i.e. 2015-16 through online transfer dated: 04/04/2015

**Signature Finance Officer with Stamp**

S. K. Biswas  
Sr. Administrative Officer (F & PM)  
Sponsored Research & Industrial Consultancy  
IIT, Kharagpur - 721302

IIT, Kharagpur  
07-Sep-16
## Fund Release Requirement

<table>
<thead>
<tr>
<th>Sl. #</th>
<th>Item</th>
<th>Amount in Rs. Cr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Total Sanction (2015-18)</td>
<td>39.80</td>
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<tr>
<td>2.</td>
<td>Fund received as on date</td>
<td>11.94</td>
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<tr>
<td>3.</td>
<td>Total expenses as on 06.9.16</td>
<td>11.19</td>
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<tr>
<td>4.</td>
<td>Unspent balance as on 06.9.16 (#2–#3)</td>
<td>0.75</td>
</tr>
<tr>
<td>5.</td>
<td><strong>FUND REQUIRED TO BE RELEASED</strong> (as recommended by PRSG)</td>
<td><strong>9.71</strong></td>
</tr>
</tbody>
</table>
Thank You
“Learning by Doing (LbD) based course content development in areas of CS and ECE”

Venkatesh Choppella
Principal Investigator
IIIT Hyderabad

venkatesh.choppella@iiit.ac.in
Agenda

• Project Objective: Learning by Doing (LbD)

• Project Status

• Financials

• Conclusion
LbD Model

Butterfly Model

Increasing level of expertise

Novice  Intermediate  Expert
Phase I Timeline

Phase I Proposal presented (SC)
August 17, 2012

Swap of PI and Co-PI. PI on record - Sandhya Kode.
August 31, 2012

Phase I proposal approved (PAB) for 17 courses at 7L/course
November 6, 2012

Phase I 1st installment received 35.7L
August 22, 2013

1st PRSG
June 27, 2014

2nd PRSG
2 course to be completed by 3rd PRSG, work on 4-6 courses
Dec 03, 2014

Before Review meeting, change of PI-Venkatesh Choppella
Budget revision to Rs. 12.4 lakhs recommended per course
May 20, 2015

11 Courses completed
2nd installment received 47.6L
Jan 1, 2015

6 in progress (20%). Completion by March 31, 2017
Aug 13, 2015

Sept 7, 2016

3rd PRSG
Recommended 70L to be released
# Project Status

<table>
<thead>
<tr>
<th>Date</th>
<th>Milestone</th>
<th>Status</th>
<th>Recommendation</th>
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</thead>
<tbody>
<tr>
<td>2015-08-13</td>
<td>3rd PRSG</td>
<td>9: under dev.</td>
<td>70L to be released</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0: delivered</td>
<td></td>
</tr>
<tr>
<td>2016-09-07</td>
<td>Review Meeting</td>
<td>6: under dev</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11: delivered</td>
<td>Funding pending</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total staff: 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>animators</td>
<td></td>
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</table>

courses uploaded to eAcharya:  
[http://eacharya.inflibnet.ac.in/search?q=iiit+hyderabad&search-button=Search&field=dins_name&opt=free](http://eacharya.inflibnet.ac.in/search?q=iiit+hyderabad&search-button=Search&field=dins_name&opt=free)

All delivered courses uploaded to: [http://enhanceedu.iiit.ac.in/moodle/](http://enhanceedu.iiit.ac.in/moodle/)
## Appendix

### list of courses and Status

<table>
<thead>
<tr>
<th>Delivered Courses</th>
<th>Courses to be delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Topics in Text and Web Mining</td>
<td>Electro Magnetic Theory</td>
</tr>
<tr>
<td>DSD Using Verilog</td>
<td>VLSI</td>
</tr>
<tr>
<td>Algorithms</td>
<td>Complexity and Advanced Algorithms</td>
</tr>
<tr>
<td>Analog Design</td>
<td>Design for Testability</td>
</tr>
<tr>
<td>Embedded Systems</td>
<td>Visual Java Development Environment</td>
</tr>
<tr>
<td>Data Mining and Data Warehousing</td>
<td>CAD for VLSI</td>
</tr>
<tr>
<td>Operating Systems</td>
<td></td>
</tr>
<tr>
<td>Social Networking</td>
<td></td>
</tr>
<tr>
<td>Introduction to e-Governance</td>
<td></td>
</tr>
<tr>
<td>Topics in Embedded Systems</td>
<td></td>
</tr>
<tr>
<td>Solid state Electronic Design</td>
<td></td>
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</table>
## Status of courses to be delivered

<table>
<thead>
<tr>
<th>Courses to be delivered</th>
<th>Status (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electro Magnetic Theory</td>
<td>15%</td>
</tr>
<tr>
<td>VLSI</td>
<td>15%</td>
</tr>
<tr>
<td>Complexity and Advanced Algorithms</td>
<td>5%</td>
</tr>
<tr>
<td>Design for Testability</td>
<td>20%</td>
</tr>
<tr>
<td>Visual Java Development Environment</td>
<td>18%</td>
</tr>
<tr>
<td>CAD for VLSI</td>
<td>20%</td>
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</table>
### Financials

<table>
<thead>
<tr>
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<th>Source</th>
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<tbody>
<tr>
<td>1</td>
<td>2012-08</td>
<td>17c @ 7L/c</td>
<td>DPR</td>
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<tr>
<td>2</td>
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<td>35.7</td>
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<tr>
<td>3</td>
<td>2015-01</td>
<td>2nd installment funding</td>
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<td>47.6</td>
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<tr>
<td>4</td>
<td>2015-08</td>
<td>Renegotiated Budget 10.24L/c x 7c + 12.4L/c x 10c</td>
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<td>5</td>
<td>2015-08</td>
<td>Amount recommended for release</td>
<td>2015-Aug PRSG</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amount to be delivered after project completion</td>
<td>2015-Aug PRSG</td>
<td>38.06</td>
</tr>
<tr>
<td>6</td>
<td>2016-09</td>
<td>Due</td>
<td>2015-Aug PRSG</td>
<td><strong>108.06</strong></td>
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</tbody>
</table>
Conclusion

PRSG recommendation sought for:

- Immediate release of 70 lakhs as recommended during the PRSG 3 meeting on 13 August 2015
- Delivery of remaining 6 courses by Jun 2017
Thank you
Main Phase Project Proposal on Development of Indian Sign Language Education and Recognition Platform for Hearing Impaired Students of India

http://www.iitg.ernet.in/isl/

Submitted to The Department of Higher Education Ministry of Human Resource Development, Govt. of India
**Project title:** Development of an Indian Sign Language Education and Recognition Platform for Hearing Impaired Students of India.

**Objectives as per the Mission Document:**
Development of interfaces for other cognitive faculties which would also help physically challenged learners.

**Organizing Institute:**
Indian Institute of Technology, Guwahati, India.

**Principal investigator:** Dr. Manas Kamal Bhuyan.
Associate Professor,
Department of Electronics & Electrical Engineering,
Indian Institute of Technology Guwahati, Assam, India.
PIN: 781039.
Tel: +91-361-258-2523 (O), Fax: +91-361-2582542
E-mail: mkb@iitg.ernet.in

**Co-Investigator:** Dr. Prabin Kumar Bora.
Professor,
Department of Electronics & Electrical Engineering,
Indian Institute of Technology Guwahati, Assam, India.
PIN: 781039.
Tel: +91-361-258-2502 (O), Fax: +91-361-2582542
E-mail: prabin@iitg.ernet.in

**Participating Institutes:**
Deaf and Dumb Educational Institutes/Schools of India including Ali Yavar Jung National Institute for the Hearing Handicapped, Mumbai, India. Most specifically, the institutes of its kind in the entire North-Eastern region of India are now participating in this project. Moreover, Engineering Colleges/Institutes of the North-Eastern region are now also contributing towards the goal of this project.

**Project period:** 36 months.
Beneficiaries: Hearing impaired/mute students of India.

Introduction:

Sign languages are natural languages that use different means of expression for communication in everyday life. More particularly, it is the only means of communication for the hearing impaired. Thus, it offers enhancement of communication capabilities among normal beings and provides replacement for speech among deaf and mute people. Because of these, automatic sign language recognition has attracted vision researchers for long. Several research works are going on sign language in order to make the communication between a deaf person and a normal person easy. Examples of some sign languages are the American Sign Language, the British Sign Language, the native Indian Sign Language, the Japanese Sign Language, and so on. Generally, the semantic meanings of the language components in all these sign languages differ, but there are signs with a universal syntax. For example, a simple gesture with one hand expressing 'hi' or 'goodbye' has the same meaning all over the world and in all forms of sign languages. In a sign language, the signs are generated by combinations of hand motions and finger gestures, frequently augmented with mouth movements according to the spoken language. Hand motions are distinguished from one sign to another by the spatial motion pattern, the speed, and in particular by the body parts that the signer touches at the beginning, during or at the end of a sign. In addition to the hand movement, the finger configuration during the slower parts of the hand movements also provides significant meaning to a gesture.

Sign languages are well structured languages with a phonology, morphology, syntax and grammar distinctive from spoken languages. The structure of a spoken language makes use of words linearly, i.e., one after the other, whereas a sign language makes use of several body movements parallely in the spatial as well as in temporal space. The linguistic characteristics of a sign language are different than that of spoken languages due to the existence of several components affecting the context such as the use of facial expressions and head movements in addition to the hand movements.

Some common facts regarding sign languages are as follows-

1. Sign languages are the pictorial representation of spoken languages.

2. Sign language is an integral part and an identifying feature of membership in the deaf culture.

3. Expressing hidden meaning is not possible in sign language.

4. Sign language has its own grammatical structure independent of any spoken or written languages.

5. The majority of deaf children are born to hearing parents and therefore do not acquire sign language as a mother tongue. They need to learn it at schools.

6. Minority of deaf children are born to deaf parents. They acquire sign language as a mother tongue.
7. According to some studies, children can learn sign language earlier than they can learn to speak.

**Motivation of the Project:**

Sign language is very popular among the deaf community. But the people who are not deaf never try to learn the sign language for interacting with the deaf people. This becomes a cause of isolation of the deaf people. If the computer can be programmed in such a way that it can translate sign language to some speech or text format, the difference between the normal people and the deaf community can be minimized. This project is aimed to develop an automatic Indian Sign Language Education and Recognition Platform for hearing impaired student of India.

**Goals and Objectives of the Project:**

This project is aimed to develop an automatic Indian Sign Language Education and Recognition Platform for hearing impaired student of India. The system can substantially help in the primary/vocational/higher education of hearing impaired student and people of India. The framework is proposed to be extended to 14 different languages of India with extensive interactive features in the audio-visual mode.

Another important aspect of the project is that, the proposed interactive system will be able to recognize different hand/body gestures of Indian Sign Language and the system can give the interpretation of the recognized gestures in the form of some text messages displayed in the computer monitor along with audio interpretation. The same module can be used as a gesture recognition system as well as a gesture animation system and it would be quite useful in the educational process of hearing impaired/mute students of India.

The important motivation of the proposed research/project is to develop an Indian Sign Language Recognition platform for mute people. Automatic sign language recognition offers enhancement of communication capabilities for the speech and hearing impaired, promising improved social opportunities and integration.

The objective of the proposed research/project work is to build a system that uses natural gestures as a modality for recognition in the vision-based and/or glove-based setup. The focus of the proposed project is to develop a Human Computer Interaction (HCI) platform in context to Indian Sign Language. The development of a system for translating Indian sign language into spoken language would be great help for deaf as well as hearing people of our country. In a country like India there is a need of automatic sign language recognition system, which can cater the need of hearing impaired people. Unfortunately, not much research works on Indian Sign Language recognition is reported till date.

Moreover, there is no officially recognized Indian Sign Language system. The ultimate gain of the proposed system would be enormous. The student will get acquainted with a comparatively latest technology in the form of HCI. We can even think of commercialization of the research outcomes in this area.
Project deliverables:

Automatic Indian Sign Language Recognition Platform for hearing impaired/mute people of India. More specifically, the system would be quite useful for the hearing impaired students of India.

Scope of Work:

In order to pursuit the goals of the project the following points are identified as essential:

1. Designing the prototype of Indian sign language education and recognition system.

2. Gathering information regarding different regional sign languages of India.

3. Creating skeleton of various signs and storing them into database for an interactive online environment.

4. Capturing gestures by the use of hand gloves or camera.

5. Making the computer understand different gestures of different sign languages and animating different gestures in real time.

Work plan:

Following few fundamental steps have to be followed for practical implementation of the project:

- **Study of wide classes/varieties of sign language all over the India:** This is the most fundamental step but equally critical phase of the development. Extensive analysis/research of different sign languages of India is required for the creation of a most generalized/unique system.

- **Creation of extensive database:** This is the most crucial step of the project. Our ultimate objective is to create an audio/video database for all the sign languages of India.

- **Audio/Video analysis:** Audio/Video analysis is another very important aspect of developing an integrated and generalized learning methodology of sign languages.

- **Generalized platform for extensive education:** This is the final step of the sign language education system. The proposed interactive system will have both audio and video materials/components for proper primary/higher education for the hearing impaired students of India.

- **Development of a more generalized hand gesture model and verifying the model behavior for wide classes of hand gestures:** Both static and dynamic hand gestures will be considered for the development of a generalized model, where the spatio-temporal variation will be exclusively taken into consideration. Subsequently, we have to resolve some critical issues related to the continuous hand gesture recognition for fluent sign language recognition.

- **Development of the hand gesture recognition algorithm:** Next phase is the development/implementation of suitable image processing algorithms along with some
advanced pattern recognition modules. Subsequently, codes are to be developed for the selected/developed algorithms to implement it in a real time and complex scenario.

- **Testing the hand gesture interface:** The interface is to be tested until it is error-free.

- **Building the prototype recognition system with full capability:** Field testing and improving different algorithms for successful implementation in a real-time error free automatic recognition platform.

- **Final product:** Assembling all the hardware and software modules for a sophisticated Indian Sign Language Education and Recognition System and handling over the software module to MHRD for possible deployment in the Deaf and Dumb Schools of India.
PILOT PHASE DETAILED PROJECT REPORT

The main motivation of the proposed research/project is to develop an Indian Sign Language education/recognition platform for mute people. The goal of this project was to develop a system that can substantially help in the primary/higher and/or vocational education of hearing impaired students/people of India. The framework is proposed to extend to 14 different languages with extensive interactive features in the audio-visual mode. Against each alphabet, number, word and sentence a multimedia comprising of audio and video will be played to interpret them. Moreover, there will be provision for text and animation describing the interpretation process. We have planned to add more features like provision of online courses, interactive session in sign language etc. The another important aspect is that, the system can recognize different hand gestures of Indian Sign Language in the form of some text messages displayed in the computer monitor.

The project work was divided into two major parts for the fulfillment of different demands of deaf community. The first objective was the up liftmen of deaf community in the field of education. Second one is to make the conversation between a deaf and a normal person easy even though the normal person does not have any exposure of sign language. For fulfilling the first need, an attractive GUI based audio-visual platform is being developed which will act as an Indian Sign Language Dictionary in alphabet, word and sentence level. Secondly, a functioning sign language recognition system can provide an opportunity for the deaf to communicate with non-signing people without the need for an interpreter. Recognition of a sign language is very important not only from the engineering point of view but also for its impact on the human society. A sign language recognition platform can be used to generate speech or text making the deaf more independent. Unfortunately, there has not been any system with these capabilities so far. Research has been limited to small-scale systems capable of recognizing a minimal subset of a full sign language. The reason for this is the difficulty in recognizing a full sign language vocabulary – recognition of gestures representing words and sentences undoubtedly is the most difficult problem in the context of gesture recognition research.

We received the first installment of the sanctioned amount on 14.07.2009 and as such, we could start our activities only after this. We have almost completed the first part of the project and fulfill most of the objectives of the pilot phase of the project.
Plan of Action:

Pilot Phase:

The pilot study was conducted in three phases which are as follows:

Part 1: Literature Study (Study of wide varieties of Sign Language all over the India) [Completed].

Part 2: Creation of an Extensive Database [Completed].

Part 3: Audio/Video Analysis [Completed].

Part 4: Generalized Platform for Sign Language Education [Completed].

Future Enhancements:

Part 5: Development of Hand Gesture Recognition Module.


Part 7: Building the Prototype Recognition System with Full Capability.

Work Accomplished:

The pilot phase work has been completed. We have the following satisfactory outcomes after the completion of the pilot phase-

1. Launch of the project website.
2. Around 100 gestures have been recognized in a vision-based setup.
3. Developed some novel gesture recognition algorithms and we are getting desired accuracy by the proposed pattern recognition algorithms.
4. Development of an extensive sign language database and different alphabets, numbers and words have been interpreted by skillful interpreters/experts.
5. We are now able to access different interpreting clips against appropriate alphabets, numbers and words from the database.
6. Different signs have been animated to get three dimensional views of signs.
7. An online dictionary of signs has been prepared to provide textual representations of signs.
**Time Schedule:**

Time schedule of different activities related to the project in the pilot phase are as follows-

<table>
<thead>
<tr>
<th>Months from Project Start</th>
<th>Activity</th>
<th>Status</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>Deciding equipment and software specification</td>
<td>Completed</td>
</tr>
<tr>
<td>2</td>
<td>Call for Quotations</td>
<td>Completed</td>
</tr>
<tr>
<td>3</td>
<td>Ordering &amp; procurement of items</td>
<td>Completed</td>
</tr>
<tr>
<td>4</td>
<td>Installation of Items</td>
<td>Completed</td>
</tr>
<tr>
<td>5</td>
<td>Setting up of a test bed for preliminary studies</td>
<td>Completed</td>
</tr>
<tr>
<td>6</td>
<td>Refinement of test bed setup for carrying out various experiments and R&amp;D activities</td>
<td>Completed</td>
</tr>
<tr>
<td>7</td>
<td>Testing and improving algorithms</td>
<td>Partially completed</td>
</tr>
<tr>
<td>8</td>
<td>Full integration of software modules for field testing</td>
<td>Partially completed</td>
</tr>
<tr>
<td>9-14</td>
<td>Documentation of Project</td>
<td>Partially completed</td>
</tr>
</tbody>
</table>

**Current financial position:**

<table>
<thead>
<tr>
<th>Amount sanctioned for the pilot phase: Rs. 132 Lakhs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount received: Rs. 132 Lakhs</td>
</tr>
<tr>
<td>Total expenditure till date*: Rs. 132 Lakhs</td>
</tr>
<tr>
<td>Balance amount: NIL</td>
</tr>
</tbody>
</table>

* Expenditure also includes funds committed for the procurement of equipments and payment to the experts.
Summary of the project: Sign language is very popular among the deaf community. But the people who are not deaf never try to learn the sign language for interacting with the deaf people. This becomes a cause of isolation of the deaf people. If the computer can be programmed in such a way that it can translate sign language to some speech or text format, the difference between the normal people and the deaf community can be minimized. This project is aimed to develop an automatic Indian Sign Language Education and Recognition Platform for hearing impaired student of India.

The objective of the proposed research/project work is to build a system that uses natural gestures as a modality for recognition in the vision-based and/or glove-based setup. The focus of the proposed project is to develop a Human Computer Interaction (HCI) platform in context to Indian Sign Language. The development of a system for translating Indian sign language into spoken language would be great help for deaf as well as hearing people of our country. In a country like India there is a need of automatic sign language recognition system, which can cater the need of hearing impaired people. Unfortunately, not much research works on Indian Sign Language recognition is reported till date.

Deliverables (year-wise), as mentioned in DPR:

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2010</td>
<td>Deciding equipment and software specifications, Setting up of a test bed for preliminary studies, Refinement of test bed setup for carrying out various experiments and R&amp;D activities</td>
<td>Completed</td>
</tr>
<tr>
<td>2011</td>
<td>Development of Indian Sign Language Education platform</td>
<td>Completed</td>
</tr>
<tr>
<td>2012</td>
<td>Development of Data Glove for HCI, and recognition of gestures in a vision-based setup</td>
<td>Completed</td>
</tr>
<tr>
<td>2013</td>
<td>Full integration of software modules for field testing, Documentation of Intermediate results of the project</td>
<td>Completed</td>
</tr>
</tbody>
</table>

The project had also won the National Award for best applied research and technological innovation. 

Video Link: [http://www.youtube.com/watch?v=7e65nRCMMM](http://www.youtube.com/watch?v=7e65nRCMMM)

2014 Development of a complete gesture recognition platform, application of this frame of for sign language recognition, extension of the proposed method for recognizing sign languages of 14 languages of India. **Not Completed** as the main phase of the project is not sanctioned till date. We don't have fund to continue the project, and the financial constraints bring this project to a standstill.

2015 Development of gesture animation framework for Indian Sign Language **Not Completed** as the main phase of the project is not sanctioned till date. We don't have fund to continue the project, and the financial constraints bring this project to a standstill.
Deliverables achieved so far with details of the work done by the project team

The main motivation of the proposed research/project is to develop an Indian Sign Language education/recognition platform for mute people. The goal of this project was to develop a system that can substantially help in the primary/higher and/or vocational education of hearing impaired students/people of India. A multimedia comprising of audio and video will be played for each alphabet, number, word and sentence for interpreting them. Moreover, there will be a provision for text and animation describing the interpretation process. We have planned to add more features like provision of online courses, interactive session in sign language etc. The another important aspect is that, the system can recognize different hand gestures of Indian Sign Language in the form of some text messages displayed in the computer monitor.

The project work was divided into two major parts for the fulfillment of different demands of deaf community. The first objective was the up liftmen of deaf community in the field of education. Second one is to make the conversation between a deaf and a normal person easy even though the normal person does not have any exposure of sign language. For fulfilling the first need, an attractive GUI based audio-visual platform is being developed which will act as an Indian Sign Language Dictionary in alphabet, word and sentence level. Secondly, a functioning sign language recognition system can provide an opportunity for the deaf to communicate with non-signing people without the need for an interpreter. Recognition of a sign language is very important not only from the engineering point of view but also for its impact on the human society. A sign language recognition platform can be used to generate speech or text making the deaf more independent. Unfortunately, there has not been any system with these capabilities so far. Research has been limited to small-scale systems capable of recognizing a minimal subset of a full sign language. The reason for this is the difficulty in recognizing a full sign language vocabulary – recognition of gestures representing words and sentences undoubtedly is the most difficult problem in the context of gesture recognition research.

We completed the first part of the project and fulfilled the most of the objectives of the pilot phase of the project.

The outcomes of the project, as stated in DPR contributing to mission objective

Till now the pilot phase work has been completed. We have the following satisfactory outcomes after the completion of the pilot phase-

1. Launch of educational portal for web learning of Indian Sign Language and development of a new laboratory for HCI research.
2. More than hundred gestures have been recognized in vision-based and glove-based setup.
3. We are getting desired efficiency in pattern recognition with the help of novel gesture recognition algorithms developed.
4. Video clips, audio descriptions, a few animations and text descriptions of different signs are made available.
5. Different signs have been animated in three dimensional views to provide a clearer picture of signs.
6. A dictionary of signs is prepared to provide user a textual description of signs.

The outcomes of the project as achieved on date, with impact assessment done, if any.

The research work so far provides a web-based interactive system for Indian Sign Language Education and Recognition.
We have developed a system for hand Gesture Recognition. More than 350 signs (hand gestures) have been recognized by the computer in a Human Computer Interactive environment. A sign displayed in front of a camera or performed by using a data glove can be processed by a computer to give textual description of the sign. So far, we have come out with the real-time recognition of alphabets, numbers (fingertips detection both single-handed and double-handed) and some words. The main objective of this part of the research/project is the elimination of social isolation of the deaf community by recognizing hand gestures/signs. Recognition of gestures would establish an interaction between a normal person (who may be unaware of Indian sign language) and a deaf person, which may be feasible in near future.

Additionally, we have developed a web-based portal for extensive Indian sign language education. This part of the research is currently supported by MHRD, Govt. of India under National Mission for Education through ICT [http://www.iitg.ernet.in/isl/]. The database driven web portal avails a learning platform of Indian sign language. The on-line system provides video, audio, animation and textual description of each of the signs of Indian sign language. Further, many features (e.g., search option) that enhance interactivity are also incorporated in the system. So far, signs of alphabets, numbers, different words and sentences have been uploaded in the developed website. With a single click on a particular word, a user can access the corresponding video clip, audio description, animation clip and finally the textual description of the sign. Description of a sign in different modes eliminates the difficulty in learning and makes a sign easily understandable. Hearing-impaired people as well as the normal one can easily interact with this user friendly e-learning interactive environment. This will significantly reduce the communication gap between the hearing impaired/mute people and the normal people.

As explained earlier, the important aspect of the developed system is that, the computer can recognize different hand gestures of Indian sign language in the form of some text messages displayed in the computer monitor. Following few fundamental steps were implemented for practical implementation of the developed system:

(A) Indian Sign Language Recognition System:

- **Development of a more generalized hand gesture model and verifying the model behavior for wide classes of hand gestures:** Both static and dynamic hand gestures are considered for the development of a generalized model, where the spatio-temporal variations are exclusively taken into consideration. Subsequently, I have resolved some critical issues related to the continuous hand gesture recognition for fluent sign language recognition.

- **Development of the hand gesture recognition algorithm:** Next phase is the development/implementation of suitable Image Processing/Computer Vision algorithms along with some advanced pattern recognition modules. Subsequently, codes (Open CV) were developed for the selected/developed algorithms to implement it in a real-time and complex scenario.

- **Testing the hand gesture interface:** Data gloves are designed and subsequently, used for gesture recognition. The interface was tested until it is error-free.

- **Building the prototype recognition and animation system with full capability:** Field testing and improving different algorithms are done for successful implementation in a real-time error free automatic recognition platform. Around 350 gestures have been recognized in a vision-based as well as glove-based setup. Gesture animation system was subsequently developed by measuring
different parameters of the hand and fingers from a gesture video. This module was implemented in the software platform of Open CV and Open GL.

- **Final product:** Finally, all the hardware and software modules are assembled for a more generalized Indian Sign Language Recognition and Education System. We are now planning to hand over the developed software module to some government agencies for possible deployment in the Deaf and Dumb Schools of India.

(B) Indian Sign Language Education System:

- **Study of wide classes/varieties of sign language all over the India:** This is the most fundamental step but equally critical phase of the development. Extensive analysis/research of different sign languages of India has been done for the creation of a most generalized/unique system.

- **Creation of extensive database:** An audio/video database for Indian sign language is created. Audio/Video analysis is another very important aspect of developing an integrated and generalized learning methodology of a sign language. This part of the research is currently supported by MHRD, Govt. of India under National Mission for Education through ICT [http://www.iitg.ernet.in/cet/homepage.htm].

- **Audio/Video analysis: Generalized platform for extensive education:** This is the final step of the sign language education system. The proposed interactive system has enough audio and video materials/components for extensive education of primary/high school standard hearing impaired students of India.

Some of the results of the entire developed system are highlighted in Figs. 2 – 8.
INDIAN SIGN LANGUAGE RECOGNITION IN A VISION-BASED SETUP
Fig. 2: Some hand gestures of Indian Sign Language which are recognized by the proposed system.
Fig. 3: The developed HCI system for vision-based gesture recognition.
Fig. 4 (a), (b), (c), (d), (e) and (f): Real-time gesture recognition (single and two-handed gestures) in a vision-based setup.
INDIAN SIGN LANGUAGE RECOGNITION IN A GLOVE-BASED SETUP

DESIGNING OF DATA GLOVES

Fig. 5: Data-Gloves for two hands are designed for Indian Sign Language recognition.
Fig. 6: Real-time Indian Sign Language recognition in a Glove-based setup.
GESTURE ANIMATION FRAMEWORK

Fig. 7: Indian Sign Language animation framework.
Fig. 8: Indian sign language education platform.
Demonstration and Validation (Test by users)

The developed Indian sign Language Recognition and Education platform was demonstrated in few deaf and dumb schools of India. Furthermore, the developed system was evaluated and validated by some domain experts. Students of some deaf and dumb schools of North Eastern Region of India used the web-based learning system of Indian Sign Language and they found the system totally informative and reliable in understanding signs i.e., sign language education. Also, they were able to make the computer to map their gestures into corresponding text by signing in front of a camera and/or by using a data gloves. Following workshops [http://www.iitg.ernet.in/isl/] were conducted for intermediate project evaluation and validation of the proposed system for the pilot phase of the project.

Workshops

1. **Indian Institute of Technology, Guwahati, India**: A workshop at IIT Guwahati was conducted during the month of November, 2011. Mr. Tomohire Morakomi, Inspec Inc., Japan and Yuji Iwahori, Professor, Dept. of Computer Science, Chubu University, Japan attended the workshop. Dr. Arun Banik, Director, National Center for Disability Studies, IGNOU from New Delhi also participated the workshop and delivered a lecture on Assistive Technology for disables. Another workshop was conducted in the month of December, 2011 for verification and validation of the developed online education system. Dr. Arun Banik (Director, NCDS, IGNOU) and Ms Indira Indira Ghosh (ISL Interpreter, AY|NIHH, Kolkata) attended the workshop.

2. **National Institute for Hearing Handicapped, Kolkata, India**: The implementation team visited National Institute for Hearing Handicapped (NIHH), Kolkata for a demonstration of the project from 29th May, 2012 to 31st May, 2012. During this workshop, a discussion was carried out with the professional sign language interpreters for validating the developed Indian Sign Language database. Additionally, real time class room teaching methodology for hearing impaired students were recorded and included in the developed portal to highlight the requirement of an online sign language education system.

The developed Human Computer Interactive System works perfectly and was tested by some domain experts of India and abroad. Following few domain experts are listed in this regard, who closely inspected/validated the developed system and gave their valuable comments.
1) Prof. Arun Banik,  
   Director,  
   National Center for Disability Studies, IGNOU,  
   New Delhi, India.

2) Prof. Vinod Kumar,  
   Professor,  
   Dept. of Electrical Engineering,  
   IIT-Roorkee, India.

3) Prof. Yuji Iwahori,  
   Professor,  
   Dept. of Computer Science and Engineering,  
   Chubu University, Japan.

4) Tomohiro Murakomi,  
   Inspec Inc.  
   Japan.

5) Dr. A. K. Sinha  
   Asst. Director,  
   Ali Yavar Jung National Institute for Hearing Handicapped,  
   Kolkata, India.

6) Mr. Amit Samal  
   Master Trainer of Indian Sign Language,  
   Ali Yavar Jung National Institute for Hearing Handicapped,  
   Kolkata, India.

7) Indira Ghosh  
   Indian sign Language Coordinator/Interpreter,  
   Ali Yavar Jung National Institute for Hearing Handicapped,  
   Kolkata, India.

8) Mr. Gopal Narayan Dwibedi  
   Indian Sign Language Interpreter,  
   Meerut, India.

9) Mr. Kshirasindhu Saraf  
   Hearing impaired student,  
   Ali Yavar Jung National Institute for Hearing Handicapped,  
   Kolkata, India.

Social Impact

The project so far provides a web-based interactive system of Indian Sign Language Education and Recognition. Currently, extensive research is going on in the field of gesture recognition. However, there still remain significant problems that need to be solved in gesture recognition, especially in sign language recognition.
The database driven web portal avails a learning platform of Indian Sign Language. The on-line system provides video, audio, animation and textual description of each of the signs of Indian Sign Language. Further, many features (e.g., search option) that enhance interactivity are also incorporated in the system. So far, signs of alphabets, numbers, and different words have been uploaded in the website. With a single click on a particular word, a user can access the corresponding video clip, audio description, animation clip and finally the textual description of the sign. Description of a sign in different modes eliminates the difficulty in learning and makes a sign easily understandable. Hearing-impaired people as well as the normal one can easily interact with this user friendly e-learning interactive environment. This will significantly reduce the communication gap between the hearing impaired/mute people and the normal people.

We have developed a system for hand Gesture Recognition. More than hundred signs have been recognized by the computer in the Human Computer Interactive Environment. A sign displayed in front of a camera or by using a data gloves can be processed by a computer to give textual description of the sign. So far, we have come out with the recognition of alphabets, numbers (fingertips detection both single-handed and double-handed) and some words. The main objective of this part of the project is the elimination of social isolation of the deaf community by recognizing hand gestures. Recognition of gestures would establish an interaction between a normal person (who may be unaware of Indian Sign Language) and a deaf person, which may be feasible in future.

The project is also boosting an important research in the field of Gesture Recognition as it covers key issues like Human Computer Interaction which is still a blur picture for many researchers working in this domain.

**Cost Benefit Analysis**

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Item</th>
<th>Population (Approx.)</th>
<th>Expense (Rs)</th>
<th>Expense/person (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Deaf people in India</td>
<td>11,00,000</td>
<td>130,00,000</td>
<td>11.80</td>
</tr>
<tr>
<td>2</td>
<td>Normal people in India</td>
<td>120,90,93,422</td>
<td>130,00,000</td>
<td>0.01 (approx.)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>1210193422</strong></td>
<td><strong>130,00,000</strong></td>
<td><strong>0.01 (approx.)</strong></td>
</tr>
</tbody>
</table>
List of publications related to the developed system:


System Development under Pilot Phase of the project
MAIN PHASE PROJECT PROPOSAL

Future Enhancements:

After completion of the pilot phase, we are left with many challenging activities for the successful completion of the project. The activities that have to be completed to get the full outcome of the proposed project are as follows.

1. Recognition of hand gestures using Data Gloves to bring more efficiency.
2. Converting different signs to textual form displayed on the computer screens to minimize the difficulties in communication with the deaf community.
3. To develop an HCI system so that people can interact with the computer directly without the need of mouse, keyboard, joystick or any other input device.
4. Character level, Word level, Sentence level, Paragraph level and finally different course level interpretations are to be implemented.
5. An audio track is to be merged with each sign clips to depict the steps to signing.
6. Interactive session in sign language will be launched.
7. Enhancement in the form of research in Virtual Reality.
8. Development of a complete animated platform.
9. Deployment of the developed system in the Deaf and Dumb Schools of India.

Work Plan:

1. **Creation of extensive database:** This is the most crucial step of the project. Our ultimate objective is to create an audio/video database for all the sign languages of India.

2. **Audio/Video analysis:** Audio/Video analysis is another very important aspect of developing an integrated and generalized learning methodology of sign languages.

3. **Generalized platform for extensive education:** This is the final step of the sign language education system. The proposed interactive system will have both audio and video materials/components for proper primary/higher education for the hearing impaired students of India.

4. **Development of a more generalized hand gesture model and verifying the model behavior for wide classes of hand gestures:** Both static and dynamic hand gestures will be considered for the development of a generalized model, where the spatio-temporal variation will be
exclusively taken into consideration. Subsequently, we have to resolve some critical issues related to the continuous hand gesture recognition for fluent sign language recognition.

5. **Development of the hand gesture recognition algorithm:** Next phase is the development/implementation of suitable image processing algorithms along with some advanced pattern recognition modules. Subsequently, codes are to be developed for the selected/developed algorithms to implement it in a real time and complex scenario.

6. **Testing the hand gesture interface:** The interface is to be tested until it is error-free.

7. **Complete animation setup:** It is proposed to develop an interactive animated system for sign language education.

8. **Research on Virtual Reality:** Extensive research on this emerging research area for possible deployment in sign language education system.

9. **Building the prototype recognition system with full capability:** Field testing and improving different algorithms for successful implementation in a real-time error free automatic recognition platform.

10. **Final product:** Assembling all the hardware and software modules for a sophisticated Indian Sign Language Education and Recognition System and handling over the software module to MHRD for possible deployment in the Deaf and Dumb Schools of India.
### Budget proposed for the main phase: 429.41 Lakhs

### Budget estimates (Summary): 459.41 Lakhs

<table>
<thead>
<tr>
<th>Items</th>
<th>Total (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Recurring</td>
<td></td>
</tr>
<tr>
<td>1. Salaries/wages</td>
<td>70.60 Lakhs</td>
</tr>
<tr>
<td>2. Consumables</td>
<td>25.00 Lakhs</td>
</tr>
<tr>
<td>3. Travel</td>
<td>30.00 Lakhs</td>
</tr>
<tr>
<td>4. Conf. &amp; workshop</td>
<td>55.00 Lakhs</td>
</tr>
<tr>
<td>5. Other cost (Contingencies)</td>
<td>22.36 Lakhs</td>
</tr>
<tr>
<td>B. Equipment</td>
<td>230.65 Lakhs</td>
</tr>
<tr>
<td>C. Honorarium to investigators/Domain Experts/PRSG members</td>
<td>25.8 Lakhs</td>
</tr>
<tr>
<td>Grand total (A+B+C)</td>
<td>459.41 Lakhs</td>
</tr>
</tbody>
</table>

#### Notes:

1. Eight research associates/scientists will be needed to carry out some of the experimental works involving design and testing.

2. Equipment consists of high-end systems for Image/Video Processing, Servers, Workstations, equipment for virtual reality applications, PCs, Printers, Scanners, Photocopiers, Video Conferencing facilities at multiple campuses, consoles and other audio-video equipment, animation platform including related software, magnetic sensors for tracking
systems, setup of servers, computers and the installation of related software, Magnetic sensors for tracking systems, Set up of servers, computers and installation of software in different nodal centers (e.g., Deaf and Dumb educational institutes) of the project.

3. Travel includes attending conferences/workshops/seminars (national and international) to present and discuss about research findings from the project and gaining knowledge regarding latest advancements in the related area. Furthermore, for data collections of Indian Sign Language and for the interactions with the deaf/dumb students, we have to visit different places of India. Finally, I am planning to visit some of the deaf and dumb institutes of India to demonstrate the developed system. Subsequently, I would like to train some of the teachers/volunteers to use the system more effectively. Also, the budget includes the cost of holding PRSG meetings.

4. Contingency is needed to buy books/periodicals to keep abreast of latest developments in the area of research.

5. Some very sophisticated equipment like very high end computing systems, sophisticated data acquisition systems etc. are needed for design, implementation and testing of proposed Indian Sign Language interface system. The cost includes transport, insurance and installation charges.

6. Expenditure related to the Conference & Workshop includes organization of some conference/workshop/symposia related to Sign Language Recognition in the national/international level. We are planning to involve deaf/dumb students of India in this process of knowledge/information sharing.

7. Travel expenditure related to visiting different states for data collection while developing the platform for 14 regional languages.
Development of an Indian Sign Language Education & Recognition Platform for Hearing Impaired Students of India

A Project Under National Mission for Education through ICT, MHRD, Government of India

http://www.iitg.ernet.in/isl/index.htm

Indian Institute of Technology Guwahati, India.
Development of an Indian Sign Language Education and Recognition Platform for Hearing Impaired Students of India

http://www.iitg.ernet.in/isl/index.htm

❖ **Principal Investigator:**

Dr. M. K. Bhuyan

Visiting Professor, University of Purdue, Indianapolis, USA.

Associate Professor, Department of EEE, IIT Guwahati, India.

❖ **Co-Investigator:**

Prof. P.K. Bora

Professor, Department of EEE, IIT Guwahati, India.
Project Deliverables

Automatic Indian Sign Language Recognition and Education Platform for hearing impaired/mute people of India. More specifically, the system would be quite useful for the hearing impaired students of India.

Organizing Institute
Indian Institute of Technology Guwahati, India.

National Institute for Orthopaedically Handicapped, Kolkata, India

Ali Yavar Jung National Institute for the Hearing Handicapped, Mumbai, India.

Deaf and Dumb Educational Institutes/Schools of North-Eastern region of India.
This project is aimed to develop an Indian Sign Language Education and Recognition Platform for hearing impaired student of India. The system can substantially help in the primary/vocational/higher education of hearing impaired student and people of India.

The important motivation of the project is to develop an Indian Sign Language Recognition platform for mute people. Automatic sign language recognition offers enhancement of communication capabilities for the speech and hearing impaired, promising improved social opportunities and integration.

The objective of the research is to build a system that uses natural gestures as a modality for recognition in the vision-based and/or glove-based setup. The focus of the proposed project is to develop a Human Computer Interaction (HCI) platform in context to Indian Sign Language.

Objectives as per the Mission Document: Development of interfaces for other cognitive faculties which would also help physically challenged learners.
Sign Language

**What?**
Sign languages are natural languages that use different means of expression for communication for hearing impaired.

**Why?**
Sign language offers enhancement of communication capabilities among normal beings and provide replacement of speech among deaf and mute people.

**How?**
Development of interfaces for other cognitive faculties which would also help physically challenged learners.
Goals

**Education**
- Education for the deaf community.
- Development of different courses for education of hearing impaired students.
- Development a complete animated platform for extensive sign language education.

**Interface**
- Enabling the physically challenged students to interact with computer.
- HCI interface for Indian Sign Language.
- Recognition in the vision-based and the glove-based setup.
- Translating gesture into some spoken language.

**Applications**
- Research on Virtual Reality for possible deployment in sign language education.
- Extension of the scope of the project for Indian classical dance education
- Deployment of the proposed system in some selected schools/institutes of India.
Project Goals and Scopes

Virtual Reality

Communicate from a distance

HCI

Sign Language Recognition

Sign Language Education
Work Plan

- Gesture animation framework
- Audio Visual database of ISL
- Platform for extensive education
- Sign language recognition platform
Indian Sign Language Education & Recognition

Work Plan

Pilot Phase
(Completed)
- Literature study of ISL
- Creation of an extensive database
- Audio/Video analysis
- Generalized platform for sign language education
- Recognition of hand gestures

Main Phase
- Development of full gesture recognition module
- Gesture animation system
- Building the prototype recognition system
- Extension related to Indian classical dance education
New lab for research
Sign language database
Audio-visual representation
Hand gesture animation
100 signs of ISL are recognized
Indian Sign Language Education

Project Website
http://www.iitg.ernet.in/isl/index.htm

This project is aimed to develop an automatic Indian Sign Language education and recognition platform for hearing impaired students of India. The system can substantially help in the primary/vocational/higher education of hearing impaired students and people of India. The framework is proposed to be extended to 14 different languages of India with extensive interactive features in the audio-visual mode.

Another important aspect of the project is that, the proposed interactive system will be able to recognize different hand/body gestures of Indian Sign Language.

Dr. M.K. Bhuwan, Principal
Investigator of the project has been awarded National Award for his contribution in the field of Indian Sign Language.
Indian Sign Language Recognition System

Roadmap for development and validation

• **Fundamental Research**
  Extensive research for the development of a versatile Human Computer Interface.

• **Building Commercial Prototype**
  Development of a prototype system for testing.

• **Testing of the system**
  Testing of the proposed system by deaf and dumb students and subsequent improvement of the system.

• **Deployment**
  Deployment in deaf and dumb institutes of India and handing over the complete setup to MHRD, Government of India for possible deployment and commercialization.
Data Gloves
Vision-based System

Wireless and Flexible
Usually Single Camera
Some Static Gestures (ASL)

http://where.com/scott.net/asl/abc.html
Chair
He has lost it
Open the door
He has forgotten it
Listen to it
Throw it away

Dynamic Gestures
http://www.comanchelodge.com/sign-language.html
Gesture Types

Hand

Gestures

Face

Body
Elements of Vision-based Interface (VBI)

- Hand tracking
- Hand gestures
- Arm gestures

- Head tracking
- Gaze tracking
- Lip reading
- Facial expression

- Body tracking
- Activity analysis
Specific Research Areas for Sign Language Recognition

Gesture Recognition
Fully automatic platform uses HCI interface.

Gait Recognition
Person identification from walking style.

Face Recognition
Face and Facial Expression recognition

Gesture Animation
Sign Language Education
Gesture Recognition System

Input Video

Local Motions

Global Motions

Complexity

Continuous gestures

Local + Global

Research Challenge
Proposed Gesture Recognition System

Different Hand Motions

Continuous

Local + Global

Global

Static & Local

ALL motions
- Co-articulation
- Movement epenthesis
  - 92.0%

Integrated
- Gesture class identification
- FSM and/or Trajectory
  - 94.1%

Trajectory
- MPEG-7 based motion trajectory
- Trajectory features matching
  - 95.6%

FSM
- MPEG-4 based VOP extraction
- Key frame extraction & summarization
  - 92.2 – 99.1%
Proposed System

Image/Video Input
Input from the image sensors/image acquisition.

Hand Segmentation
Object-based video abstraction (MPEG-4)

KEY frame extraction
Shape comparison by Hausdorff distance.

Gesture Summarization Recognition
Final classification by FSM and Trajectory features.

Indian Sign Language Education & Recognition System

A project under National Mission On Education
through ICT of Ministry of Human Resource and Development

Gesture Recognition Level

- Fingertip Detection I
- Fingertip Detection II
- Fingertip Detection III
- Two Handed Fingertip Detection I
- Two Handed Fingertip Detection II
- Gestures having global motions

Indian Sign Language Recognition System
Two Hand Fingertip Detection (Part II)

Expression Of Interest...

IT Guwahati, India invites academics, institutions for their active participation/contribution

Review...
- Research Publications Related to The Project
- List of Reviewers of the Project
- Snaps of different Equipments used in the Project

Hand Gesture Animation
Gait Recognition

Image Acquisition

Image Enhancement and Segmentation

Feature Extraction

Mathematical Representation of the Image Attributes

Classification of patterns, Image Understanding and Decision making.
Proposed System

Pre-processing
Background subtraction and Moving Target Classification

Feature Extraction
Combined features of width and shape of the binary silhouette. PCA to reduce dimensionality

Classification
HMM Recognition accuracy: 92.7%

Facial Expression Recognition
Indian Sign Language Recognition System

Upward arrow: works already carried out
Downward arrow: works to be done.

- Fusion of Information
- Vision & Glove-based Recognition
- Hand Segmentation
- Continuous Gestures
- Gesture Animation
- Facial Expression
Overall Development

Indian Sign Language Education & Recognition System
Under National Mission Project on Education through ICT, MHRD, Govt. of India.
Workshops Organized

• **Indian Institute of Technology, Guwahati, India**
  
  Mr. Tomohire Morakomi, Inspec Inc., Japan  
  Dr. Yuji Iwahori, Professor, Chubu University, Japan  
  Dr. Arun Banik, Director, National Center for Disability Studies, IGNOU  
  Ms Indira Indira Ghosh (ISL Interpreter, AYINIH, Kolkata)

• **National Institute for Hearing Handicapped, Kolkata, India**
  
  Demonstration and Validation of the project
National Award for Best Applied Research and Innovation

I was awarded the National Award for "Best Applied Research/Technological Innovation" by Government of India. The award was conferred by Honorable President of India at Vigyan Bhawan, New Delhi on 6th February, 2013.

Demonstrating my interactive gestural sign language innovation at CET, IIT Guwahati, India.
National Awards for the Empowerment of Persons with Disabilities 2012
February 2013, Vigyan Bhavan, New Delhi
Ministry of Social Justice and Empowerment, Government of India
List of publications related to the developed system:


Current Financial Position

Amount sanctioned for the pilot phase: Rs. 132 Lakhs.
Amount received: Rs. 132 Lakhs
Total expenditure till date: Rs. 132 Lakhs
Balance amount: **NIL**
Over Expenditure: Rs. 39,437.00

Main phase project proposal was submitted on the standing committee meeting (16th July, 2011) and discussed on the standing/evaluation committee meeting (3rd Sept, 2011)

Budget proposed for the main phase: Rs. 426.41 Lakhs
Thank You!
Major Equipment to be Procured