

Annual Report for Period:09/2007 - 08/2008

Submitted on: 08/06/2008

Principal Investigator: Prabhakaran, Balakrishnan .

Award ID: 0237954

Organization: U of Texas Dallas

Submitted By:

Prabhakaran, Balakrishnan - Principal Investigator

Title:

CAREER: Animation Databases

Project Participants

Senior Personnel

Name: Prabhakaran, Balakrishnan

Worked for more than 160 Hours: Yes

Contribution to Project:

B. Prabhakaran is the PI of the project. During this year, I graduated 3 PhD students and 4 Masters' thesis students who worked on various research issues pertaining to this project. Currently, I am supervising 4 PhD students and 3 Masters students in this research area.

Post-doc

Graduate Student

Name: Li, Chuanjun

Worked for more than 160 Hours: Yes

Contribution to Project:

Chuanjun Li developed Singular Value Decomposition (SVD) based similarity measure for content-based motion retrieval as well as motion classification/ metadata generation. He also used the SVD approach to train Support Vector Machines (SVMs) for fast motion classification. He has also developed an interval-based index structure for efficient content-based retrieval of 3D motions.

Chuanjun Li was supported as a Teaching Assistant by the Department of Computer Science as a matching support for the NSF project.

Chuanjun graduated with his Phd degree and is currently a post-doc at the Brown University.

Name: Li, Hui

Worked for more than 160 Hours: Yes

Contribution to Project:

Hui Li worked on his PhD thesis that focused on transmission of 3D models and animations over networks. He developed heuristics to support streaming of 3D models.

Hui Li was supported as a Teaching Assistant by the Department of Computer Science as a matching support for the NSF project.

Hui graduated as a PhD student and is current a Research Engineer at Ask.com

Name: Agarwal, Parag

Worked for more than 160 Hours: Yes

Contribution to Project:

Parag Agarwal is working on collision detection/resolution in animation authoring. He is developing heuristics to reduce the search-space for checking possible collisions.

Parag Agarwal was supported as an RA by the Dean's matching grant for the NSF grant. Parag expects to defend his PhD thesis in Fall 2007.

Name: Pradan, Gaurav

Worked for more than 160 Hours: Yes

Contribution to Project:

Gaurav Pradhan is working on indexing approaches for content-based motion comparison. He has developed an interval-tree based index structure that prunes irrelevant motions efficiently. He is being supported as a student assistant from the NSF grant and is working on his PhD thesis.

Name: Arun, Prakash

Worked for more than 160 Hours: Yes

Contribution to Project:

Arun Prakash completed his Masters dissertation on visualizing animation databases. He developed user interfaces that aid in visualizing the responses from animation databases.

Name: Li, Mng

Worked for more than 160 Hours: Yes

Contribution to Project:

Ming Li completed his PhD thesis on Quality of Service (QoS) support for wireless networks to aid in streaming 3D models and motions. He was supported as a Teaching Assistant of the Computer Science department, as a matching fund for the NSF career grant.

Ming is currently a tenure-track Assistant Professor at the California State University, Fresno.

Name: Adi, Ketaki

Worked for more than 160 Hours: Yes

Contribution to Project:

Ketaki implemented several Watermarking approaches for copyright protection of 3D motions.

Name: Naik, Sagar

Worked for more than 160 Hours: Yes

Contribution to Project:

Sagar Naik completed his Masters thesis on 3D model matching. He developed similarity measures that can compare 3D models.

Name: Tang, Ziyang

Worked for more than 160 Hours: Yes

Contribution to Project:

Ziyang Tang is currently working for her PhD dissertation. She is addressing the issues involved in using deformable 3D models in animations. These issues include streaming, and classification.

Name: Zhou, Junqiang

Worked for more than 160 Hours: Yes

Contribution to Project:

Junqiang is a PhD student co-supervised by me and another faculty. He is working on analyzing 3d motion capture camera placement problems and optimizing them for maximum coverage and reliability. He will also apply these results for 2D video camera placement and reliability.

Name: Pawar, Manoj

Worked for more than 160 Hours: Yes

Contribution to Project:

Manoj carried out Masters thesis work on creating a visual query interface for 3D motion capture databases. With this interface, users can draw simple actions that need to be part of the retrieved 3D motions.

Name: Ramaswamy, Vivekshankar

Worked for more than 160 Hours: Yes

Contribution to Project:

Vivek carried out his Masters thesis work on streaming animation scenes. He came up with scheduling algorithms that aid delivering 3D models comprising an animation in succession.

Name: Agrawal, Sameer

Worked for more than 160 Hours: Yes

Contribution to Project:

Sameer also did his Masters thesis work. This work was on streaming 3D models compressed using Progressive Forest Split (PFS). He exploited the characteristics of PFS that aid streaming.

Name: Chin, Yohan

Worked for more than 160 Hours: Yes

Contribution to Project:

Supported as Teaching Assistant by the Department. He developed techniques that would aid in reconstructing 3D data from 2D video data. This has several applications such as improving 2D video gesture recognition accuracy, entertainment/education (3D animations).

Name: Suk, Myunghoon

Worked for more than 160 Hours: Yes

Contribution to Project:

Supported as Research Assistant. He worked with Yohan in 3D extrapolation from 2D video data.

Name: Panchanathan, Magesh

Worked for more than 160 Hours: Yes

Contribution to Project:

Supported as Research Assistant. He developed visualization platform for 3D animations.

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Name: Washenfelder, Jacob

Worked for more than 160 Hours: Yes

Contribution to Project:

Supported as student worker. He worked in refining and removing bugs in animation toolkit.

Name: Torres, Luis

Worked for more than 160 Hours: Yes

Contribution to Project:

Supported as student worker. He worked in refining and removing bugs in animation toolkit.

Organizational Partners

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:

Project Home Page: <http://www.utdallas.edu/~praba/animdb.html>

The initial proposal was to carry out research activities on partial fuzzy query resolution, collision detection, model & motion comparison,

segmentation, and querying. An animation toolkit was also proposed to be implemented. Of these, the following activities have been completed:

- a. Partial, fuzzy query resolution: result accepted as a research paper in the ACM Transactions on Multimedia, Computing, and Applications (TOMCCAP).
- b. Collision detection: research paper accepted and published by Visual Computer journal.
- c. Segmentation & motion comparison: several research papers published, including one in ACM Transactions on Multimedia (TOMCCAP).

I felt we have completed major part of the proposal with significant publications in prestigious journals and conferences. Hence, I 'expanded' on the research activities to include some medical aspects that can be considered as part of the prior research in animation databases. I have been able to expand on the scope of research activities to include the medical aspects because of the excellent matching funds provided by my University and School of Engineering. The following activities were carried last year (some from the proposed tasks and some from the expanded tasks):

1. Integration of 3D motion capture with other medical sensor data.
2. Using deformable 3D models for animation and streaming,
3. Tamper proofing and watermarking 3D models and motions.
4. Reconstructing 3D data from 2D video data.

Several conference papers have been published on the topics involving medical sensors and digital watermarking of 3D data. We are currently working on the journal versions of these papers.

We also developed new approaches that would aid in 2D video gesture recognition using 3D motion capture data. We also worked on techniques that would aid in applying information retrieval techniques on 3D motion capture data. These tasks resulted in some conference publications and we are working on their journal versions. These techniques will have several interesting applications in education and entertainment.

Through these research activities, several graduate students were trained. 6 PhD students and 7 Masters students carried out research under various topics. Total of 4 PhD students have defended their theses so far. Last year, 1 PhD student and 2 Masters student defended their theses last year.

The animation toolkit underwent several updates. We have sophisticated user interfaces and a decent database of 3D models and motions. The toolkit source code has been made public in Fall 2007. 2 Undergrad students including 1 of Hispanic origin were supported and worked as student workers for carrying out this task.

I also taught a graduate course on Multimedia Systems in Spring 2008. I had around 25 students (with nearly 10 women students) who carried out projects on different aspects of multimedia systems including applications on cell phones.

Findings:

1. We developed a new approach for data mining in multiple medical sensor data. This approach helps in finding out association rules among muscle sensor data, exploring the correlations among different muscle activities. We believe that these rules will aid in designing better prosthetic devices.
2. We designed a technique that would aid in applying information retrieval techniques for 3D motion capture data. This technique allows 3D motion data to be treated as a text document, i.e., 3D motions are mapped onto text strings.
3. For better 2D video gesture recognition as well as for reconstructing 3D data from 2D video, we came up with a Hidden Markov Model based strategy that infers the missing third dimension in the 2D video and then recognizes the gesture in the 2D video data.

Training and Development:

Through these research activities, several graduate students were trained. 1 PhD students and 2 Masters students defended their theses last year. 5 Phd students and 2 MS students are currently carrying out research under various topics.

Outreach Activities:

ACM's SIGMM (Special Interest Group on Multimedia) web site is being hosted from my lab. I am disseminating the project findings through this web site. I also made the animation toolkit source code public.

Journal Publications

Chuanjun Li, S. Q. Zheng and B. Prabhakaran, "Segmentation and Recognition of Multi-Attribute Motion Sequences", ACM Transactions on Multimedia Computing, Communications and Applications (ACM TOMCCAP), p. 1-24, vol. 3, (3), (2007). Published, August 2007

Phani S Kotharu and B. Prabhakaran, "Partial Fuzzy Query Resolution for Animation Authoring", ACM Transactions on Multimedia Computing, Communications, and Applications (TOMCCAP), p. , vol. , (2008). Accepted,

Chuanjun Li, P. R. Kulkarni and B. Prabhakaran, "Motion Stream Segmentation and Recognition by Classification", International Journal of Multimedia Tools and Applications (MTAP), p. 55-70, vol. 35, (1), (2007). Published, October 2007

Gaurav N. Pradhan, Chuanjun Li, and B. Prabhakaran, "Hand Gesture-based Computing for Hearing and Speech Impaired", IEEE Multimedia, p. 20-27, vol. 15, (2), (2008). Published, April-June 2008

Hui Li, Ming Li, and B. Prabhakaran, "On Supporting High Quality 3D Geometry Multicasting over IEEE 802.11 Wireless LANs", IEEE Transactions on Computers, p. , vol. , (2008). Accepted,

Ming Li and B. Prabhakaran, "On Supporting Reliable QoS in Multi-hop Multi-rate Mobile Ad Hoc Networks", ACM/Springer/URSI Wireless Networks (WINET), p. , vol. , (2008). Accepted,

Parag Agarwal and B. Prabhakaran, "Minimizing Collision Pairs Searched in Interactive Animation Authoring", The Visual Computer, p. 347-359, vol. 24 (5), (2008). Published, May 2008

Books or Other One-time Publications

Hui Li, Parag Agarwal, Balakrishnan Prabhakaran, "Data Hiding based Compression Mechanism for 3D Models", (2007). Conference Proceedings, Published
Bibliography: IEEE Data Compression Conference 2007 (DCC 2007).

Puneet Maheshwari, Parag Agarwal, B. Prabhakaran, "Progressive Compression Invariant Semi-fragile Watermarks for 3D Meshes", (2007). Workshop proceedings, Accepted
Bibliography: Proceedings of ACM Multimedia and Security Workshop 2007 (MM&Sec 2007), pp. 245-250, September 2007.

Hui Li, Ming Li, B. Prabhakaran, "On Supporting High Quality 3D Geometry Multicasting over IEEE 802.11 Wireless LANs", (2007). Conference Proceedings, Accepted
Bibliography: IEEE Broadnets September 2007

Parag Agarwal, and B. Prabhakaran, "Robust Blind Watermarking Mechanisms for 3D Point Sampled Geometry", (2007). Workshop proceedings, Accepted
Bibliography: Proceedings of ACM Multimedia and Security Workshop 2007 (MM&Sec 2007), pp. 175-186, September

Gaurav N. Pradhan, N. Engineer, M. Nadin, B. Prabhakaran, "An Integrated Mobile Wireless System for Capturing Physiological Data Streams during a Cognitive-motor Task: Applications for Aging", (2007). Conference Proceedings, Published
Bibliography: 2007 IEEE Dallas Engineering in Medicine and Biology Workshop, pp. 67-70, November

Manoj Pawar, Gaurav N. Pradhan, Kang Zhang, B. Prabhakaran, "Content Based Querying and Searching for 3D Human Motions", (2008). Conference Proceedings, Published
Bibliography: Proceedings of ACM Multimedia Modeling Conference (MMM) 2008, pp. 446-455, Kyoto, Japan, January 9-11,

Yohan Jin and B. Prabhakaran, "Semantic Quantization of 3D Human Motion Capture Data Through Spatial-Temporal Feature Extraction", (2008). Conference Proceedings, Published
Bibliography: Proc. Of International Multimedia Modeling Conference (MMM08'), pp 318-328. Kyoto, Japan Jan. 9-11,

Web/Internet SiteOther Specific ProductsContributions**Contributions within Discipline:**

1. For tamper proofing and copy righting 3D models and motions, we identified that the main problem is formulating a cluster of data points. We developed approaches that will enable identification of data clusters. These data clusters can then carry watermarks either for tamper proofing or copyrighting.
2. For integrated medical data, we have come up with variations of 'Multi-factor analysis' (MFA) approach. This approach help us to classify the integrated medical data with reasonable accuracy and we are currently working on mining patterns in this database.
3. We extended our error concealment approach for 3D mesh streaming to provide more accurate reconstruction of the meshes under lossy network conditions.
4. We developed a new approach for data mining in multiple medical sensor data. This approach helps in finding out association rules among muscle sensor data, exploring the correlations among different muscle activities. We believe that these rules will aid in designing better prosthetic devices.
5. We designed a technique that would aid in applying information retrieval techniques for 3D motion capture data. This technique allows 3D motion data to be treated as a text document, i.e., 3D motions are mapped onto text strings.
6. For better 2D video gesture recognition as well as for reconstructing 3D data from 2D video, we came up with a Hidden Markov Model based strategy that infers the missing third dimension in the 2D video and then recognizes the gesture in the 2D video data.

Contributions to Other Disciplines:**Contributions to Human Resource Development:**

Several graduate students were trained. I have graduated 4 PhD students so far: one is working as an Assistant Professor (California State University, Fresno), another as Post-doc (Brown University), and the 3rd as Research Engineer (Ask.com). Fourth student has joined FairWarning, Inc. û a start-up on medical security software. Several Masters students also carried out research under various topics and have been well placed.

Currently, 5 PhD students and 2 MS students are working with me.

Contributions to Resources for Research and Education:

A large repository of 3D motions is now available to researchers as public data. Animation toolkit source code has also been made available to the public.

Contributions Beyond Science and Engineering:Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Organizational Partners

Any Web/Internet Site

Any Product

Contributions: To Any Other Disciplines

Contributions: To Any Beyond Science and Engineering



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DEPARTMENT OF COMPUTER SCIENCE

July 23, 2008

Dear Sir/Madam,

RE: Endorsement of the Work and Career Development Plan for National Science Foundation,
Grant # 0237954, entitled "CAREER: Animation Databases" by PI: B. Prabhakaran

This letter is to reaffirm the commitment of UT Dallas' Computer Science Department for the PI of the above proposal, Dr. Balakrishnan Prabhakaran.

The Department of Computer Science is providing Dr. Prabhakaran with lab space for his research group and the use of computer equipment as well as secretarial support. The Department also has supported him to teach a course on Multimedia Database Management Systems in Fall 2006 and Spring 2008, and an undergraduate course on Computer Animation in Fall 2007. Through these courses, Dr. Prabhakaran has been able to share and disseminate the findings of the project to graduate and undergraduate students. He plans to teach these courses again in the future.

Yours truly,

A handwritten signature in black ink, appearing to read 'D. T. Huynh', written in a cursive style.

Dr. D. T. Huynh
Professor and Department Head