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IMSC brings in nearly \$50 million

NSF, industry partners and others have contributed heavily since the Center's founding in 1996

By **Chrysostomos L. (Max) Nikias, IMSC Director**

Looking back since IMSC's founding nearly five years ago, I am extremely impressed by the \$48.5 million that our partners have contributed to the Center—detailed in a special insert in this issue of the *IMSC News*.

USC President Steven Sample surely hit the mark when he offered this prediction on the occasion of IMSC's genesis as a National Science Foundation (NSF) Engineering Research Center (ERC):

"I see the NSF grant as a match on a little gasoline. It will start a bonfire of research and innovation."

Truly, a bonfire of research and innovation is now lighting the sky. Many have contributed to this bonfire, but none more than the IMSC faculty.



They come from across the campus, across many disciplines, to stand as proof of USC's strategic move into wide-spread cross-disciplinary research and education in communications.

The faculty come not only from the School of Engineering, but from the Annenberg School for Communication, Linguistics, Fisher Gallery, Information Sciences Institute, Cinema-Television, Education, Fine Arts, Gerontology and Music.

These faculty have come to join the unique national integration experiment that is IMSC.

They have given substance to our early outline for a national center that would lead in the burgeoning multimedia and Internet fields, that would endeavor to give clear direction to our launch into this next phase of our digital era.

IMSC faculty are indeed providing the needed strategic

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Toyota USA Foundation awards 3-year grant to BioSIGHT project

The Toyota USA Foundation awarded a three-year, \$400,000 grant last November to IMSC's BioSIGHT project for continued development of an interactive high school biology curriculum.



Dr. Wee Ling Wong

for all of kindergarten through 12th grade education.

Wee Ling Wong, IMSC's principal investigator for BioSIGHT, said that

The goal of the BioSIGHT project is to develop a biology curriculum with fundamental digital technologies that will serve as a prototype for entirely new digital curricula

field tests of BioSIGHT's first module in immunology were conducted last summer with good results in 12 high schools in Los Angeles, the San Francisco Bay Area and Boston. One of the schools was Foshay Learning Center in Los Angeles, one of USC's Family of Five Schools.

Dr. Wong, who also has a faculty appointment in Biomedical Engineering at USC, said that the Toyota grant will be used to develop and assess a cell biology module.

She said that BioSIGHT's interactivity and visualization are geared to spark an enthusiasm for biology in a generation accustomed to the fast pace and colorful animation of video games.

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In his leadership retreat last November, USC President Steven Sample lauded IMSC's research in developing technologies for the future of distance learning.

Potential of immersive technologies termed exciting for assisting people with disabilities

IMSC's progress in immersive technologies is "really exciting" for potential applications to assist people with disabilities, according to Dr. Larry Scadden, a Senior Program Director for the National Science Foundation (NSF) who heads an NSF program that encourages students with disabilities to enter careers in science.



Dr. Larry Scadden

Dr. Scadden, who is blind, attended IMSC's joint Board of Councillors and Scientific Advisory Board meeting last December.

"I was really pleased to observe IMSC's technology

integration work in action," he said, praising the Center's research in immersive technologies that relate to such senses as sight, sound and touch.

"Without question, when you have multi-modal information displays, the information becomes more understand-

able to people with sensory disabilities," he said.

Dr. Scadden was impressed by IMSC's haptics research. "I have been interested in haptics for years, and I think IMSC is ahead of other places in haptics research," he said.

IMSC's Haptic Museum project is developing technologies to allow the user to experience realistic tactile sensations of representations of remote museum objects transmitted over the Internet.

As part of the project, IMSC investigators are conducting research to improve the functionality of two haptic devices—the PHANToM, a pen-like device that provides force feedback to the fingertip as the user traces the contours of the object, and the CyberGrasp, a glove that provides realistic whole-hand force feedback as the user grasps, pokes and prods objects on the screen. One demonstration involves two users "shaking hands" by using haptic devices over a network.

Dr. Scadden also stressed his interest in IMSC's BioSIGHT project, which is creating an interactive high school biology curriculum as a prototype for digital curricula for kindergarten through 12th grade education. He pointed out that in the future, schools will make good use of simulations in science classes to augment the real laboratory experience. He said immersive technologies facilitating transmission of simulations over the Internet will provide flexibility for study at home or other places outside of the classroom. "I'm very impressed with BioSIGHT's content," he said. BioSIGHT has developed such interactive tools as a virtual microscope and virtual reagent kit.

Dr. Scadden praised IMSC's industry relations program as well, saying he is pleased that the Center has been extremely successful in leveraging NSF funding by attracting continuing, substantial funding from its more than 30 corporate partners.

IMSC student making his mark after graduation

After graduating from USC in 1999 with a Ph.D. in Computer Science, Dr. Ali Dashti, IMSC's first Student Leadership Council president, is now beginning to make his mark in the world, serving as an example of how IMSC's programs are producing leaders in the multimedia/Internet field.

Dr. Dashti has become an Assistant Professor in his home country of Kuwait at the University of Kuwait, and he is working with his former advisor, IMSC key investigator Prof. Cyrus Shahabi, and other former IMSC students to launch a new company called INSITE as a startup from IMSC.

"Ali is an excellent example of how IMSC is carrying out its mission to produce leaders for our new multimedia/Internet era," said IMSC Director Chrysostomos L. (Max) Nikias.

Prof. Shahabi counts Dr. Dashti

among the best of his students, saying, "Ali was a top student who has shown great skill in research on multimedia hierarchical storage servers."



Dr. Ali Dashti

and visualization of a user's navigation paths on Web sites. INSITE facilitates real-time target advertising, personalization of contents and customer behavior analysis.

Dr. Dashti said he is excited about working on the launch of a startup. Citing INSITE's "sound fundamentals,"

he said the project has great potential because of an emerging market for its core products. He is working with Prof. Shahabi and two former IMSC students, Vishal Shah and Adil Faisali, to develop financial support.

Dr. Dashti was active in IMSC in the Center's early stages. He became president of the IMSC Student Council in 1997, shortly after IMSC was started in 1996. Under his leadership, the IMSC Student Council initiated a Student Conference in 1997 as an annual event. Keynote speeches by highly regarded executives in multimedia/Internet and presentations by IMSC corporate partners, first introduced at the 1997 Student Conference, have become standard activities at subsequent conferences.

Dr. Dashti said the Council also
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Joint BOC-SAB meeting focuses on Immersipresence

Members of IMSC's Board of Councillors (BOC) and Scientific Advisory Board (SAB) met in a successful joint meeting in December to advise the Center on its strategic direction and various programs.



Keynote speaker Dr. Vic Nalwa

Through Immersipresence™, remote live scenes will be transmitted in 3D by way of the Internet to augment the real environment.

The keynote address was given by Dr. Vic Nalwa, Chief Executive Officer of FullView, on "Panoramic Cameras: Designs and Applications." FullView, a Lucent Technologies spinoff, is developing panoramic video systems. Dr. Nalwa cited a number of applications that would benefit from 360-degree, panoramic photography, including virtual presence over the Internet; interactive viewing (e.g., homes for sale); distance learning; video

As the central theme of the meeting, the attendees examined IMSC's vision of Immersipresence™ as the future of the Internet.

IMSC views Immersipresence™ as the next great breakthrough in our digital era that will dramatically change our world within this decade, transforming our two-dimensional world of computers, TV and film into three-dimensional immersive environments in our own living rooms—or anywhere else.



Co-leaders of the three breakout sessions formed a panel at day's end to present the deliberations. Pictured from left to right: Dr. Frederick Betz, University of Maryland; Al Schleicher, retired, IBM; Adam C. Powell III, Freedom Forum; Jeff Gralnick, Explosion Consulting; Dr. Keith Uncapher, emeritus, USC School of Engineering; and Tom Malzbender, Hewlett-Packard.

conferencing, especially for groups; robot navigation; personal and military surveillance; security; and endoscopy.

IMSC is conducting experiments with panoramic imagery and Immersive Audio™ to provide viewers with a completely new level of 3D visual and aural immersion in events.

BOC and SAB members and invited guests from the USC community and elsewhere attended breakout sessions, a panel discussion and interactive demonstrations. The breakout sessions were "Immersipresence: The Future of the Internet—Technological Challenges," "Commercial Applications of Immersipresence" and "Human Factors in Immersipresence Applications." At the end of the day, the co-leaders of the three breakout sessions joined in a panel to summarize the discussions and answer questions.



IMSC Ph.D. student Jun Yong Noh discusses IMSC's research in face modeling and animation with BOC member Barbara Sampson, President and Chief Executive Officer of TERC, a nonprofit research organization.



IMSC investigator Prof. Gaurav Sukhatme (right) details IMSC's haptics research for USC Prof. Aristides Requicha (left) and Dr. Mita Desai, IMSC's National Science Foundation Program Director.



PANORAMIC VIDEO CAMERA GIVES 360-DEGREE RANGE OF VIEW—This photo shows the full-circle wraparound view captured by IMSC's Immersivision™ panoramic video technology at USC's homecoming game with UC Berkeley last October.

IMSC records "immersive" USC homecoming game

When USC played its homecoming game against UC Berkeley last October, IMSC investigators were there to record the action in an immersive style as part of the Center's work in creating immersive environments. IMSC has coined the term, Immersivision™, to describe this new media system.

Investigators recorded the game and the USC band by employing a 360-degree panoramic camera and Immersive Audio™ to give viewers a completely new visual and aural sensation. The action was captured using five video streams and 20 microphones.

The project, which is a collaboration between USC Intercollegiate Athletics and IMSC, now uses the recorded material for playback demonstrations in the laboratory to present the heightened sense of immersion. The project plans to:

- Provide Internet transmission of the recordings

- Produce a Web site where people can download a file to play on a PC

- Produce a CD or DVD that can play demos on any PC

The Internet and CD or DVD experiments will convey a much greater sense of immersion than the usual Internet, CD and DVD experiences.

Currently, in IMSC's laboratory demo, a viewer using a head-mounted display can see the entire 360 degrees of action simply by a turn of the head. Look straight ahead and there's the game on the field. Turn to the left and there's the band playing near the sidelines. Turn to look behind and there are the spectators cheering in the stands.

The different views are fed to the head-mounted display in response to the head's movement through use of a tracking device attached to the display. Computer processing is used to continu-

ally refresh the various views. The audio is matched with the different views so it sounds like it's coming from the proper direction.

IMSC key investigator Prof. Ulrich Neumann said that Immersivision™ panoramic video technology opens up the possibility of providing each viewer with individual control of his or her viewing experience, thus challenging video's standard view, which is controlled at the source and remains identical for all viewers. "The combination of Immersivision™ and Immersive Audio™ allows viewers to become virtual participants immersed in the scene and to experience a new dimension in the way video imagery is perceived," he said.

IMSC key investigator Prof. Chris Kyriakakis, who specializes in Immersive Audio™, said four factors were involved in the audio integration—microphone techniques, acoustics, psychoacoustics and Immersive Audio™ signal processing.

"The most important part of the integration was ensuring the synchronization of information among the five video feeds and the 20 mike feeds," Dr. Kyriakakis pointed out.

IMSC will continue to develop Immersivision™ and Immersive Audio™ technologies as the Center experiments with the recording and playback of other events, with the aim of producing live demos over Internet 2.



NEW IMSC STUDENT LEADERSHIP COUNCIL—The IMSC Student Leadership Council for the 2000-2001 academic year includes (left to right): Front row—Naomie Worrell, President; Kemal Demirciler (seated), Student Conference Co-Chair; and Zahir Alpaslan, Student Conference Co-Chair. Second row—Karyn Cordova, Industry Day Co-Chair, and Didi Yao, Industry Day Co-Chair. Third row—Mike Fanous, IMSC Web site; Doug Fidaleo, Industry Day Co-Chair; Rajiv Garg, Vice President; and Amol Ghoting, Student Seminar Series Co-Chair. Not pictured: Amber Gray, Treasurer; and Ali Taha, Past President.

IMSC offers plan for Taiwan multimedia industry

IMSC delivered a strategic plan for developing Taiwan's networked multimedia industry at a workshop last October in Taipei.

"The goal of the strategic plan is to help Taiwan increase its networked multimedia industry from a market scale of nearly three-fourths of a billion dollars today to \$10.6 billion in five years," according to Dr. Isaac Maya, IMSC's Director of Industry and Technology Transfer Programs, who led the team that prepared the strategic plan.

IMSC prepared the plan for the Institute for Information Industry (III), which conducts research funded by Taiwan's Ministry of Economic Affairs (MOEA) and transfers results to private industry in Taiwan. III, which is one of the largest research centers in Taiwan, has been an IMSC partner for several years.

Other team members besides Dr. Maya were Kenneth E. Dozier, Executive Director of USC's School of

Engineering Technology Transfer Center, and Dr. Susan Hackwood, Executive Director of the California Council on Science and Technology (CCST). Dozier contributed in the areas of technology, applications and global analysis, and Dr. Hackwood contributed in the areas of education and government policy.

About 150 senior industry executives, academics and government officials attended the one-day workshop.

Strategic plan recommendations included:

- Use a global perspective in evaluating industry characteristics and adapt relevant lessons from other countries in selecting Taiwan's courses of action.

- Employ technology roadmaps to guide selection of future Internet technologies and applications.

- Characterize design and development needs for selected next generation opportunities.

- Participate in the standards

development community.

- Establish Taiwan in the top-level international "Internet connectivity layer."

- Initiate student/teacher education and workforce training development based on projected needs and lead times.

- Use multimedia and distance learning technologies to be most effective in education and training.

- Form Taiwanese university-industry partnerships.

- Determine and then establish or complete supporting laws and regulations.

The workshop keynote presentation on Internet technology trends was given by Dr. Robert Spinrad, who was Xerox's Vice President for Technology Strategy before he retired in 1998. He is currently a CCST member.

IMSC Director Chrysostomos L. (Max) Nikias spoke on "The Future of Immersipresence," IMSC's vision for the 3D future of the Internet. Dozier and Dr. Hackwood also spoke at the workshop.

A press conference on the strategic plan was held for the Taiwanese media.

Dr. Ali Dashti . . .

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initiated a student-run barbecue and a speaker forum.

"I was very fortunate to be associated with IMSC," he said. "It was a great experience working with IMSC faculty, staff and students. It also gave me good exposure to IMSC corporate partners."

Asked how IMSC students can get the most out of their participation in the Center, Dr. Dashti recommended that they join the Student Council and that they become actively involved in the Student Conference and other events.

He also praised IMSC's vision of Immersipresence™ for the future of the Internet as providing a reachable goal that everyone at the Center—students, faculty and staff—can work toward. IMSC envisions that through Immersipresence,™ our two-dimensional world of computers, film and television will be transformed via the Internet into 3D immersive environments.



ASIA-PACIFIC IT SUMMIT—IMSC Director Chrysostomos L. (Max) Nikias (right) talks with John Morgridge, Chairman of Cisco Systems, at the VIP dinner of the Fourth Asia-Pacific Information Technology Summit last November in San Francisco. Dr. Nikias gave a presentation at the conference on "Immersipresence: The Future of the Internet." Dr. Richard Drobnick, USC Vice Provost for International Affairs, also attended the meeting. The Summit, which was organized by the Pacific Economic Cooperation Council, brought together more than 450 top officials from business, academia and government for an in-depth look at the future of the Asia-Pacific information technology landscape.

Radio & TV news directors briefed on immersive news

IMSC investigator Larry Pryor explored key issues in immersive news gathering and presentation on the Internet in a panel discussion at the annual convention of the Radio-Television News Directors Association (RTNDA) last September in Minneapolis.



Prof. Larry Pryor

Prof. Pryor is co-project leader for ImmersiNews, an IMSC Application Research Project that is developing a system for the field acquisition of 3D immersive news experiences, for the preparation of multidimensional interactive news stories and for the presentation of customized news based on these stories over the Internet. He is also Assistant Professor at the Annenberg School for Communication and Director of the School's Online Program.

In his presentation, Prof. Pryor described how the IMSC and Annenberg School collaboration is "beginning to test how immersive technology can be used and what its introduction will mean to news organizations and audiences."

He explained that "media empires that own print, broadcast and Internet

properties have been quick to embrace the concept of convergence" of various media, citing substantial efforts by the Tribune Company of Chicago, Media General of Richmond, VA, and A.H. Belo of Dallas to combine their various newsrooms.

"Stories at more and more news organizations now go out on multiple platforms, sometimes simultaneously,"

Undergrad research program underway

Fourteen undergraduates are participating in IMSC's second annual undergraduate research project, according to Nancy Sweeny, IMSC Special Projects Manager.

Sweeny said this academic year's program started last October and will end by April 30. The students, who receive grants for their participation, are working on a total of 12 projects that relate to IMSC's research priorities.

IMSC faculty sponsors conceived the projects and oversee the research, and graduate students serve as mentors to the undergraduates. The undergraduates submitted proposals based on requests for proposals developed by the IMSC faculty.

"This program provides undergraduates from a variety of academic disciplines with the opportunity to experience what conducting research is all about, and, hopefully, will motivate

he said. "Newspaper photographers carry digital video cameras, print reporters go on television, audio feeds go to both radio stations and Web sites and news writers struggle to convert stories from one medium to the other."

He called this trend "bold, ambitious, pioneering work that requires large investments, versatile
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them to continue their academic career as graduate student researchers. At the same time, graduate students are provided the opportunity to mentor and direct someone else's efforts, similar to what their faculty sponsors do for them," Sweeny said.

Some of the topics include "3D Object Modeling—Haptic Museum," "Streaming Video Transmission Analysis," "Use of Sociolinguistic Markers in Child-Machine Conversational Interactions and Implications for Development of Child Oriented ASR Systems" and "Graphical User Interface Design of Mobile Robot."

The students attend regular project meetings scheduled by their graduate student mentors and submit monthly progress reports and a final report. The undergrads also attend monthly meetings with IMSC staff to give them the
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Intel donates PCs for undergrad research lab

Intel Corp., a longtime IMSC partner, recently donated 10 high-end Dell PC workstations to the Center, according to Alexander A. (Sandy) Sawchuk, IMSC Deputy Director.

The PCs will provide the core computing hardware for an IMSC Undergraduate Multimedia Education and Research Laboratory. The lab facilities will support multimedia courses and projects that require high-performance computing and networks, multimodal audiovisual systems and special-purpose human-computer interface devices.

"We are delighted that Intel has equipped this dedicated undergraduate laboratory," Prof. Sawchuk said. "The lab facilities will offer hands-on experimentation and project development to support the greatly increasing number of IMSC undergraduate research opportunities and course offerings," he explained.

Typical experiments using the lab facilities will include the design and implementation of audio and video streaming, analyzing the performance of video conferencing applications and the development of interactive panoramic image construction and object tracking algorithms.

IMSC News

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IMSC brings in close to \$50 million as an NSF ERC . . .

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direction, fundamental research and application development that will fuel the transformation of our society in the coming years.

We envision the rise of "Immersipresence™," as the future of the Internet. We see it as the next great breakthrough that will dramatically change our world within this decade, transforming our 2D world of computers, TV and film into 3D immersive environments in our living rooms—or anywhere.

Through Immersipresence™, remote live scenes will be transmitted in 3D by way of the Internet to augment the real environment.

Unique technologies developed

Already, IMSC faculty have developed such unique immersive technologies as 3D face modeling and animation, video rendering methods from multiple projections and Immersive Audio™.

They are also making major progress in haptics (touch-related), data compression and wireless communications.

Their technological innovations have translated into an extensive program of industry collaboration and technology transfer. The 44 industry representatives on our Scientific Advisory Board and the 38 industry visionaries on our Board of Councilors have powered the Center forward with their enthusiastic participation.

IMSC faculty, graduate students and postdocs have developed a thriving environment of high-level academic scholarship at the Center. They have published more than 900 papers, with 232 in peer-reviewed journals.

IMSC now counts 57 invention disclosures, 20 patents filed, six patents issued, 23 licenses and four start-ups.

Here are just a few technology transfer examples:

Boeing has licensed IMSC's augmented reality technology to

evaluate its prospective use on the factory floor in aircraft assembly.

Lockheed Martin relied on IMSC support in showing how the new, developing MPEG-4 multimedia compression standard will function in the real-world networking environments of satellite and Internet transmission.

NCR used IMSC technology in enhancing the Teradata Object Relational Database, a multimedia database.

Degree program launched

IMSC faculty have been in the forefront of the Center's initiatives in developing new cross-disciplinary degree programs at USC.

The Center has launched six degree programs, including a Master of Science in Integrated Media Systems, a Master of Science in Electrical Engineering with a specialization in Multimedia and Creative Technologies, a Master of Science in Computer Science with a specialization in Multimedia and Creative Technologies, a Bachelor of Science in Electrical Engineering with an emphasis in Integrated Media Systems and two undergraduate minors in Multimedia and Creative Technologies.

IMSC stands out in the nation for its degree program development activities. An IMSC survey of the top 20 engineering schools found that while these schools might offer courses in the multimedia area, they do not offer the kind of comprehensive degree programs created by IMSC.

Worker retraining carried out

Faculty have also been closely involved with IMSC's retraining program for dislocated workers, which has placed more than 240 unemployed workers. Fifty of them were unemployed aerospace workers who earned Master's degrees and were placed in jobs that called for use of their new multimedia technology skills.

In addition, faculty have partici-

pated in IMSC's Multimedia University Academy (MUA), which offers training and career development to at-risk, inner-city youth from 17 to 22 years old. The MUA has graduated some 59 young people from four annual programs, and virtually all graduates are either working in the field, continuing their education, or both.

NSF approved renewal

We were truly gratified last year when NSF approved the critical five-year contractual renewal of IMSC as the Foundation's only ERC for multimedia and Internet research.

And we were pleased when USC's Vice Provost for Research Neal Sullivan told a Congressional committee that IMSC's successes in getting lab bench discoveries to the marketplace were "on a time scale that is quite remarkable." Vice Provost Sullivan was testifying in favor of the NSF annual budget request before the Subcommittee on Basic Research of the House Committee on Science.

I want to express my sincere appreciation for faculty leadership to five faculty who hold leadership positions in IMSC—Prof. Dennis McLeod, Prof. Jerry Mendel, Prof. Ulrich Neumann, Prof. Alexander A. (Sandy) Sawchuk and Prof. Alan Willner.

I also would like to thank Sue Lewis, Executive Administrative Director, and Nichole Phillips, Chief Financial Officer, for leadership in IMSC's administration and Dr. Isaac Maya, Director of Industry and Technology Transfer Programs, and Ann Spurgeon, Associate Director of Industry Programs, for leadership in the Center's industry programs.

Throughout these nearly five years, I have continued to rely on the IMSC faculty's energy and resolve to put IMSC on the map. I have seen President Sample's bonfire of research and innovation grow brighter and higher each year, and I am convinced that IMSC will continue to fulfill his promise.

BioSIGHT awarded grant . . .

(Continued from page 1)

She explained that the project uses three components—the exploratory challenge that introduces complex scientific concepts in the form of a puzzle, the interactive storyboard that uses advanced multimedia tools to convey content for individual exploration and collaborative investigations that involve simulated experiments and virtual tools, such as a virtual reagent kit and virtual microscope.

Dr. Wong pointed out that her team collaborates with two nationally-recognized organizations on the project—SRI International of Menlo Park, CA, for assessment and evaluation assistance, and TERC of Cambridge, MA, for pedagogical development work.

Student research program . . .

(Continued from page 6)

opportunity to discuss any concerns or issues related to their research. At the end, they are given an opportunity to fill out an evaluation form on the project as a whole.

Three meetings are held throughout the year for the graduate mentors. The first meeting focuses on initial project questions and concerns, the second addresses the research project itself, and the third centers on an evaluation of the undergraduate's progress and participation and suggestions for future project improvement. Student research projects will be displayed at the annual IMSC Student Conference in the spring.

Immersive news . . .

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news teams and a powerful digital delivery infrastructure.”

Prof. Pryor listed such key issues for immersive news as:

—Experimenting to find new ways to present information by combining text, hypertext, audio, video and graphics.

—Cross-cultural news presentation on the worldwide medium of the Internet

—The necessity for further development of broadband technology

—Newsroom chains of command and procedures for covering events

—Increased compensation to employees for working on multiple platforms

Prof. Pryor described the ultimate vision of immersive news: “Simply put, in some situations, the viewer can be immersed in a news story. The most dramatic examples would be an urban riot, an unfolding natural disaster or a major spectacle, such as the opening of the Olympics or a Presidential Inauguration. The real event would be digitally re-created as a virtual event that surrounds the viewer with a visual, aural and even tactile experience.”

He further said that “immersive technology puts control of news coverage in the hands of viewers. They can accept a default perspective picked by a director or they can opt for a different perspective or news experience, placing themselves in alternative parts of an event or even requesting a reporter to get added information.”

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