

Proposal for an Option in the

Master of Engineering Degree in

Media Convergence
Games and Media Integration (GMI)

College of Engineering and Applied Science

University of Colorado at Colorado Springs

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Game and Media Integration Program Committee

Chair: Professor Sudhanshu Semwal, Computer Science

Professor Valerie Brodar, Visual and Performing Arts

Professor Tim Chamillard, Computer Science

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Professor Edward Chow, Computer Science

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Professor Chip Benight, Psychology

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Professor Yunyu Wang, Colorado College, Dance and Performance

Master of Engineering Degree in Games and Media Integration

Introduction

This document presents the rationale for developing a new Games and Media Integration (GMI) option in the Master of Engineering degree program offered through the Department of Computer Science in the Engineering and Applied Science (EAS) College of the University of Colorado at Colorado Springs (UCCS) starting Fall 2007. With a rationale developed, the paper then presents a tentative program including specific course offerings, and course descriptions, and the preferred order of course sequencing. This new GMI option will be offered at the graduate level of studies and provides a substantial technical foundation in the area of Games, Digital Animation and Movie Making, Virtual Reality, Graphics, Wearable Computing, and human-computer interaction.

With the proposed degree program starting in Fall 2007, faculty from the Colleges of Education, EAS, and LAS representatives from the Teaching and Learning Center and Information Technology are part of the Program Committee for this program. The committee has identified the need for graduate level programs with a focus on interdisciplinary research and industry interaction in the general area of Games and Media Integration. The Masters of Engineering Degree program is an important initial step towards developing further graduate level program in the area of Games and Media Integration in future.

Vision Statement

The vision statement for the degree program is as follows:

The Masters of Engineering degree in Games and Media Integration will be an interdisciplinary degree that gives all students a firm foundation in pursuing research and development in the area of games, animation and movie making, and wearable computing. Development of new forms of interaction, innovative research in a team environment, and portfolio development are the core foundation of the proposed degree. All courses in the curriculum will emphasize creativity and team participation by all students. Potential projects and application include -- graphical asset generation, virtual reality, education, medical, movie making and animation, rehabilitation and geriatric healthcare, history and theory, mixed, augmented and wearable computing, and simulation and training.

Both animation and games industry, and the wearable computing community demand highest quality portfolio in place before students graduate. Up to six credit hours of Portfolio Development is an important feature of this degree program. In addition a complete Game program, a short animated movie, or a wearable computing product, portfolio development may include auditing classes in Language , Arts and Sciences

(LAS) and the College of Business. Because of the internationalization of Games and Media Integration degree program, students would develop portfolio with global perspective necessitating cultural awareness and language sensitivity. The degree program will provide an opportunity to attract companies to our region. Examples of small studio by students are --- Rustcycle (Adrian Johnson); NewtsPrism (Jonathan Kip Knight); and MorningStar productions (Jonathan Pearson). In addition to animation and game design industry, employment in medical, gerontology, exercise and outdoor industry is expected. Sampling of Industry where students might find employment in is at <http://www.coloradogamedev.org/companies.php>).

We expect some students to continue their graduate work at UCCS after completing their BS in CS, or the proposed BS degree in Game Design and Development. Students from Arts Institute of Colorado and employees of local companies who are interested in interactive media applications. BA/BFA students would have programming prerequisites. Some students with MS in Computer Science might consider this degree program as well. As the program grows, the Interdisciplinary Master of Science in two years and Doctor of Philosophy degrees are planned in five years.

Program Goals

Program graduates will know and be able to perform to professional standards in the following areas:

- Broad understanding of the entire spectrum of games and media integration;
- A thorough understanding of the process of creating, designing, product development and deployment of a game, animation and movie, or a wearable computing product;
- Proficiency with many of the tools and techniques for implementing game and media integration product for the industry.

A. Program Description

1. Basic Program Design

Program Flexibility and Uniqueness

One of the most exciting aspects of the degree program described here is the combination of a set of required courses to ensure all students develop a firm foundation in the basics of design and development of games and media integration products, and the opportunity for students to pursue their special interests through several elective courses and portfolio development.

Applicants for graduate study in Games and Media Integration must hold a B.S., B.A. or B.F.A. degree and have considerable computing experience and show promise of ability

to pursue advanced study and research. Entering students must have the equivalent of the following UCCS courses:

- (i) CS145 (Data Structure and Algorithms)
- (ii) CS306 (OO Programming with C++) or CS302 (C#)
- (iii) MATH 215 (Discrete Mathematics)
- (iv) MATH 313 (Introduction to Linear Algebra)

A student who lacks one or more of the above courses may be admitted, but would still be required to satisfy the above requirement after admission. Students with considerable knowledge of programming and/or mathematical experience in the industry are encouraged to apply.

Plan of Study

The student, in consultation with his/her major advisor, must complete a Plan of Study consisting of at least 30 semester hours. The Plan of Study must be submitted prior to the completion of 12 semester hours of graduate work. This document specifies the courses and options chosen by the student and must be approved by the student's GMI Graduate Advisory Committee and the Chairman of the GSC. With GMI Advisory Committee approval, this Plan of Study may be changed during the course of the student's graduate program.

In order to insure that the graduate of the program will have acquired a sufficient breadth of knowledge in games and media integration, the following three courses or their equivalents are required if they were not previously taken as an undergraduate:

CS580 Introduction to Computer Graphics
 CS578 3D Games and Digital Contents Creation
 CS572 Design and Analysis of Algorithms

The entrance requirements coupled with these three courses insure that the graduate of the GMI program will have acquired a sufficient breadth of knowledge in computer science. Students who have had advanced undergraduate courses in these exact areas will not be allowed to take these courses for graduate credit, but instead are required to include other graduate level computer science courses in their Plan of Study from the list of elective courses.

In addition students will be required to develop an industrial portfolio (up to six credit hours), and complete a project (three credit hours) or a thesis (up to six credit hours). A maximum total of nine credit hours of thesis or project, and portfolio is allowed ensuring that students have sufficient coursework in the games and media integration areas.

The proposed program is unique in a variety of ways. The interdisciplinary nature of the program provides all students with extensive knowledge in the widely-varied aspects of Games and Media integration. In turn, this provides students with the chance to integrate technical and artistic ideas in their portfolio. Portfolio requirement would allow students to carry out a concept to completion. As story would be conceived and then animated; a

quest imagined and then fulfilled; or wearable computing product imagined and implemented.

Several places such as Michigan State has a program in the area of game design at the undergraduate level; Central Florida has an interactive media program, and Universiteit Utrecht has a Masters program in Games and Media technology. However, none of these programs include the complete comprehensive view as the degree program proposed here. Finally, the program is unique because UCCS would be the only state-supported school to offer such a program and because UCCS would be the only school in Colorado Springs to offer such a program. This is significant, because much of the UCCS student population comes from the Colorado Springs area, and many of those students can not afford the tuition and other expenses at a private university. The combination of state support and geography make this an attractive program at UCCS for students in our typical demographic who are also interested in this area of study. We also believe that the program would be particularly interesting to those students who are already doing MS in Computer Science, and wish to seek another degree at the Masters level instead of pursuing a PhD degree.

Our evaluation of student demand and our student enrollment projections are provided in the following sections, but we believe the characteristics discussed above will foster significant student interest in the program.

A. Program Quality, Admission, Transfer and Graduation Standards

Admission Requirements

- b. Applicants for graduate study in Games and Media Integration must hold a B.S., B.A., or B.F.A. degree and have considerable computing experience and show promise of ability to pursue advanced study and research. Entering students must have the equivalent of the following UCCS courses:
 - (i) CS145 (Data Structure and Algorithms)
 - (ii) CS306 (OO Programming with C) or CS302 (C#)
 - (iii) MATH 215 (Discrete Mathematics)
 - (iv) MATH 313 (Introduction to Linear Algebra)

A student who lacks one or more of the above courses may be admitted, but would still be required to satisfy the above requirement after admission. Students with considerable knowledge of programming and/or mathematical experience in the industry are encouraged to apply.

- c. An overall undergraduate grade point average of 3.0 on a scale of 4.0. Applicants with a grade point average of less than 3.0 may be provisionally admitted on a case by case basis,
- d. Completed Admission Forms including two copies of official transcripts and references from three people to be sent to the address below.

Degree Requirements

- a. An overall 3.0 grade point average in all graduate work.
- b. Advisor appointed during the first semester of graduate work.
- c. All work applied to the degree must be accomplished within a six year time limit.
- d. Up to 9 hours of graduate work may be transferred from an accredited graduate program, provided:
 - i. Course work has not been used for any other degree,
 - ii. Grade earned for the course(s) is B or better,
 - iii. The course work has been taken within past six years,
 - iv. The course coverage is equal in level, content, and depth to the course for which it is being substituted.
- e. All courses included for this degree must be part of an approved plan of study. This plan must be developed by the student and approved by his/her advisor or program director within the first semester after being admitted to the program.

Further Information

For more information, call (719) 262-3243, visit our Web site www.cs.uccs.edu or write:

Department of Computer Science
University of Colorado at Colorado Springs
P.O. Box 7150
Colorado Springs, Colorado 80933-7150

Curriculum Description and Program Requirements

A student will earn a Masters of Engineering degree in Games and Media Integration consists (GMI) after completing 30 hours of graduate work, as follows:

Required Courses (9 credit hours)

- | | |
|--|----------------|
| (a) CS 580 Introduction to Computer Graphics (or equivalent) | 3 credit hours |
| (b) CS572 Design Analysis of Algorithms (or equivalent) | 3 credit hours |
| (c) CS 578 3D Games and Digital Content Creation (or equivalent) | 3 credit hours |

Student demonstrating that they have taken the above required courses in their undergraduate and graduate degree programs would choose additional nine hours of coursework from the list of courses below.

Required: Masters of Engineering Thesis (up to 6 credit hours) or Project (3 credit hours)

Student will be expected to work with an advisor in the GMI area of concentration following the guidelines of MS Thesis or Project work in the CS Department.

Required: GMI Portfolio Development (up to 6 credit hours):

Will involve completed works with an interdisciplinary focus. Student will work with at least one faculty member from CS and at least one faculty member from LAS. Complete works are expected to be submitted to SigGraph Animation and Film Festival, International Symposium on Wearable Computing, variety of virtual reality and HCI interaction conference, Game Developers Conference, or other related venues around the world. Portfolio advisory committee would consist of three faculty members from the consisting of at least one CS graduate faculty member and, if applicable one faculty member from LAS. The third member should preferably come from a local industry representing, e.g. the SigGraph, IGDA community with major portfolio development experience. Dr. Semwal would be initially the CS member. Portfolio may include interdisciplinary applications and completed works by student. Suggested applications, with strong GMI emphasis areas, include but are not limited to – applications integrated in TheatreWorks Productions with strong GMI emphasis, Digital Animation Movie Production; and/or Production of Game; Coordination with center of aging, visual and performing arts, and disability applications. The student would be required to show an ability to completely realize their *individual* contributions resulting in possibly a high quality exhibit, movie, or game.

Note: Student can not take more than a total of 9 credit hours for their Masters of Engineering Thesis or Project, and the GMI portfolio. For example, if a student takes 6 credit hours of portfolio development then only 3 credit hours would be allowed for MS thesis or project. Similarly, if a student takes 6 credit hours of MS thesis then the portfolio can only be a maximum of 3 credit hours. This requirement allows student to take up to 21 credit hours of courses from the following list.

List of Elective Courses:

Remainder of up to 21 credit hours would be from the following elective courses. Some courses have prerequisites as noted. New courses are identified in bold.

- (i) CS 577 Animation and Visualization
- (ii) CS 677 Virtual Reality and Human Computer Interaction
- (iii) CS 571 Evolutionary Computation
- (iv) CS575: Computational Geometry
- (v) CS581 Advanced Computer Graphics/Morphing
- (vi) CS678 Advanced Digital Effects and Olfactory applications**
- (vii) CS 579 Wearable Computing and Complex Systems
- (viii) CS 589 Computational Linguistics (prerequisites)
- (ix) CS 525 MultiMedia
- (x) CS526 Advanced Web Systems and Internet
- (xi) CS 584 Computer Vision (prerequisites)
- (xii) CS505 Computational Computer Vision (prerequisites)
- (xiii) ECE5530: Multivariate control I (prerequisites)

- (xiv) ECE5520: Multivariate Control II (prerequisites)
- (xv) CS587: Introduction to Artificial Neural Networks
- (xvi) CS551: Distributed Systems (requires CS550 – Operating Systems)
- (xvii) CS 522: Computer Communication
- (xviii) MAE 5130-001: Advanced Fluid Dynamics (prerequisites)

Course Sequencing and Program Flow

The Program Director in consultation with two other GMI Program Committee members would form a GMI graduate admission committee and determine the appropriate option for a student.

Option A:

Course	Credit Hours
CS 580: Introduction to Graphics	3
CS 572: Analysis	3
CS 578: Games	3
Portfolio	6
MS Project or Thesis	3
Four courses from List of courses above	12

Total Program - 30 credit hours

Option B:

Course	Credit Hours
CS 580: Introduction to Graphics	3
CS 572: Analysis	3
CS 578: Games	3
Portfolio	3
MS Thesis	3
Five courses from List of courses above	15

Total Program - 30 credit hours

Option C: If CS580, CS572 and CS578 or equivalent are already taken by the student

Course	Credit Hours
Seven courses from List of courses above	21
Portfolio	3
MS Thesis	6

Total Program - 30 credit hours

Option D: If CS580, CS572 and CS578 or equivalent are already taken by the student

Course	Credit Hours
Seven courses from List of courses above	21
Portfolio	6
MS Project	3

Total Program - 30 credit hours

New courses:

CS678: Advance Digital Effects and Olfactory Applications: Students will learn state of the art in natural phenomena simulation of water, fire, wind, snow, forests, and trees using the latest implementations. Latest applications particularly generation of scents and smell applications in virtual environments and games would be discussed. Text Books: Charles River Media Game Gems 1-VI, SigGraph Papers. A term project would be required. Dr. Semwal, faculty of CS would be teaching this course in future.

GMI Portfolio Development: CS 702-6: Will involve completed works with an interdisciplinary focus. Complete works are expected to be submitted to SigGraph Animation and Film Festival, International Symposium on Wearable Computing, variety of virtual reality and HCI interaction conference, IGDA Game Conference, or other related venues around the world. Portfolio advisory committee would consist of three faculty members from the GMI Program committee consisting of at least one CS graduate faculty member and, if applicable, one LAS faculty member. The third member should preferably come from a local industry representing, e.g. the SigGraph, IGDA community with major portfolio development experience. Dr. Semwal would be initially the CS member. Portfolio may include interdisciplinary applications and completed works by student. Suggested areas include, but not limited to -- TheatreWorks Productions, Animation Movie Production; and/or Production of Game; Coordination with center of aging, visual and performing arts, and disability applications. The student would be required to show an ability to completely realize their *individual* contributions resulting in possibly a high quality exhibit, movie, or game.

On-Line Courses

Students will have an opportunity to undertake several credit hours on-line. Both thesis/project (maximum of six credit hours) and portfolio (maximum of six credit hours) can be taken on-line under the supervision of graduate faculty and approval of the Director of the Program. In addition, computational geometry (CS575, 3 credit hours, summer course) will be offered on-line starting summer 2008 pending approval. Thus, a student can take up to fifteen credit hours of this degree program.

If strong interests in online courses exist then more online courses will be offered after approval/consultation with EAS Dean and CS Chair, and pending qualified faculty interest and support in teaching of more online courses.

eCompanion will be added to 100% of the courses Dr. Semwal would be teaching in future which we expect most of the students will be taking in their degree program starting Fall 2007. This assuming that transition may be over the summer and as the courses appear in schedule of offering for next year.

eCompanion is used by UCCS at this time by some instructors, and it is free, and is good for content delivery. Normally, a student will be taking seven courses and six courses are in Dr. Semwal's area. In addition, thesis and portfolio could be done on line or by eMail, assuming that we can work an understanding for large memory space with the UCCS-computing services, 90% of the GMI degree program could be online delivery of contents. If CS572 will use eCompanion for his/her class then the GMI program will be 100% online content delivery. This may be useful for students who are working in Colorado Springs or nearby.

eCourse option is somewhat expensive, and GMI program will have see what EAS does - - if eCourse will be available then it would be possible to conduct a class for students from outside US assuming that testing and examinations could be proctored at the source of student, and instructor's workload is fair,. This option may be more useful when students from outside US will show interest because we will need to have them interact online live. We are also told that it would be relatively easy transition from eCompanion to eCollege whenever changes occur down the road.

Supplementary Information

A. Student Learning Goals

In large part, our student learning goals are related to student learning of both the foundational and specialized topics covered by the proposed curriculum, though they also include the goal that the students will learn to work effectively in teams. Specific student learning goals follow.

1. Students should learn the breadth and depth of knowledge in the area of games and media integration.

At the minimum students will complete minimal of 21 credit hours of course work while pursuing games and media integration (GMI) degree.

2. Students should learn specialized topics in chosen concentration courses

Students will complete a GMI Portfolio and MS project or thesis specializing in a particular GMI sub-area of their interests.

3. Students should learn to work effectively in teams

Although using teams in this domain lets students develop more complex applications and artifacts because the work can be distributed across the team members, student's *unique* contribution to the team would be clearly identified and students would be accountable for their own contribution. In industry application development is almost always conducted in teams – sometimes with hundreds of members – so developing these skills in our students will also help them in the longer term. Portfolio development would encourage a student to target region specific strategies for their product.

B. Concerns to be Addressed

1. Bona Fide Need: Student Demand, Workforce Demand, Enrollment Projections

Community Survey

In early November 2005, the Vice Chancellor for Academic Affairs (VCAA) assembled an Academic Strategic Steering Committee which hosted series of *campus conversations*. The campus conversations were open discussion sessions that provided campus community several opportunities to share their views with the committee. With the input from the greater Pikes Peak region through University Club and Chancellor's Roundtable, the committee developed a survey to which approximately one thousand students responded. Out of about one thousand students, about sixty eight percent were female, and thirty-one percent male; about forty-one percent were junior and seniors and about

twenty percent had a Baccalaureate, Masters, PhD or MD Degree. Twelve percent of students identified themselves from Engineering/CS. Among others, Master of Science and PhD in Human Computer Interaction with an emphasis on graphics, VR, and Wearable Computing was listed as one of many possible new degree programs. Approximately sixty four percent of students (603 out of 941 who responded) selected the MS program to be valuable or very valuable to offer. Approximately sixty percent of students (551 out of 936) selected the PhD program as valuable or very valuable to offer. About eighteen percent (177 out of 937) of the participants surveyed rated the MS program as their top three choices, and about ten percent participants rated the PhD program as their top three choices. As a result, the Masters of Engineering in Games and Media Integration (GMI) was identified as one of the graduate programs by the committee. A very conservative estimate of two percent of six hundred and three interested students could still result in about ten to twelve program students.

Further Student Demand

The Computer Science Department initiated its Game Design and Development Minor in Fall 2005. This program currently has 9 Juniors pursuing the minor and 23 Freshmen in CS 110 who have also indicated that they plan to pursue the minor. In fact, numerous freshmen told the Engineering Advisor during Freshman Orientation that they came to UCCS because of the minor! During the Spring 2006 semester, Dr. Chamillard has been visiting Colorado High Schools to present the current GDD curricular options at UCCS and to describe the proposed Bachelor's degree. Student response to those presentations has been very positive, with over 100 students expressing interest in pursuing the Bachelors degree in Game Design and Development alone. Certainly some of these students would choose to pursue their graduate work and the proposed degree program would be of interest to them. At least five of our students in the minor program have indicated that they intend to pursue the GMI program when offered.

In addition, wearable computing and animation industry has been a worldwide career field. NASSCOM fact sheet estimates the global world market for animation at around 50 billion for the animation industry alone. More than twenty students have worked directly in this area with Dr. Semwal alone in past several years. In addition, several students in senior level classes have shown interests to pursue Games and Media Integration as their choice in the graduate work. Many of our alumni's who have chosen not to enroll in PhD program may become interested in pursuing a second degree program at the Masters level.

For part-time, working students, we expect that they would be interested in taking one to two courses per semester allowing them to graduate in as early as four to five semesters. There is a six-year limit for completing the degree program by the graduate school. It is expected, of course, that a part-time student will take longer to complete the degree, but there's sufficient flexibility built into the curriculum that they should have access to courses as they need them.

In our program, we'll work to ensure that all under-represented groups feel welcome and experience retention rates at least as high as other groups. We feel compelled to note, however, that a recent survey of 3,128 game developers (Game Developer Demographics: An Exploration of Workforce Diversity, October 2005, IGDA) implied that 83.3% of game developers are white and that 88.5% of game developers are male. Although all groups will be welcomed and encouraged to complete our program, expecting significantly different demographics in the program would probably represent an unreasonable expectation. Similar gender ratio prevails in the animation industry as well where up to 90% of animator credits favor men. Scan of wearable computing literature provides no conclusive data with expectation that creative merger of fashion industry and technology may provide better ratio in the future.

Workforce Demand

In 2004, sales in the computer game industry topped \$7B. Also in 2004, Halo 2 had over \$125M in sales on the first day it was available. A search on Gamasutra's job site (http://www.gamasutra.com/php-bin/jobs_display.php) yielded 365 game-related job opportunities posted in November 2005 alone. Employment at Electronic Arts, the No. 1 game maker, has almost doubled since 2000, with the number of employees actually creating games almost tripling in the same time period. Electronic Arts has also started sponsoring academic programs in game design and development programs because "... the students are starting to come out of school immediately able to contribute to real projects, which is what we need ... there is still not as much talent as there is opportunity."(NY Times) We also note that the Colorado Game Developers Association lists 31 companies in Colorado that engage in game development activities (<http://www.coloradogamedev.org/companies.php>).

Graphics and Animation industry has seen growth even in hard times according to the ACM SigGraph's first fifty years of Computer Graphics video presentation. World wide projections of animation industry are at \$50 billion with animation services for gaming accounting for around \$5 billion (www.nasscom.org/download/animation_fact.pdf) world wide.

Wearable computing is becoming increasingly popular in games and media industry in providing support for mobile user. International Symposium on Wearable Computing (ISWC) lists several research laboratory and companies creating novel applications all throughout the world with leaders such as Advanced Telecommunication Research Lab, Japan; and Charmed Technologies (<http://www.charmed.com/>) leading the way. Novel mobile applications would provide new forms of interaction as well.

As indicated earlier, three of our students have formed small companies while working in the industry. Many others may find jobs in the games and media integration industry on the east coast or west coast. One of the feedback from the industry has been the lack of the portfolio of our students. The proposed program addresses this issue by requiring all students would graduate with GMI portfolio.

Graduate studies in Computer game and media integration is clearly a viable career choice, and provides opportunities to EAS for being the southern Colorado leader in supporting research in this area. It's also important to note that companies that build applications designed for entertainment aren't the only employment possibility for graduating GMI students who decide to work in the industry. Opportunities exist in local industry -- simulation and training, education, healthcare – are all also a fast-growing domain.

On-Line Survey of Existing EAS students

In November an online survey was conducted and 120 EAS undergraduate, MS and PhD students were asked to take the online survey at <http://www.cs.uccs.edu/~semwal/GMISurvey2006Final.htm>. Approximately 30 students chose to answer survey questions. In particular results of the survey justified the projected enrollment of ten with 9 out of 29 students showing strong interests in the degree program (part I, question 3). In addition, 18 out of 29 students already enrolled in the CS MS program indicated their strong interests in the GMI degree program as second degree (Part I, question IV) once they complete the MS program. In addition, among the students who chose to complete the survey there were good interest in several of the sub-areas of the program showing a good balance of student to faculty ratio. Contact Dr. Semwal for survey results, if interested.

The survey of existing EAS students showed the feasibility and justification of critical enrollment projections. In addition, as we mentioned earlier (pp.11), community survey indicated large interdisciplinary interest in the proposed program showing a possible potential for growth from students outside the EAS. The Interdisciplinary nature of our program is expected to provide additional student interests and enrollment.

With feedback in the EAS student survey regarding the name of the degree program, it is felt that Human-Media convergence and integration would better reflect the degree program.

Synergy between MEngg GMI and BS GDD Curriculum Growth Opportunities

The proposed Games and Media Integration program has strong ties with the BS GDD program which is undergoing an evaluation process at this time as well. Several members of the GMI program committee are also members of the GDD Program Committee as well. Although the two programs are de-coupled in terms of the approval process, we expect a variety of valuable synergies between the programs.

C. Role and Mission Criteria

The UCCS Mission Statement is as follows:

The Colorado Springs campus of the University of Colorado shall be a comprehensive baccalaureate liberal arts and sciences institution with selective admission standards. The Colorado Springs campus shall provide selected professional programs and such graduate programs as will serve the needs of the Colorado Springs metropolitan area, emphasizing those programs not offered by other institutions of higher education (Colorado House Bill 1187, Section 5).

The proposed program is congruent with the role and mission of the campus, because the program is an interdisciplinary degree in liberal arts and sciences. The proposed program is also unique across the state-supported schools in Colorado, providing residents with an economical opportunity to pursue this field of study. Finally, the program is consistent with the University's commitment to quality undergraduate education, which includes expanding graduate program offerings as appropriate.

The GMI Master of Engineering Degree is precursor to the GMI Masters of Science degree which is currently being integrated into the latest version of the campus strategic academic plan.

Particular institutional strengths in this program area include the current GMI MEngg curricular options is already in place at UCCS; the capabilities of both the EAS and LAS faculty, particularly in the Departments of Computer Science and Visual and Performing Arts; and the enthusiasm the participants from both EAS and LAS have both for getting the program approved and for collaborating on the program once it's in place.

1. Duplication

There is no duplication for this program among state-supported colleges and universities within Colorado. Among private colleges and universities in Colorado, Westwood College of Technology and the University of Denver offer related bachelor degrees. Westwood College offers a Bachelor of Science in Game Software Development. The University of Denver (DU) has a program to pursue a BA or BS degree based on their interest, then essentially minor in the "allied field." No programs exist in Colorado where a comprehensive degree program covering games, animation and digital movie making and wearable computing is offered at the graduate level.

2. Statutory Requirements

The proposed program conforms to all applicable statutory requirements.

D. Assessment Plan

As noted in the Student Learning Goals section (A.2), our student learning goals for this program are:

1. Students should learn the breadth and depth topics in GMI.
2. Students should learn specialized topics in chosen concentration courses.
3. Students should learn to work effectively in teams

We will use a variety of techniques to assess our achievement of these goals, including those described below.

Course Assessments

Student learning goals 1 and 2 are clearly focused on student learning of the foundational and specialized topics in the GMI degree curriculum. We believe that assessing achievement of these goals, at least in the short term, is best done through the course assessments in the courses that present those topics. Other assessment tools are described below.

To provide a broader program perspective, however, we'll consolidate that assessment information for all the GMI courses into a single location so that we can perform cross-course analysis to identify trends and problem areas at the program level.

Team Assessments

Student learning goal 3 addresses student ability to work in teams. As part of the team work in the courses in the curriculum, we plan to have students provide peer reviews of their team members. This helps particular course instructors assign appropriate individual grades based on the contributions of each team member, but will also let us assess the development of each individual student's teaming ability over their progression through the program. We'll consolidate those peer reviews into a single location so we can assess each individual's ability to work in teams across the courses in the program. Students are expected to work in teams in several of their courses.

GMI Thesis/Project Rubric

The thesis/project will be an application developed in the area of games and media integration, and would be student's own individual work. This serves two purposes. The first is to provide the student with an ability to implement a new feature to an existing program or a novel idea which they have implemented and feasibility of the idea can be shown. The second which applies to our assessment plan, is to provide the student's GMI advisory committee with insight into the foundational and specialized knowledge of each individual student graduating with the degree.

GMI Portfolio Development Rubric

GMI portfolio fulfils the requirement that a student is capable of creative concepts or storyline implementation. The work will be sufficiently different that the work the student undertakes for their GMI Thesis or project. Completed works are expected to be submitted to SigGraph Animated Film Festival, International Symposium on Wearable Computing, variety of virtual reality and HCI interaction conference, IGDA Game Conference, or other related venues around the world. Portfolio advisory committee would consist of three faculty members -- at least one CS graduate faculty member and, if applicable, one faculty member from LAS. The third member should preferably come from a local GMI industry e.g. the SigGraph, IGDA community with major portfolio development experience. Dr. Semwal would be initially the CS member. The outcome is a completed movie or product exhibit to targeted audiences worldwide. The completed works of the students would be exhibited as short animations or products in relevant international conferences, museums or exhibits. Portfolio is essential in GMI industry and would position the student for employment. Acceptance as an exhibit in conferences or other venues would assure the quality of the portfolio.

Using Assessment for Continuous Program Improvement

One of the GMI Program Committee members has extensive experience in this area; he annually analyzes survey data for computer science majors to identify weaknesses in that program and to suggest possible program modifications to address those weaknesses.

On an annual basic, the GMI Steering Committee will analyze the assessment results with the goal of improving the assessment mechanisms itself. Where that analysis indicates weaknesses or adverse trends in the program as a whole, the committee will identify those issues and provide suggestions for their resolution. Specific resolution approaches will then be propagated throughout the program or pushed down to specific courses as appropriate.

3. Professional Requirements or Evaluations

There is no regional or professional accrediting association or licensing requirements related to this program.

E. Institutional Factors

Diversity Goals

As discussed on pages 11-12, we expect the GMI degree program to help attract and retain under-represented groups. Given the current demographics in this field and the local area, however, we don't expect this program to make significant contributions to department or campus diversity goals.

Effect on Other Programs and Campuses

The largest effect on other instructional, research, or service programs at UCCS is an expected increase in enrollments in the existing courses, which is of course a desired effect. We do not anticipate any effects from this program on other campuses.

Effect on Existing Resources

We do not anticipate any effects from this program on library or laboratory resources. Already existing lab such as Games, Media Convergence and Integration Lab will be available for use by the GMI students. All existing classes listed in the GMI program would use existing computing resources and laboratories.

Formal Relationships with Other Parties

We do not anticipate any formal relationships with other parties for this program.

F. Physical Capacity and Needs

Program Delivery and Program Space Requirements

We do not anticipate the need for any additional program delivery space to provide this program. The Games, Media Convergence and Integration Laboratory would be used by students in this program (<http://www.cs.uccs.edu/~semwal/MICL/index1.htm>). Critical need for a dedicated Game Design and Development (GDD) Lab has been identified elsewhere (<http://www.cs.uccs.edu/~chamillard/GDDProgramProposals/index.htm>).

G. Cost Description and Source of Funds

Cost Estimates and Sources of Funds

Because the GMI degree is part of the Masters of Engineering degree program, cost estimates and source of funds information is not applicable at this time. In future, as the growth in the program would lead into an MS degree, we would be providing detailed Operating Costs estimates (see the standard financial performance as well as the IT expenditure calculation worksheet with this proposal).

The program described in this proposal includes one new course and portfolio development, both of them would be the responsibility of Dr. Semwal initially as noted earlier.

Despite our conservative enrollment estimates of ten-twelve students in the program, we also believe that in the longer term this program will provide a significant revenue stream to UCCS through enrollment in the program. Should that turn out to be true in practice, we envision using part of that program revenue to hire additional tenure-track faculty to support the program, to purchase more advanced laboratory equipment and other hardware, and/or to acquire other resources to help the program become even more effective over time.

We also include \$3,000 per year for IT personnel to perform standard maintenance activities in the Games, Media Convergence and Integration Lab for next year.

Administrative Costs

The Program Director will incur the majority of the additional work generated by the operation, management, and oversight of the new program. This additional work will most appropriately count as service credit in workload; reduction in other service activities is a reasonable response to this additional service load.

Capital Start-Up Needs

Not applicable at this time.

H. Other Relevant Information

The program will initially be administered by a Games and Media Integration (GMI) Program committee, chaired by Dr. Semwal as the Program Director. All of the courses in the program will be taught as courses from existing departments. Faculty supporting the program by teaching program-related courses are therefore conceptually matrixed to the program when they teach those courses. We believe this structure will be very effective during the initial stages of the program.

Our long-term goal, however, is to have the program be a part of a more formal structure designed to house interdisciplinary programs; our working name for this structure is the Institute of Interdisciplinary Studies. We expect that much of the administration of the program would continue to be accomplished by an interdisciplinary team, but we believe that a formal organization housing this and other interdisciplinary programs that cross colleges and other organizational boundaries will be a necessity as these kinds of programs to grow. We believe that the appropriate trigger point for transitioning to this more formal structure would be the hiring of our first full-time faculty member dedicated to this program (rather than to a specific department or college).

TABLE 1: ENROLLMENT PROJECTIONS

1.1.1

Name of Program:	<u>Game and Media Integration (MEngg)</u>
Name of Institution:	<u>University of Colorado at Colorado Springs</u>

DEFINITIONS:

Academic year is the period beginning July 1 and concluding June 30.

Headcount projections represent an unduplicated count of those students officially admitted to the program and enrolled at the institution during the academic year.

FTE is defined as the full-time equivalent number of those students majoring in the program, regardless of the classes enrolled, during the academic year.

Program graduate is defined as a student who finishes all academic program requirements and graduates with a formal award within a particular academic year.

Program Headcount Projection Methodology

Initial Enrollment Projections

One standard way to develop enrollment projections for a new program is to consider actual enrollment in a similar program at a comparable college. Unfortunately, this approach isn't feasible in this case for a number of reasons as other institutions only offer parts of the proposed degree program not the full comprehensive array of courses and interdisciplinary focus provided by the proposed GMI program. Although curricular options in this area are currently experiencing a significant increase across the country and overseas, Masters's degrees in this field combining all aspects of media integration and games are still relatively rare. That's actually one of the driving factors for us to pursue one now instead of waiting until such programs are common! In addition, most schools offering degrees can't be considered "comparable colleges"; in general, they're either more vocationally-oriented, they're not in the same classification as UCCS, and/or they don't draw a significant percentage of their student population from Colorado. Some of them are outside USA.

We do, however, have a source of student interest data that we've used to develop our enrollment projections as discussed on pages 10-11 earlier. In early November 2005, the Vice Chancellor for Academic Affairs (VCAA) assembled an Academic Strategic Steering Committee which hosted series of *campus conversations*. The campus

conversations were open discussion sessions that provided campus community several opportunities to share their views with the committee. With the input from the greater Pikes Peak region through University Club and Chancellor's Roundtable, the committee developed a survey to which approximately one thousand students responded. Out of about one thousand students, about sixty eight percent were female, and thirty-one percent male; about forty-one percent were junior and seniors and about twenty percent had a Baccalaureate, Masters, PhD or MD Degree. Twelve percent of students identified themselves from Engineering/CS. Among others, Master of Science and PhD in Human Computer Interaction with an emphasis on graphics, VR, and Wearable Computing was listed as one of many possible new degree programs. Approximately sixty four percent of students (603 out of 941 who responded) selected the MS program to be valuable or very valuable to offer. Approximately sixty percent of students (551 out of 936) selected the PhD program as valuable or very valuable to offer. About eighteen percent (177 out of 937) of the participants surveyed rated the MS program as their top three choices, and about ten percent participants rated the PhD program as their top three choices. As a result, the Masters of Engineering in Games and Media Integration (GMI) was identified as one of the graduate programs by the committee. A very conservative estimate of two percent of six hundred and three interested students could still result in about ten to twelve program students.

During the Spring 2006 semester, Dr. Chamillard has been visiting Colorado High Schools to present the current Game Design and Development (GDD) curricular options at UCCS and to describe the proposed Bachelor's degree. Details of the analysis and projections can be found elsewhere (<http://www.cs.uccs.edu/~chamillard/GDDProgramProposals/index.htm>). Here we will like to point out that out of 171 questionnaire 105 students in High School were either interested (level 4) or very interested (level 5, highest).

We also note that enrollments in the courses in the GDD Minor are particularly strong. Specifically, CS 110 had 32 students in Fall 2005, CS 335 had 20 students in Fall 2005, and CS 480 has 24 students this semester. There is clearly strong student interest in this area of study, though we didn't try to include this information in our enrollment projections. CS578 – 3D Games and Digital Content creation course had 22 students (Fall 2005). Several students pursuing MS and PhD with Dr. Semwal have shown interests in innovative approaches such as portfolio development as essential for them to get leading jobs in the industry. Therefore, our conservative estimate for the Masters of Engineering GMI degree program is at 10.

Annual Enrollment and Growth Projections

Based upon our conservative estimate of ten students, a conservative estimate for the program graduates is around 4-5 students graduates per year starting third year. For our annual enrollment growth, we projected a 3% growth in enrollment each year. This percentage is actually quite difficult to predict, since the campus as a whole is experiencing growing enrollments each year while particular majors (particularly Computer Science) have been experiencing drops in enrollment. We therefore believe

that a 3% annual enrollment growth rate is a reasonably conservative estimate for this program. We also believe that the program would draw from the professionals working at local companies. Many of our students are working and companies pay for the tuition costs and many local companies typically pay tuition for the students for graduate work in Computer Science. The Masters of Engineering program would also appeal to students who have already completed an MS in Computer Science and would like to pursue another Masters degree instead of the PhD program. Many students plan to open their own small companies and have shown interests in pursuing games and animations from their home as a side business as well.

TABLE 3: PROJECTED NEW EXPENSES FOR NEW PROGRAM

I. Expenses

The forms for IT expenditures and Standard Proforma for the new degree program are included with this report.

II. Narrative Explaining How Costs are to be covered

Survey data was analyzed by Dr. Bob Durham, Chair, Psychology Department at UCCS, and the resident expert in analyzing the survey data and projections based on that. His letter (dated April 11, 2007) provides a basis for the numbers in the Standard Proforma form. The out of state numbers include the projections for online students as well as resident graduate students. The proforma form includes support for students from third year onwards, which may be used to support students in the GMI program. One of the duties of these students will be to work with the program committee and maintain the laboratory resources. Thus, the IT expenditure cost is projected to be zero. Dr. Semwal has experience with working with students and supporting GMI resources with only occasional cost. The GMI lab resources were updated in 2006 with the support of Intel grant. It is expected that in the fourth year of the program hardware and software update will become a priority and thus, \$40,000 lab upgrade is projected in the budget. Graduate students budget for the first two years should be sufficient for maintaining the Media Convergence and Integration Laboratory. Intel provided donation for supporting the graphic, VR research for the Media Integration and Convergence Lab (<http://www.cs.uccs.edu/~semwal/MICL/index1.htm>). The lab is also further expected to be supported by research and grant money generated due to research contracts from local industry and government agencies.

Applications will be received by the CS department. The application forms and information about the GMI program will be online on EAS website. Dr. Semwal will be the Point of Contact and the Director of this program, and his workload will be adjusted to 40-30-30 when the degree program is approved, allowing him to be the POC for the program and answer questions from potential students. Summer events are already planned by Dr. Semwal consisting of workshop introducing the program to potential students. Online courses may require additional compensation to the instructor teaching the course similar to the Winterim courses. Workload adjustment, e.g. substituting the

online course with the service and research expectations within the EAS college guidelines is also a possibility. A budget of \$90,000 is allocated in Year four (2010-11) onwards to support a half time to full time faculty, assuming the enrollment exceeds more than 15 students.

III. Dean's Statement.

Attach a statement from the Dean verifying Adequacy of Resources to Support New Program and confirming that the projected resources and reallocations are reasonable.

Appendix A: Program Faculty Vitae

c. Describe the qualifications of the proposed programs' faculty. Include in an appendix short vitae (one-page) for the faculty who will teach regularly in this program.

Short Vitae for Valerie Brodar

Short Vitae for Tim Chamillard

EDUCATION

University of Massachusetts, Amherst, Massachusetts
Ph.D. in Computer Science, 1996.

2 **University of Southern California, Los Angeles, California**

Master of Science in Computer Engineering, 1990.

3

4 **Georgia Institute of Technology, Atlanta, Georgia**

Bachelor of Electrical Engineering, 1987.
Computer Engineering Certificate
Graduated with Highest Honor

ACADEMIC EXPERIENCE

Assistant Professor of Computer Science *2003-present*
University of Colorado at Colorado Springs (UCCS), Colorado

Associate Professor of Computer Science *1998-2000*
United States Air Force Academy (USAFA), Colorado

Assistant Professor of Computer Science *1996-1998*
United States Air Force Academy, Colorado

Instructor of Computer Science *1991-1993*
United States Air Force Academy, Colorado

COURSES TAUGHT

Six semesters teaching experience at UCCS. Taught a total of 319 students enrolled in 5 different graduate software engineering courses, a freshman game creation course, and a junior game design and development course. Courses taught:

CS 110	Problem Solving through Game Creation
CS 335	Introduction to Game Design and Development
CS 531	Software Requirements Analysis and Specification
CS 532	Software Design
CS 534	Software Maintenance
CS 535	Software Project Management
CS 536	Software Product Assurance

Six years teaching experience at U.S. Air Force Academy. Taught a total of 525 students enrolled in 30 sections of 7 different undergraduate computer science and astronautics courses.

GAME-RELATED ACTIVITIES

Developed and taught CS 110, Problem Solving through Game Creation
Developed and taught CS 335, Introduction to Game Design and Development
Co-developer and co-administrator of Game Design and Development Minor
Chair, Game Design and Development Program Committee

TEACHING AWARDS

College of Engineering and Applied Science Outstanding Teacher of the Year (UCCS)
Outstanding Military Educator in Computer Science (U.S. Air Force Academy)

2005
1992-1993

Short Vitae for Sudhanshu Semwal

EDUCATION

University of Central Florida

Ph.D. in Computer Science, 1987.

5

6 **University of Alberta, Canada**

Master of Science in Computing Science, 1984.

7

8 **University of Roorkee, IIT-Roorkee, India**

Bachelor of Electronics and Communication Engineering, 1980.

ACADEMIC EXPERIENCE

Professor of Computer Science

2000-present

University of Colorado at Colorado Springs (UCCS), Colorado

Interim Chair, Computer Science

January 2002-June 2002

University of Colorado at Colorado Springs (UCCS), Colorado

Associate Professor of Computer Science

1994-2000

University of Colorado at Colorado Springs (UCCS), Colorado

Assistant Professor of Computer Science

1987-1994

University of Colorado at Colorado Springs (UCCS), Colorado

Visiting Researcher

Summer 96-98, 2001, 2002

ATR Media Integration and Communication Lab/Wearable Computing Lab, Kyoto, Japan

Visiting Researcher

1991-1992

CRL, Matsushita, Osaka, Japan

Sabbatical

Summer 1995

VRIS Lab, Sandia National Lab, Albuquerque

COURSES TAUGHT

Teaching at UCCS since 1987, have taught courses at all levels from introductory programming courses to PhD level graduate. Estimated 1200 students at the graduate and undergraduate level. List of selected courses taught are:

CS 480/580	Introduction to Graphics
CS 472/572	Analysis of Algorithms
CS 581	Advanced Computer Graphics
CS 577	Animation and Visualization
CS 677	Human Computer Interaction and Virtual Reality
CS 578	3D Games and Digital Contents Creation
CS 579	Wearable Computing and Complex Systems
CS575	Computational Geometry
CS576	Geometric Modeling

GAME-RELATED ACTIVITIES

Developed and taught CS 578, 3D Games and Digital Content Creation – 1st Game course (Spring 2004).

Guiding MS and PhD thesis in 3D Games/HCI area for last several years

Director of Media Integration and Convergence Lab; VR Graphics Lab; CoFounder of Wearable Computing Lab

Co-developer and co-administrator of Game Design and Development Minor

Member, Game Design and Development Program Committee

TEACHING AWARDS

CS Nominee for the College of Engineering and Applied Science Outstanding Teacher of the Year (UCCS) 2004

MITRE

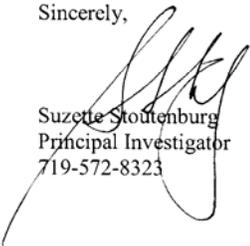
11 April 2007

Dr. Jeremy Haefner
Dean, College of Engineering and Applied Science
University of Colorado
1420 Austin Bluffs Parkway
Colorado Springs CO 80933

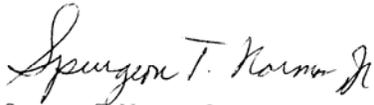
Dear Dr. Haefner,

It is a pleasure to write this letter of support for the proposal to add a Master's Degree program in Games and Media Integration at the College of Engineering at UCCS. Dr. Semwal has developed an exciting proposal that will offer graduate level studies in the areas of Games, Digital Animation and Movie Making, Virtual Reality, Graphics, Wearable Computing, and human-computer interaction. We at the MITRE Corporation are very supportive of this idea since gaming techniques apply directly to many of our sponsor's most critical needs, including flight and battlefield simulations for operational plan development, test, and training. Graphical asset generation, wearable computing and human-computer interaction are also of paramount interest to us. We foresee the opportunity to collaborate with UCCS on joint research projects in these critical areas in the future. We also have a number of local engineers who have already expressed interest in the Master's Degree in Games and Media Integration. Therefore, as a local engineering company that will benefit from advanced education in this area, we encourage you to approve this outstanding and innovative initiative by the UCCS Engineering faculty.

Sincerely,



Suzette Stoutenburg
Principal Investigator
719-572-8323



Spurgeon T. Norman, Jr.
Site Director, MITRE-Colorado Springs
719-572-8440

April 11, 2007
62 So. Roosevelt St.
Colorado Springs, CO 80910

To Whom It May Concern:

This is a letter of support for the proposed Master of Engineering Degree in Media Convergence Games and Media Integration (GMI).

Dr. Semwal and I collaborated on a project for the visually impaired about fifteen years ago when I was the Educational Technologist for the Blind at the Colorado School for the Deaf and the Blind. I am presently employed by the Colorado Department of Education as Technology Consultant for the Blind throughout the state of Colorado. Dr. Semwal and I are planning on collaborating once again to develop a new project for assisting the visually impaired.

The GMI program has many well stated purposes, including options for developing technology to assist people with Alzheimers and people with visual impairments. This is cutting edge technology, and has great potential for providing needed services for people with the aforementioned disabilities. With this in mind, I strongly support the creation of the GMI Master of Engineering Degree and I hope that it will be made available to students at UCCS by the Fall of 2007.

Sincerely,

Bonnie L. Snyder

Bonnie L. Snyder