**New York City College of Technology, CUNY**

**Department of Computer Engineering Technology**

**Proposal for New Course**

**CET 4920 Introduction to Computer Vision**

**September 19, 2018**

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New York City College of Technology, CUNY

CURRICULUM MODIFICATION PROPOSAL FORM

This form is used for all curriculum modification proposals. See the [Proposal Classification Chart](http://openlab.citytech.cuny.edu/collegecouncil/files/2014/08/2013-10-09-Proposal_Classification_Chart.pdf) for information about what types of modifications are major or minor. Completed proposals should be emailed to the Curriculum Committee chair.

|  |  |
| --- | --- |
| **Title of Proposal** | Proposal for new course CET 4920 Introduction to Computer Vision |
| **Date** | September 19, 2018 |
| **Major or Minor** | Major |
| **Proposer’s Name** | Xiaohai Li, Lili Ma |
| **Department** | Computer Engineering Technology |
| **Date of Departmental Meeting in which proposal was approved** | November 08, 2018 |
| **Department Chair Name** | Sunghoon Jang |
| **Department Chair Signature and Date** |  |
| **Academic Dean Name** |  |
| **Academic Dean Signature and Date** |
| **Brief Description of Proposal**  (Describe the modifications contained within this proposal in a succinct summary. More detailed content will be provided in the proposal body. | Department of Computer Engineering Technology (CET) proposes a new course, *CET 4920 Introduction to Computer Vision*, as a new technical elective course in its CET BTech program curriculum. |
| **Brief Rationale for Proposal**  (Provide a concise summary of why this proposed change is important to the department. More detailed content will be provided in the proposal body). | The need to offer a course on Computer Vision is presented by the current technology trend. These days cameras are literally ubiquitous – in our smartphones, homes, cars, retail stores, cashless tolling on bridges or tunnels, and so on. Opportunities for computer vision are endless, stretching from security system, robotics, smart retailing, transportation, healthcare, assistive living, to many other application areas.  This course is designed as a technical elective in the Computer Engineering Technology BTech program. It introduces students to the rapidly booming field of Computer Vision and prepares them with fundamental knowledge and techniques which will help them successfully extend their careers in this and related fields. |
| **Proposal History**  (Please provide history of this proposal: is this a resubmission? An updated version? This may most easily be expressed as a list). | This is a new proposal. |

Please include all appropriate documentation as indicated in the Curriculum Modification Checklist.

For each new course, please also complete the New Course Proposal and submit in this document.

Please submit this document as a single .doc or .rtf format. If some documents are unable to be converted to .doc, then please provide all documents archived into a single .zip file.

**ALL PROPOSAL CHECK LIST**

|  |  |
| --- | --- |
| Completed CURRICULUM MODIFICATION FORM including: |  |
| * Brief description of proposal | Y |
| * Rationale for proposal | Y |
| * Date of department meeting approving the modification | Y |
| * Chair’s Signature | Y |
| * Dean’s Signature | Y |
| Evidence of consultation with affected departments  List of the programs that use this course as required or elective, and courses that use this as a prerequisite. | NA |
| Documentation of Advisory Commission views (if applicable). | NA |
| Completed [Chancellor’s Report Form](http://openlab.citytech.cuny.edu/collegecouncil/files/2014/08/2013-10-09-Chancellor_Report_Quick_Reference_Guide1.doc). | Y |

**EXISTING PROGRAM MODIFICATION PROPOSALS**

|  |  |
| --- | --- |
| Documentation indicating core curriculum requirements have been met for new programs/options or program changes. | NA |
| Detailed rationale for each modification (this includes minor modifications) | NA |

New York City College of Technology, CUNY

NEW COURSE PROPOSAL FORM **(CET 4920)**

This form is used for all new course proposals. Attach this to the [Curriculum Modification Proposal Form](http://openlab.citytech.cuny.edu/collegecouncil/files/2014/08/2013-10-10-Curriculum_Modification_Proposal_Form.docx) and submit as one package as per instructions. Use one New Course Proposal Form for each new course.

|  |  |
| --- | --- |
| **Course Title** | Introduction to Computer Vision |
| **Proposal Date** | September 19, 2018 |
| **Proposer’s Name** | Xiaohai Li, Lili Ma |
| **Course Number** | CET 4920 |
| **Course Credits, Hours** | 4 credits, 3 class hours and 3 lab hours |
| **Course Pre/co-Requisites** | CET 3640 or departmental approval |
| **Catalog Course Description** | Introduction to the fundamentals and basic application techniques of computer vision. Topics include image formation, camera model and imaging geometry, image processing, feature detection, background subtraction, and visual tracking. Students use the latest hardware and software tools to design and develop a prototype computer vision application. The course requires a background in object-oriented programming and microprocessor. |
| **Brief Rationale**  Provide a concise summary of why this course is important to the department, school or college. | The need to offer a course on Computer Vision is presented by the current technology trend. These days cameras are literally ubiquitous – in our smartphones, homes, cars, retail stores, cashless tolling on bridges or tunnels, and so on. Opportunities for computer vision are endless, stretching from security system, robotics, smart retailing, transportation, healthcare, assistive living, to many other application areas.  According to ZDNet, computer vision engineer is the most wanted among the top 10 IT jobs that will be most in-demand in 2020. According to Glassdoor.com, as of May, 2018, the national average base salary for a computer vision engineer is $94.9K/yr. According to Hired.com, as of August, 2018, the average salary for a computer vision engineer in NY area is $135K/yr.  This course is designed as a technical elective in the Computer Engineering Technology BTech program. It introduces students to the rapidly booming field of Computer Vision and prepares them with fundamental knowledge and techniques which will help them successfully extend their careers in this and related application fields. Students will have the opportunity to use the latest hardware and software tools to design and develop a prototype computer vision application system. |
| **CUNY – Course Equivalencies**  Provide information about equivalent courses within CUNY, if any. | No |
| **Intent to Submit as Common Core**  If this course is intended to fulfill one of the requirements in the common core, then indicate which area. | No |
| **For Interdisciplinary Courses:**   * Date submitted to ID Committee for review * Date ID recommendation received   - Will all sections be offered as ID? Y/N | Not applicable |
|  |
|  |
| **Intent to Submit as a Writing Intensive Course** | No |

Please include all appropriate documentation as indicated in the NEW COURSE PROPOSAL Combine all information into a single document that is included in the Curriculum Modification Form.

**NEW COURSE PROPOSAL CHECK LIST**

Use this checklist to ensure that all required documentation has been included. You may wish to use this checklist as a table of contents within the new course proposal.

|  |  |
| --- | --- |
| **Completed NEW COURSE PROPOSAL FORM** | **√** |
| * Title, Number, Credits, Hours, Catalog course description | **√** |
| * Brief Rationale | **√** |
| * CUNY – Course Equivalencies | **√** |
| Completed [Library Resources and Information Literacy Form](https://openlab.citytech.cuny.edu/collegecouncil/files/2014/08/curriculum_modification_library_form-rev3F16.doc) | **√** |
| **Course Outline**  Include within the outline the following. | **√** |
| Hours and Credits for Lecture and Labs  If hours exceed mandated Carnegie Hours, then rationale for this | **√** |
| Prerequisites/Co- requisites | **√** |
| Detailed Course Description | **√** |
| Course Specific Learning Outcome and Assessment Tables   1. Discipline Specific 2. General Education Specific Learning Outcome and Assessment Tables | **√** |
| Example Weekly Course outline | **√** |
| Grade Policy and Procedure | **√** |
| Recommended Instructional Materials (Textbooks, lab supplies, etc) | **√** |
| Library resources and bibliography | **√** |
| **Course Need Assessment.**  Describe the need for this course. Include in your statement the following information. | **√** |
| Target Students who will take this course. Which programs or departments, and how many anticipated?  Documentation of student views (if applicable, e.g. non-required elective). | **√** |
| Projected headcounts (fall/spring and day/evening) for each new or modified course. | **√** |
| If additional physical resources are required (new space, modifications, equipment), description of these requirements. If applicable, Memo or email from the VP for Finance and Administration with written comments regarding additional and/or new facilities, renovations or construction. | **√** |
| Where does this course overlap with other courses, both within and outside of the department? | **√** |
| Does the Department currently have full time faculty qualified to teach this course? If not, then what plans are there to cover this? | **√** |
| If needs assessment states that this course is required by an accrediting body, then provide documentation indicating that need. | NA |
| **Course Design**  Describe how this course is designed. | **√** |
| Course Context (e.g. required, elective, capstone) | **√** |
| Course Structure: how the course will be offered (e.g. lecture, seminar, tutorial, fieldtrip)? | **√** |
| Anticipated pedagogical strategies and instructional design (e.g. Group Work, Case Study, Team Project, Lecture) | **√** |
| How does this course support Programmatic Learning Outcomes? | **√** |
| Is this course designed to be partially or fully online? If so, describe how this benefits students and/or program. | **√** |
| **Additional Forms for Specific Course Categories** | NA |
| [Interdisciplinary Form](http://openlab.citytech.cuny.edu/collegecouncil/files/2014/08/Application-for-Interdisciplinary-Course-Designation.docx) (if applicable) |  |
| Interdisciplinary Committee Recommendation (if applicable and if received)\*  \*Recommendation must be received before consideration by full Curriculum Committee |  |
| [Common Core (Liberal Arts) Intent to Submit](http://openlab.citytech.cuny.edu/collegecouncil/files/2014/08/CommonCoreCourseSubmissionForm_4.2.12.doc) (if applicable) |  |
| Writing Intensive Form if course is intended to be a WIC (under development) |  |
| If course originated as an experimental course, then results of evaluation plan as developed with director of assessment. |  |
| **(Additional materials for** [**Curricular Experiments**](http://www.300jaystreet.com/college-council/curriculum_proposals/curricular-experiments)**)** | NA |
| Plan and process for evaluation developed in consultation with the director of assessment. (Contact Director of Assessment for more information). |  |
| Established Timeline for Curricular Experiment |  |

Chancellor's Report Section AIV: New Courses

|  |  |
| --- | --- |
| **Department(s)** | Computer Engineering Technology |
| **Academic Level** | **[X] Regular  [   ] Compensatory  [   ] Developmental  [   ] Remedial** |
| **Subject Area** | Computer Engineering Technology |
| **Course Prefix** | CET |
| **Course Number** | 4920 |
| **Course Title** | Introduction to Computer Vision |
| **Catalog Description** | Introduction to the fundamentals and basic application techniques of computer vision. Topics include image formation, camera model and imaging geometry, image processing, feature detection, background subtraction, and visual tracking. Students use the latest hardware and software tools to design and develop a prototype computer vision application. application. The course requires a background in object-oriented programming and microprocessor. |
| **Prerequisite** | CET 3640 or departmental approval |
| **Corequisite** |  |
| **Pre- or corequisite** |  |
| **Credits** | 4 |
| **Contact Hours** | 3 Class Hours, 3 Lab Hours |
| **Liberal Arts** | **[ ] Yes  [X] No** |
| **Course Attribute (e.g. Writing Intensive, etc)** |  |
| **Course Applicability** | |  |  |  | | --- | --- | --- | | **[X] Major** |  | | | **[ ] Gen Ed Required** | **[ ] Gen Ed - Flexible** | **[ ] Gen Ed - College Option** | | **[ ] English Composition** | **[ ] World Cultures** | **[ ] Speech** | | **[ ] Mathematics** | **[ ] US Experience in its Diversity** | **[ ] Interdisciplinary** | | **[ ] Science** | **[ ] Creative Expression** | **[ ] Advanced Liberal Arts** | |  | **[ ] Individual and Society** |  | |  | **[ ] Scientific World** |  | |
| **Effective Term** | Fall 2019 |

**Rationale:** This course is designed as a technical elective in the Computer Engineering Technology BTech program. It introduces students to the rapidly booming field of Computer Vision and prepares them with fundamental knowledge and techniques which will help them successfully extend their careers in this and related application fields.

**LIBRARY RESOURCES & INFORMATION LITERACY: MAJOR CURRICULUM MODIFICATION**

Please complete for **all** major curriculum modifications. This information will assist the library in planning for new courses/programs.

Consult with your library faculty subject specialist (<http://cityte.ch/dir>) **3 weeks before the proposal deadline**.

Course proposer: please complete boxes 1-4. Library faculty subject specialist: please complete box 5.

|  |  |  |
| --- | --- | --- |
| **1** | **Title of proposal**  CET4920 – Introduction to Computer Vision | **Department/Program**  Computer Engineering Technology (CET) / BTech in Computer Engineering Technology |
|  | **Proposed by** (include email & phone)  Prof. Xiaohai Li  xhli@citytech.cuny.edu / 718-260-5885  Prof. Lili Ma  lma@citytech.cuny.edu / 718-260-5885 | **Expected date course(s) will be offered**  Fall 2019  **# of students** 22 |

|  |  |
| --- | --- |
| **2** | **The library cannot purchase reserve textbooks for every course at the college, nor copies for all students. Consult our website (**[**http://cityte.ch/curriculum**](http://cityte.ch/curriculum)**) for articles and ebooks for your courses, or our open educational resources (OER) guide (**[**http://cityte.ch/oer**](http://cityte.ch/oer)**). Have you considered using a freely-available OER or an open textbook in this course?**  As to the proposer’s knowledge, there is no open textbook available for this course, but plenty OER and open-source tech documentations available online which will be used in the class. |

|  |  |
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| **3** | **Beyond the required course materials, are City Tech library resources sufficient for course assignments? If additional resources are needed, please provide format details (e.g. ebook, journal, DVD, etc.), full citation (author, title, publisher, edition, date), price, and product link.**  A search of the CityTech/CUNY library catalog and database with the keyword “Computer Vision” shows sufficient print and electronic resources are available, some of which can be used as reference materials for this course. |

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| **4** | **Library faculty focus on strengthening students'** information literacy **skills in finding, critically evaluating, and ethically using information. We collaborate on developing assignments and customized instruction and research guides. When this course is offered, how do you plan to consult with the library faculty subject specialist for your area? Please elaborate.**  Once the course is offered, the department faculty teaching the course may consult with the library faculty subject specialist to determine the future needs of textbook change or update, and acquisition of additional journals and online resources. |

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| **5** | **Library Faculty Subject Specialist Junior Tidal**  **Comments and Recommendations**  After surveying the collection, I suggest that the library purchase additional materials related to image processing outlined in the syllabus. I also recommend that the library acquire any multimedia materials, such as software or videos, that could further augment the library’s collection to support students in the course, pending course approval.  Date 10.23.18 |

Computer Engineering Technology Department

Computer Engineering Technology Program

Sample Course Outline

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Prepared by** | Xiaohai Li and Lili Ma | Revision date |  | |
| **Course No. & Title** | CET 4920 Introduction to Computer Vision | | | |
| **Course Description** | Introduction to the fundamentals and basic application techniques of computer vision. Topics include image formation, camera model and imaging geometry, image processing, feature detection, background subtraction, and visual tracking. Students use the latest hardware and software tools to design and develop a prototype computer vision application. The course requires a background in object-oriented programming and microprocessor. | | | |
| **Hours / Credits** | 3 class hrs, 3 lab hrs / 4 credits | | | |
| **Pre-requisite** |  | | | |
| **Pre- / Co-requisite** | CET 3640 or departmental approval | | | |
| **Gen-Ed Objectives** | Acquire discipline-specific knowledge.  Gather, interpret and evaluate information from a variety of sources.  Have effective reading and written/oral communication skills.  Function as an effective team member. | | | |
| **Course Objectives/ Student Learning Outcomes** | Recognize and use technical terms in the field of image processing and computer vision.  Understand foundation of image and video formation and 2D computer vision.  Be able to describe and apply basic technical approaches in computer vision.  Be able to apply major techniques in basic image and video processing and analysis.  Be able to select and apply hardware and software tools to develop a prototype computer vision application. | | | |
| **Textbook** | Computer Vision: Algorithms and Applications | | |  |
| **Author** | Richard Szeliski | | |  |
| **Publisher / Year** | Springer / 2011 | | |  |
| **ISBN** | ISBN-13: 978-1848829343  ISBN-10: 1848829345 | | |  |
|  |  | | |  |
| **Lab Ref. Book** | Practical Computer Vision with SimpleCV | | |  |
| **Author** | Anthony Oliver, Katherine Scott, Kurt DeMaagd, and Nathan Oostendorp | | |  |
| **Publisher / Year** | O'Reilly Media / 2012 | | |  |
| **ISBN** | ISBN-13: 978-1449320362  ASIN: 1449320368 | | |  |

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| --- | --- | --- |
|  | **Weekly Topics** | |
| **Wk** | **Lecture** | **Lab** |
| 1 | Introduction to computer vision applications and related professional ethics.  Introduction to the course; course project (examples, ideas, and requirements); team formation for course project | Get ready for computer vision programming: install and setup cross-platform tool-chain, install libraries, and introduce Git |
| 2 | Introduction to computer vision;  Primer of relevant mathematics | Programming for matrix operations |
| 3 | Image formation, camera model and imaging geometry | Get started with OpenCV – Display image and video from a camera |
| 4 | Data structure for computer vision | Basic data structure for computer vision – efficient image scanning and simple image arithmetic |
| 5 | Processing of image colors | Color distance and color comparison, converting color representations |
| 6 | Basic image transform and mapping | Resizing, rotating, warping, and polar mapping of image |
| 7 | Basic filters | Smoothing by Gaussian filter |
| 8 | Morphological filters and Laplacian | Image erosion and dilation  **Midterm project report due** |
| 9 | Histogram and threshold | Mean-shift segmentation |
| 10 | Contours and components extraction | Contour extraction, connected components analysis |
| 11 | Interest points, descriptors and matching | Creating panorama image |
| 12 | Video sequence, background subtraction | Background subtraction |
| 13 | Motion estimation and tracking | Object tracking |
| 14 | Project hours | |
| 15 | Course project demonstration and presentation | |

**Reading and Reference Materials:**

* Mark Nixon, *Feature Extraction and Image Processing for Computer Vision*, 3rd Edition, Academic Press, 2012.
* Adrian Kaehler and Gary Bradski, *Learning OpenCV*, O'Reilly Media, 2008.
* Ashwin Pajankar, *Raspberry Pi Computer Vision Programming* , Packt Publishing, 2015.
* Simon J. D. Prince, *Computer Vision: Models, Learning, and Inference*, Cambridge University Press, 2012.
* Jae Soo Lim, *Two-dimensional Signal and Image Processing*, Prentice Hall, 1990.
* David Forsyth and Jean Ponce, *Computer Vision: A Modern Approach*, 2nd Edition, Pearson, 2011.
* Jan Erik Solem, *Programming Computer Vision with Python: Tools and Algorithms for Analyzing Images*, O'Reilly Media, 2012.
* Daniel S. Stutts, Linear Algebra Primer, available at http://web.mst.edu/~stutts/ SupplementalNotes/LinearAlgebraPrimer4.pdf, 2014
* Juan C. Niebles and Fei-fei Li, Linear Algebra Primer, Stanford Vision Lab, available at http://vision.stanford.edu/teaching/cs131\_fall1516/lectures/cs131\_linalg \_review.pdf, 2015.
* Additional reading and reference materials will be provided on Blackboard (under *Contents* section) as needed.

**Library Resources:**

* Students are encouraged to use the library for supplementary resources in support of the lectures and labs.

**COURSE POLICIES:**

**Grading:**

* Midterm Project Report: 20 %
* Final Project: 30 %
* Labs: 20 %
* Homework Assignments: 20 %
* Attendance, Class and Group Participation: 10 %
* Total: 100 %

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Score % | < 60 | 60-69.9 | 70-76.9 | 77-79.9 | 80-82.9 | 83-86.9 | 87-89.9 | 90-92.9 | 93-100 |
| Grade | F | D | C | C+ | B- | B | B+ | A- | A |

**Blackboard:**

* Blackboard will be used extensively to provide course material, collect assignments and reports and provide detailed grading information. Students must make sure their Blackboard login works in the beginning of the course.

**Hardware and Software for Lab/Project:**

* Desktop/laptop or single-board computer can be used for the lab and course project.
* Program development tools (such as Visual Studio on Windows, Eclipse on Unix/Linux or Mac) are needed for the lab and course project.
* Other open-source or free software/library will be used in the labs and course project. Links to download the software/library will be posted on Blackboard.

**Lab Reports:**

* Lab reports must be submitted INDIVIDUALLY.
* All lab reports must be submitted through Blackboard – Assignments section.
* Each lab report is due one week after the lab work is performed.
* Any late lab report will have a 30% late penalty per week; a submission will not be accepted if it is more than three weeks late.
* Additional requirements regarding lab report’s content and format will be posted on Blackboard.

**Homework:**

* 3~5 assignments will be assigned. Each homework assignment equally contributes to the final grade.
* Homework will be done in a group or individually. See Blackboard for detailed instructions.
* All homework must be submitted through Blackboard.
* Any late homework will have a 30% late penalty per week; a submission will not be accepted if it is more than three weeks late.

**Project:**

* 2~3 students form a team to propose, develop and finish a project during the semester. The project needs to be approved by the instructor before proceeding.
* Each team needs to submit a midterm project report at the middle of semester. The report should be submitted to Blackboard.
* Final project demonstration/presentation will be done on the last week of the class. All team members in a team need to be present for the demonstration/presentation except emergencies.

**Attendance:**

* At the beginning of each class, the instructor will make a roll call of all the student names to check the attendance.
* Any latenesses must be reported to the instructor by the students before the class is dismissed.
* A name without on-time attendance nor reported lateness will be considered to be absent.
* 2 lateness will be considered equal to 1 absence.
* Any absence due to emergencies (e.g., emergency medical condition or no-fault legal crisis) needs to be notified to the instructor by email or in-person.
* Excused absences can ONLY be considered with signed explanatory notes from a proper party with proper authority.

**Classroom Conduct Policy:**

* Cell phone ringing and any other distracting and disruptive behavior such as talking loudly without permission are absolutely prohibited and may cause the student to be expelled from class.
* Any activity that threatens the college academic integrity will result in a disciplinary action.
* Please refer to the Student Handbook and the Catalog of New York City College of Technology for a full listing of Student Code of Conduct, Classroom Behavior Guidelines and Academic Integrity Rules.

**Academic Integrity Policy:**

Students and all others who work with information, ideas, texts, images, music, inventions, and other intellectual property owe their audience and sources accuracy and honesty in using, crediting, and citing sources. As a community of intellectual and professional workers, the College recognizes its responsibility for providing instruction in information literacy and academic integrity, offering models of good practice, and responding vigilantly and appropriately to infractions of academic integrity. Accordingly, academic dishonesty is prohibited in The City University of New York and at New York City College of Technology and is punishable by penalties, including failing grades, suspension, and expulsion.

**Assessment Methods**

|  |  |
| --- | --- |
| **General Education Learning Outcomes** | **Assessment Methods** |
| Acquire discipline specific knowledge. | Students will at minimum, demonstrate knowledge of basic technical terms related to computer vision such as those found in a job interview in the technology field. Students who excel will be able to use logic and reasoning to find answers to new questions. This will be demonstrated by homework, midterm project report and final project presentation. |
| Have effective reading and written communication skills. | Effective reading will be demonstrated by accurate interpretation of reading/reference materials and weekly lab procedures. Effective writing will be demonstrated in lab reports, midterm project report and online project/labs documentation. |
| Have effective oral communication skills. Gather, interpret and evaluate information from a variety of sources. | Students will verbally discuss a computer vision application (project proposal) and explain basic concepts to the class. Each group of students will give a brief oral presentation on their project at the end of the semester. Students will also demonstrate their projects to the class at the end of semester. |
| Be able to work in a team and group while being aware of the ethical and conflict related situations in group dynamics. | Students will work together in groups to design, build and demonstrate/present a prototype computer vision system. Teamwork rubrics will be used for the assessment. |

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| **Course Specific Learning Outcomes** | **Assessment Methods** |
| Recognize and use technical terms in the field of image processing and computer vision. | Analysis of student performance on lab reports, homework, midterm report and final project presentation. |
| Understand the foundation of image and video formation and 2D computer vision. | Analysis of student performance on homework, lab reports, and midterm report. |
| Be able to describe and apply basic technical approaches in computer vision. | Analysis of student performance in homework, hand-on lab experiments, lab reports and final project presentation. |
| Be able to apply major techniques in basic image and video processing and analysis. | Analysis of student performance in hand-on lab experiments, lab reports, midterm report and final project. |
| Be able to select and apply hardware and software tools to develop a prototype computer vision application. | Students will select and apply appropriate tools through different stages of the project. Analysis of student performance in project exercises, midterm report and final demonstration/presentation of project. |

**Course Need Assessment**

The need to offer a course on Computer Vision is presented by the current technology trend. According to Indeed data, the demand for computer vision engineers has grown steadily since 2013. According to ZDNet, computer vision engineer is the most wanted among the top 10 IT jobs that will be most in-demand in 2020 [1]. According to Glassdoor.com, as of May, 2018, the national average base salary for a computer vision engineer is $94.9K/yr [2]. According to Hired.com, as of August, 2018, the average salary for a computer vision engineer in NY area is $135K/yr [3]. Interests to learn computer vision and image processing have been expressed by CET students who recently took CET4900 Internship and who conducted research projects with CET faculty.

Students in Computer Engineering Technology Department are required to take two technical elective courses before obtaining their CEB degrees. In recent academic years, three or four existing technical elective courses have been offered by the department every semester. This proposed course will provide another option for the students and offer another choice of a 4 credit technical elective course.

This course provides students with fundamental knowledge and techniques in computer vision, a rapidly booming area in recent few years. It directly supports one of the program educational objectives of the CET BTech program, which states that graduates of the CET program are expected to be employed, as engineering technologists or the equivalent, in positions beyond the entry-level for which this program has prepared them.

This course has no overlap with any other courses offered in the CET Department. According to the current College Catalog, this course does not overlap with any course offered in any other departments.

Course Design

The course will be offered to the CET BTech (CEB) junior or senior students in the Computer Engineering Technology Department. It is expected that a section (22 students as maximum) will take this course when it is offered in both Spring and Fall semesters every year.

The course is structured as a combination of lecture sessions and hands-on lab sessions. The hands-on sessions include lab exercises, experiments and group projects. This course is not designed to be online.

No additional physical resources are required since students will take this course in lieu of existing courses in the CEB program. Adequate equipment and resources in the CET Department are available for the hands-on components (lab experiments and course project) of this course. Two existing CET full-time faculty who have extensive experiences in Computer Vision are qualified and available to teach this course every semester.

**References**

[1] The 10 IT jobs that will be most in-demand in 2020, ZDNet, December 1, 2017, retrieved on Augus 17, 2018, URL: https://www.zdnet.com/article/the-10-it-jobs-that-will-be-most-in-demand-in-2020/

[2] Computer Vision Engineer Salaries, retrieved on August 17, 2018, URL: https://www.glassdoor.com/Salaries/computer-vision-engineer-salary-SRCH\_KO0,24.htm

[3] Compare Computer Vision Engineer salaries by region, retrieved on August 17, 2018, URL: https://hired.com/salaries/san-francisco-bay-area/computer-vision-engineer

**APPENDIX**