

Proposal Template for COMP 692 and 693: Independent Study I and II

I. Course Title and Proposed Supervisor

The course title should reflect the topics covered in the proposed study and must be 60 characters or fewer. The course must be approved by your proposed supervisor prior to submission to the MSc CIS program director.

Example

Course Title: Streaming Video Processing and Reenactment Analytics

Supervisor: Dr. Bill Smith

II. Rationale

The rationale for the independent study course will explain how the proposed study is not covered in existing MSc CIS courses and why the study is important. You may justify your study based on achieving the program learning outcomes, preparing for other advanced courses, or completing the program thesis or project. You must also provide a list of completed graduate courses to show preparedness to undertake independent study.

Example

The aim of this independent-study course is to build the required knowledge and skill set to complete a research project for developing an application using computer vision and prerecorded image data to render upscaled video from a low-latency video feed. The advanced algorithms for computer vision and video processing are not covered in any of the existing MSc CIS courses, and this independent study is developed with and approved by my supervisor, Dr. Bill Smith.

List of completed graduate courses:

- COMP 501: Systems Development with Emerging Technology
- COMP 504: Object Structure and Programming
- COMP 601: Survey of Computing and Information Systems
- COMP 604: Enterprise Computer Networks
- COMP 605: Project Management for Information Systems
- COMP 607: Ethical, Legal, and Social Issues in Information Technology
- COMP 617: Designing Real-time Software
- COMP 656: Cloud Computing
- COMP 695: Research Methods in Information Systems

III. Learning Outcomes

The learning outcomes should describe the core knowledge and skills you will possess as well as the depth of learning expected upon completion of the course. Make sure to articulate learning outcomes that are tied to the proposed assessment.

Example

Upon successful completion of this course, I should be able to

- develop video processing algorithms and transmission protocols.
- define the images library and indexing of images.
- develop efficient algorithms for retrieval of high-resolution images.
- design and implement computational infrastructure to enable low-latency or latency-free retrieval.

IV. Study Plan

The study plan should outline the course duration, indicating a potential start date and end date for a period of four months. A weekly schedule for completing the course activities should also be attached.

Example

The course runs from April 27, 2026, to July 26, 2026.

Activity	Weeks
Synthesis of literature relevant to video processing algorithms and transmission protocols	Weeks 1–2
Synthesis of literature relevant to images library and indexing of images	Weeks 3–4
Synthesis of literature relevant to algorithms for retrieval of high-resolution images	Weeks 5–6
Application design and system architecture	Weeks 7–8
Prototype implementation and evaluation	Weeks 9–12
Final report of the implemented system	Weeks 13–14

V. Course Description

The course description provides details about the course content and outlines the course material and resources needed for different learning tasks.

Example

The primary focus of the course will be acquiring the appropriate background knowledge on the type of systems needed to carry out project tasks. Studying contemporary literature in the field will allow me to choose the best applicable methods for achieving the project goals.

The entirety of this course content will focus on high-dimensional data transmission protocols that can be used to transmit low-dimensional data with an index, and upscaling the low-dimensional data into high-dimensional data at the retrieval point. The result of this study would be to implement a prototype using a framework that provides an increase in data transmission speed at the expense of storage space on the receiving end.

Activity 1: Synthesis of Literature Relevant to Project

Outcomes

Discuss relevant research related to the proposed patent application prototype and discuss the use cases of current video transmission paradigms combined with modern computer vision applications and how they relate to enhancing real-time video transmission feeds using indexed image files.

Readings

- Santos-González, I., Rivero-García, A., Molina-Gil, J., Caballero-Gil, P. (2017). Implementation and analysis of real-time streaming protocols. *Sensors (Basel)*, 17(4), 846. <https://doi.org/10.3390/s17040846>
- Pereira, R., & Pereira E. G. (2014). Dynamic adaptive streaming over http and progressive download: Comparative considerations. *Proceedings of the IEEE International Conference on Advanced Information Networking and Applications Workshops*, Victoria, BC, 905–909.
- Schulzrinne, H., Casner, S., Frederick, R., & Jacobson, V. (2003). *RTP: A transport protocol for real-time applications* (RFC 3550). Internet Engineering Task Force. <https://tools.ietf.org/html/rfc3550>
- Umesh, A. (2015). *Performance analysis of transmission protocols for H. 265 encoder* [Doctoral thesis, Blekinge Institute of Technology].
- Schulzrinne, H., Rao, A., & Lanphier, R. (1998). *Real time streaming protocol* (RFC 2326). Internet Engineering Task Force. <https://tools.ietf.org/html/rfc2326>
- Schulzrinne, H., Casner, S., Frederick, R., & Jacobson, V. (1996). *RTP: A transport protocol for real-time applications* (RFC 1889). Internet Engineering Task Force. <https://www.ietf.org/rfc/rfc1889>
- Bergkvist, A., Burnett, D., Jennings, C., Narayanan, A. (2021, January 26). *WebRTC 1.0: Real-time communication between browsers*. <https://www.w3.org/TR/2021/REC-webrtc-20210126/>

- McGrew, D., & Rescorla, E. (2010). *Datagram transport layer security (DTLS) extension to establish keys for secure real-time transport protocol (SRTP)* (RFC 5764). <https://datatracker.ietf.org/doc/rfc5764>
- Baugher, M., McGrew, D., Naslund, M., Carrara, E., & Norrman, K. (2004). *The secure real-time transport protocol (SRTP)* (RFC 3711). <https://tools.ietf.org/html/rfc3711>
- Pereira, R., & Pereira, E. G. (2017). *Video streaming*. <https://silo.tips/download/program-module-1-what-is-streaming-video-and-internet-transmissions-protocols>

Activity 2: Application Design

Outcomes

Create and submit for approval a design document for a prototype of sufficient scope to demonstrate the technological capabilities of the proposed algorithms.

Include the following:

- Application overview (functional description)
- Discussion of relevant algorithms
- Data storage and retrieval mechanisms
- Discussion of required sensors and communication between sensors and application
- User interface (description of how the application is used)
- UML Design

Readings

- Thies, J., Zollhöfer, M., Stamminger, M., Theobalt, C., & Nießner, M. (2018). Face2Face: Real-time face capture and reenactment of RGB videos. *Communications of the ACM*, 62(1), 96–104. <https://doi.org/10.1145/3292039>
- Blanz, V., & Vetter, T. (1999). A morphable model for the synthesis of 3D faces. *SIGGRAPH '99: Proceedings of the 26th Annual Conference on Computer Graphics and Interactive Techniques*, 187–194. <https://doi.org/10.1145/311535.311556>
- Bouaziz, S., Wang, Y., & Pauly, M. (2013). Online modeling for realtime facial animation. *ACM Transactions on Graphics (TOG)*, 32(4), Article 40. <https://doi.org/10.1145/2461912.2461976>
- Bregler, C., Covell, M., & Slaney, M. (1997). Video rewrite: Driving visual speech with audio. *SIGGRAPH '97: Proceedings of the 24th Annual Conference on Computer Graphics and Interactive Techniques*, 353–360. <https://doi.org/10.1145/258734.258880>
- Cao, C., Bradley, D., Zhou, K., Beeler, T. (2015). Real-time high-fidelity facial performance capture. *ACM Transactions on Graphics (TOG)*, 34(4), Article 46. <https://doi.org/10.1145/2766943>
- Cao, C., Hou, Q., & Zhou, K. (2014). Displaced dynamic expression regression for real-time facial tracking and animation. *ACM Transactions on Graphics (TOG)*, 33(4), Article 43. <https://doi.org/10.1145/2601097.2601204>
- Chen, Y.-L., Wu, H.-T., Shi, F., Tong, X., & Chai, J. (2013). Accurate and robust 3D facial capture using a single RGBD camera. *2013 IEEE International Conference on Computer Vision*, 3615–3622. <https://doi.org/10.1109/ICCV.2013.449>

- Garrido, P., Valgaerts, L., Rehmsen, O., Thormaehlen, T., Perez, P., & Theobalt, C. (2014). Automatic face reenactment. *CVPR '14: Proceedings of the 2014 IEEE Conference on Computer Vision and Pattern Recognition*, 4217–4224. <https://doi.org/10.1109/CVPR.2014.537>
- Garrido, P., Valgaerts, L., Sarmadi, H., Steiner, I., Varanasi, K., Perez, P., & Theobalt, C. (2015). Vdub: Modifying face video of actors for plausible visual alignment to a dubbed audio track. *Computer Graphics Forum*, 34(2), 193–204. <https://doi.org/10.1111/cgf.12552>
- Hu, L., Saito, S., Wei, L., Nagano, K., Seo, J., Fursund, J., Sadeghi, I., Sun, C., Chen, Y., & Li, H. (2017). Avatar digitization from a single image for real-time rendering. *ACM Transactions on Graphics (TOG)*, 36(6), Article 195. <https://doi.org/10.1145/3130800.31310887>
- Kemelmacher-Shlizerman, I., Sankar, A., Shechtman, E., & Seitz, S. M. (2010). Being John Malkovich. (2010). *ECCV'10: Proceedings of the 11th European Conference on Computer Vision: Part I*, 341–353. <https://dl.acm.org/doi/10.5555/1886063.1886090>
- Li, H., Yu, J., Ye, Y., & Bregler, C. (2013). Realtime facial animation with on-the-fly correctives. *ACM Transactions on Graphics (TOG)*, 32(4), Article 42. <https://doi.org/10.1145/2461912.2462019>
- Li, K., Xu, F., Wang, J., Dai, Q., & Liu, Y. (2012). A data-driven approach for facial expression synthesis in video. *2012 IEEE Conference on Computer Vision and Pattern Recognition*, 57–64. <https://doi.org/10.1109/CVPR.2012.6247658>
- Ramamoorthi, R., & Hanrahan, P. (2001). A signal-processing framework for inverse rendering. *SIGGRAPH '01: Proceedings of the 28th Annual Conference on Computer Graphics and Interactive Techniques*, 117–128. <https://doi.org/10.1145/383259.383271>
- Saragih, J. M., Lucey, S., & Cohn, J. F. (2011). Deformable model fitting by regularized landmark mean-shift. *International Journal of Computer Vision*, 91(2), 200–215. <https://doi.org/10.1007/s11263-010-0380-4>
- Saragih, J. M., Lucey, S., Cohn, J. F. (2011). Real-time avatar animation from a single image. *2011 IEEE International Conference on Automatic Face & Gesture Recognition (FG)*, 213–220. <https://doi.org/10.1109/FG.2011.5771400>
- Shi, F., Wu, H.-T., Tong, X., Chai, J. (2014). Automatic acquisition of high-fidelity facial performances using monocular videos. *ACM Transactions on Graphics (TOG)*, 33(6), Article 222. <https://doi.org/10.1145/2661229.2661290>
- Siegl, C., Lange, V., Stamminger, M., Bauer, F., & Thies, J. (2017). FaceForge: Markerless non-rigid face multi-projection mapping. *IEEE Transactions on Visualization and Computer Graphics*, 23(11), 2440–2446. <https://doi.org/10.1109/TVCG.2017.2734428>
- Sumner, R. W., & Popović, J. (2004). Deformation transfer for triangle meshes. *ACM Transactions on Graphics (TOG)*, 23(3), 399–405. <https://doi.org/10.1145/1015706.1015736>
- Thies, J., Zollhöfer, M., Nießner, M., Valgaerts, L., Stamminger, M., & Theobalt, C. (2015). Real-time expression transfer for facial reenactment. *ACM Transactions on Graphics (TOG)*, 34(6), Article 183. <https://doi.org/10.1145/2816795.2818056>
- Thies, J., Zollhöfer, M., Stamminger, M., Theobalt, C., & Nießner, M. (2016). Demo of face2face: Real-time face capture and reenactment of RGB videos. *SIGGRAPH '16: ACM SIGGRAPH 2016 Emerging Technologies*, Article 5. <https://doi.org/10.1145/2929464.2929475>
- Thies, J., Zollhöfer, M., Stamminger, M., Theobalt, C., Nießner, M. (2016). Face2Face: Real-time face capture and reenactment of RGB videos. *2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, <https://doi.org/10.1109/CVPR.2016.262> .

- Thies, J., Zollhöfer, M., Stamminger, M., Theobalt, C., & Nießner, M. (2016). FaceVR: Real-time facial reenactment and eye gaze control in virtual reality. *ArXiv*. <https://doi.org/10.48550/arXiv.1610.03151>
- Vlasic, D., Brand, M., Pfister, H., & Popović, J. (2005). Face transfer with multilinear models. *ACM Transactions on Graphics (TOG)*, 24(3), 426–433. <https://doi.org/10.1145/1073204.1073209>
- Weise, T., Bouaziz, S., Li, H., & Pauly, M. (2011). Realtime performance-based facial animation. *ACM Transactions on Graphics (TOG)*, 30(4), Article 77. <https://doi.org/10.1145/2010324.1964972>
- Weise, T., Li, H., Gool, L. V., & Pauly, M. (2009). Face/off: Live facial puppetry. *SCA '09: Proceedings of the 2009 ACM SIGGRAPH/Eurographics Symposium on Computer Animation*, 7–16. <https://doi.org/10.1145/1599470.1599472>

Activity 3: Technology Prototype

Outcomes

Demonstrate the feasibility of one or more of the following in the context of using computer vision technologies to

- transmit high-res video using low-res latency.
- provide a framework for real-time geographically distributed performances.
- enhance footage taken at a distance.
- apply in educational and training contexts.

VI. Assessment

The assessment should describe the course evaluation components as well as the marking scheme that defines the grading weight and the passing grade for each component.

Example

To receive credit, a composite course grade of B– (70 percent) or higher must be achieved, including a minimum grade of 60% on each of the following assignments. The weighting of the composite grade is as follows:

- Synthesis of Literature Relevant to Project (35%)
- Application Design Report (25%)
- Prototype Demonstration and Implementation Report (40%)