## Year-6_ CVDI IP Report

The following tables list the Intellectual Property (IP) items developed for each Year 6 project that are available for licensing, along with a description of key features.

Project reports containing detailed information about the associated research results will be sent separately.

The ID numbers that appear in the tables are identified by the following patterns: IP Item: Project-[Project #]-[ Item #]

### CVDI Project 6A.001.TUT – Automatic Face Completion And Restoration, Drs. Moncef Gabbouj, Jenni Raitoharju, Honglei Zhang, Lei Xu and Juhani Ahonen (Tampere University of Technology)

| IP Item Description |
|---|
| **P – 6A.001.TUT - 1 : Still under consideration at this time.** |
| **Key Concept 1:** Dataset of images and ground-truths for image-to-image mapping. |
| **Key Concept 2:** Trained model for image mapping that is visually plausible to a human observer. |
| **Key Concept 3**: Trained model for image mapping, enhancing recognition performance. |
| **Key Concept 4**: Real-time implementation of both approaches. |

### CVDI Project 6A.002.TUT – Monitoring & Advance Warning For Cardiac Arrhythmia Using PCG & ECG, Drs. Moncef Gabbouj, Serkan Kiranyaz, Morteza Zabihi, Matti Vakkuri (Tampere University of Technology)

| IP Item Description |
|---|
| **P – 6A.002.TUT - 1 : Still under consideration at this time.** |
| **Key Concept 1:** Realization of the capabilities of the PCG/ECG signals in early detection of heart anomalies. |
| **Key Concept 2:** Design the state of the art classification method (Normal vs. Abnormal) for the PCG dataset. |
| **Key Concept 3:** Design the state of the art classification method (Normal, AF, other rhythms, and too noisy) for the ECG dataset. |
| **Key Concept 4:** Modeling the common cause of “degradation system” for advance warning. |

### CVDI Project 6A.006.TUT – Learning (Scene & Object Recognition) from Few Examples, Drs. Moncef Gabbouj, Jenni Raitoharju, Firas Laakom, Guanqun Cao and Jarno Nikkanen (Tampere University of Technology)

| IP Item Description |
|---|
| **P – 6A.006.TUT - 1 : Still under consideration.** |
| **Key Concept 1:** Dataset of Color Constancy and literature review. |
| **Key Concept 2:** Learning strategies for model training from few examples. |
| **Key Concept 3:** Evaluation of new models and comparison with existing ones. |
| **Key Concept 4:** Realization and integration to the final system. |

**CVDI Project 6A.008.TUT – Co-botics: Intelligent Cooperating Robots & Humans, Drs. Moncef Gabbouj, Jenni Raitoharju, Alexandros Iosifidis, Fahad Sohrab, Matti Vakkuri, Peter Mathews and Steven Greenspan**
**(Tampere University of Technology)**

| IP Item Description |
|---|
| **P – 6A.008.TUT - 1 : Still under consideration at this time.** |
| **Key Concept 1:** Multi-modal datasets. |
| **Key Concept 2:** Trained models of multi-modal data embedding. |
| **Key Concept 3**: Data analysis and decision making in the latent space. |
| **Key Concept 4**: Efficient implementation. |

**CVDI Project 6A.009.TUT – Nature vs. Nurture: Analyzing The Interplay Of Meme – and Social Graph Node Attributes, Drs. Jukka Perkio (UH), Joel Pyykko (UH), Petri Myllymaki (UH), Dorota Glowacka (UH), Kimmo Valtonen (M-Brain)**
**(Tampere University of Technology)**

| IP Item Description |
|---|
| **P – 6A.009.TUT - 1 : Refined hash based random projections. (Incomplete software prototype under development)** |
| **Key Concept 1:** Efficient dimensionality reduction for categorical sparse data. |

| IP Item Description |
|---|
| **P – 6A.009.TUT - 2 : Lightweight distributional word representations based on feature hashing and random projections. (Incomplete software prototype under development)** |
| **Key Concept 1:** Simple count based statistics. |
| **Key Concept 2:** Very easily updatable model suitable for monitoring word meaning drift. |

| IP Item Description |
|---|
| **P – 6A.009.TUT - 3 : R**efined multilingual document representation learned from parallel related corpora. **(Incomplete software prototype under development)** |
| **Key Concept 1:** Utilize pretrained word representation either based on the above methodology or other readily available techniques. |
| **Key Concept 2:** Utilize shallow multivariate nonlinear regression to learn representations. |
| **Key Concept 3:** Utilize shallow binary logistic regression (as a classification task) to learn representations. |
| **Key Concept 4:** Alternative dual (cosine and Euclidean distance) optimization target when using random projection based word representations. |

**CVDI Project 6A.022.UL – Mitigating Concept Drift for Time-Varying Domains through Adaptive Learning, Drs. Jian Chen, Jennifer Lavergne, Raju Gottumkkala, Satya Katragadda, Adeola Siwoku, Ryan Benton, Tom Johnsten and Michael Lucito**
**(University of Louisiana at Lafayette)**

| IP Item Description |
|---|
| **P – 6A.022.UL - 1 : Combination of Paired Learner and ADWIN Algorithms.** |
| **Key Concept 1:** Paired Learner is suitable for detecting abrupt changes and omits gradual changes. |
| **Key Concept 2:** ADWIN is designed to detect gradual changes but omits abrupt changes. |
| **Key Concept 3:** Paired Learner + ADWIN enables discovery of gradual and abrupt concept drifts. |

| IP Item Description |
|---|
| **P – 6A.022.UL - 2 : Refined Paired Learner** |
| **Key Concept 1:** Original Paired Learner algorithm focuses mainly on frequency of the changes detected not the magnitude of the changes. |
| **Key Concept 2:** In the refined paired learner, we introduced a severity measurement for concept drift, Sine Alpha, Alpha being the prediction error slope comparing to the ground truth. |

## CVDI Project 6A.027.SBU – The Intelligent Dashboard, Drs. Darius Coelho, Bhavya Ghai, Arjun Krishna, Klaus Mueller (Stony Brook University), Stephen Greenspan, Maria Velez-Rojas (CA Technologies) and Brian Foose (Smith Glaxo Kline) (Stony Brook University)

| IP Item Description |
|---|
| **P – 6A.027.SBU - 1 :** Automatically finds interesting patterns in multivariate data and ranks them according to a human-centric interestingness score. |
| **Key Concept 1:** Automatic ranking of patterns in multivariate data. |
| **Key Concept 2:** Interestingness score relevant to human cognition and perception. |

| IP Item Description |
|---|
| **P – 6A.027.SBU - 2 :** Automatically assigns the best fitting visualization to a data pattern, given a user's organizational role, task, clearance, visual literacy, and data exploration tasks, such as exploration, prediction, monitoring, etc. |
| **Key Concept 1:** Automatic determination of best base visualization for a given data pattern. |
| **Key Concept 2:** Automatic determination of best base visualization flavor for a given data pattern. |
| **Key Concept 3:** Applies multiple organization criteria such as user's organizational role, task, and clearance. |
| **Key Concept 4:** Applies multiple personal criteria such as visual literacy data and preferences. |
| **Key Concept 5:** Applies multiple task-based criteria such as exploration, prediction, monitoring, etc. |

| IP Item Description |
|---|
| **P – 6A.027.SBU - 3 :** Automatically assembles these ranked best fitting visualizations into a small, optimal, and consistent ensemble for integration into an informative dashboard. |
| **Key Concept 1:** Automatic assembly of visualizations into a small and consistent ensemble. |
| **Key Concept 2:** Optimization of the ensemble's size and magnitude based on the conveyed information. |
| **Key Concept 3:** Automatic integration and organization of this ensemble into an informative dashboard. |

## CVDI Project 6A.029.SBU – Independent Certification Of Trusted Aerospace Products, Drs. A. Kaufman (PI-Stony Brook University) and R. Kelly (Stony Brook University) (Stony Brook University)

| IP Item Description |
|---|
| **P – 6A.029.SBU - 1 :** A process for the evaluation of trusted aerospace products (e.g., Vehicle Management Systems). Languages/technologies: A process for the inclusion of cyber-security principles in the design and software development phases of trusted aerospace products. Languages/technologies: All languages and technologies used in the production of trusted aerospace products. All languages and technologies used in the production of trusted aerospace products. |
| **Key Concept 1:** Evaluating trusted product software and software designs for inclusion of standard principles of cyber-security. |
| **Key Concept 2:** Selection of a suite of tools for the automated analysis of software used in trusted aerospace products. |

**CVDI Project 6A.060.UL – Detecting And Identifying Wildlife Animals From Images Using Deep Learning, Drs. Henry Chu and Keying Xu**
**(University of Louisiana at Lafayette)**

| IP Item Description |
|---|
| **P – 6A.060.UL - 1 :** Tuned deep learning, viz. YOLOv2, YOLOv3 and Detectron, algorithms to detect wildlife animals such as tegu lizards in digital images captured by motion-sensed cameras. The method can be adapted to other targets.<br><br>**Keywords:** Machine learning, supervised learning, deep learning, object detection in images. |
| **Key Concept 1:** Adjusted hyper-parameters to train models with best performance on YOLOv2 and YOLOv3 algorithms. |
| **Key Concept 2:** Adopted different backbone neural networks and adjusted hyper-parameters to train deep learning models with best performance on Detectron. |
| **Key Concept 3:** Analyzed and summarized the configuration with the best precision/recall performance measures. |

| IP Item Description |
|---|
| **P – 6A.060.UL - 2 :** Implemented two image classification algorithms, VGG16 and Alexnet, in Keras to perform binary classification on images.<br><br>**Keywords:** Machine learning, supervised learning, deep learning, transfer learning, image classification. |
| **Key Concept 1:** Used transfer learning to train models and computed precision and recall measures for the USGS tegu lizard data set. |
| **Key Concept 2:** Analyzed performance and tweaked hyper-parameters to optimize detection performance. |