**Design Project Group #10: Progress Report #1**

**Due: October 8th, 2019**

**Project Name:** Using Pose Machines for Identifying Penalties in Hockey Videos

**Group Members:**

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**Project supervisors:**

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**Group meetings and meetings with advisor(s):**

* **Meeting #1 (Thursday September 19th, 2019):**
  + Absentee: Marine Huynh
  + Summary: We discussed a possible plan to separate the work into 2 parts. The first part will include an initial research on the literature available. We must try to find if hockey penalty detection is a problem that has already been attempted before by someone else and if so, what approach did they use. Dr. Levine estimates that very little literature, if not at all, will be available. Karl’s and I suggestion were expand the scope of the literature research to sports in general if there is not for hockey penalty and see what there is generally available.   
      
    We then discussed how the work will be separated amongst three students. A first student will need to research the categorization of hockey penalties and create a sample dataset of ~30 clips for each penalty. A second student will need to conduct a literature review on penalty detection as mentioned above. A third student will need to attempt to implement the pose estimation results obtained in the paper **“OpenPose: Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields”** by Z. Cho et al.
* **Meeting #2 (Thursday October 3rd, 2019):**
  + Absentee: None.
  + Summary: We discussed the paper **“OpenPose: Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields”** by Z. Cho et al. The contents of the paper describe the functioning of the OpenPose library, which is code that the authors wrote that allow for pose detection in a video stream. Fay and Dr.Levine helped us clarify several aspects of the paper that was a bit too abstract for us and made sure that we understood their procedure. We also discussed the next step of the project, which is to start replicating the results of the paper using CIM machines.

**Progress Report #1**

**Engineering Tools:**

* The engineering tools required for this project includes:
  + Access to CIM computers with GPUs: Needed to time-efficiently train our machine learning models. We estimate that our personal computers are not fast enough to perform this computational heavy computing. Also, it is good that the work of all three students remain in one place.
  + Access to CIM database: Needed to store clips of hockey video penalties so that Dr. Levine and his team can have access to them for future use if need be.
  + Python with OpenCV and OpenPose: Needed to conduct design project. These are all open source. We might need authorization to download OpenPose and OpenCV libraries onto CIM systems from an IT administrator.
  + TeamViewer (or similar remote access SSH software): Needed to work remotely. This will greatly increase the number of hours our team can put into the design project.

**Teamwork:**

* We decided to separate the work as discussed in our first meeting with Dr. Levine and Fay. One student will research on NHL hockey penalties and create a database of clips that we can train on. Another student will perform a literature review of available papers on methodology of penalties detection. This student might be done early due to the possible lack of papers in that field. If that is the case, he/she will help out student #1 build the database of hockey penalties clips. The third student will try to reproduce the OpenPose paper’s result. Afterwards, the three students will get together and all attempt to build a classifier that will identify hockey penalties in clips that the machine has never seen before (i.e. apply machine learning methods).
* We are going to communicate with the supervisors via email. In-between teammates, we are planning to use a Microsoft Teams conversation to better help isolate different conversation going on during our design project. Our student license allows us to use this professional program. For typing up reports, we are using Microsoft Word Online alongside our Microsoft OneDrive to store the documents.

**Impact on Environment:**

* This project’s impact on the environment will be relatively small, both during the developmental phase and as a marketed product. As the project is purely a software project, it does not have any direct impact through physical interaction. However, the tools used to develop it and the industry it encourages do have an impact. Implementing and training the machine learning algorithms that will be used to perform the identification of penalties will require a substantial amount of computations which will be powered by carbon emitting electricity (hydroelectricity). Furthermore, the hockey/sports industry has an impact on the environment through the electricity it uses to power its stadiums and the products consumed by its customers. This project aims to improve this industry and, by extension, increase its impact on the environment.

**Ethics and Equity:**

* At this moment, the team has not yet encountered any ethical dilemmas. However, as with anything related to machine learning, this project does deal with ethical issues such as online and real-world privacy. As expected, computer vision can be used to facilitate the analysis of large datasets of images rapidly, allowing governments or private corporations to harvest data on individuals automatically. Specific to this project, pose estimation in combination with penalty detection will be used to identify the behavior of one or many individuals on an image. In a different context, this could be used facilitate the identification of illegal actions in a crowd of people. Although certainly beneficial to law enforcement, this could enable mass surveillance of crowds where there is virtually no privacy.

**Lifelong Learning:**

* Our various backgrounds complement each other well. However, we still have a lot to learn regarding machine learning. To rectify this, we are all taking machine learning classes over the course of the project. Furthermore, we have already taken, are taking, or plan on taking computer vision classes which will greatly help our understanding of the background research that will be used to implement this project.

**Recent Progress:**

* So far, our team members had met 2 times with professor Levine and Fay to assure a continuous development of the project. We started by having a general understanding of what the project entailed, by reading and watching videos about the general concepts such as human poses estimations. A breakdown of the different tasks that needs to be completed was proposed, and we separated them between the members of our team. All members read the paper “Realtime Multi-Person 2D Pose Estimation using Part Affinity” which is a technical paper on part affinity fields used to detect parts of the body on 2D poses with multiple people. We want to have a strong understanding of this paper as our project will be built on these concepts, and adapt it on hockey players to detect penalties. More readings were done depending on the high knowledge of each member to comprehend the paper in more depth. We also had the chance to discuss our understanding and ask questions to professor Levine and Fay in order to better our understanding and have more detailed information. We then started to look at the software and the existing code.

**Future Plans:**

* For the next 2 weeks, we want to familiarize ourselves with the software and the code on <https://github.com/ZheC/Realtime_Multi-Person_Pose_Estimation> by doing hands-on with either of the two datasets used in the paper (MPII or COCO datasets). We will try to mimic what has already been done by validating it with the expected output. To help with this, we need to have access to servers in order to run large data, which was provided by professor Levine and Fay to facilitate our research and development phase. On the side, we will do more readings on penalty detection methods and how to categorize those penalties.