EE/CprE/SE 492 GROUP PROGRESS REPORT

Group number:
sdmay22-45
Project title: ***Machine Learning in an Embedded Systems Application***
Client: ***Dr.Rover***
Advisor: ***Dr.Rover***
Team Members: ***Tyler Ingebrand, Amy Wieland, Yi Ting Liew, Chris Hazelton, Sean McFadden, Nathan Bruck, Nayra Lujano***

- **Project Summary:** *(Short summary about the project. What are the design goals? Has the direction or scope of the project changed? This should be about a paragraph in length.)*

In this project, we are seeing how machine learning can be incorporated into current or future courses at Iowa State. In doing this, we are using reinforcement learning to teach a robot dog how to walk. The robot will be trained in a virtual environment. This will then be deployed on our robot to walk in the physical world. Our goals are to demonstrate machine learning in an embedded application and to make recommendations on incorporating an embedded machine learning course for the department.

- **Accomplishments** *(Please describe/summarize as to what was done, by whom, when and, collectively as a group since the last report. This should be about a paragraph or two in length. Bulleted points are acceptable as well. Please keep only your technical details related to your project. Figures, schematics, flow diagrams, pseudocode, and project related results are acceptable, but please ensure that they are legible (clear enough to read) and to provide an explanation. If researching a topic, please add a few details about what was learned and how it is relevant to the project. If two or more people worked on a single task, be sure to distinguish how each member contributed to the task. Specific details relating to the assistance provided to other members may be included here.**)**

Amy: Since the last group report, I have been working on shifting our c++ application to compile using a cmake file rather than a MakeFile. It has been a little bit tricky figuring out how to incorporate the different dependencies we need for the embedded side and agent side into the cmake format. I also implemented the neural network agent interface. This interface is what will work with the neural network model to determine the robot's next action and communicate this to the embedded side of our application. Lastly, I worked with Yi Ting to fix some compiling issues with the logger.

Chris: Since the last group report, I have found all of the security features I plan to put on the raspberry pi and plan to do so very soon. I have not had the chance to work with the raspberry pi the last 3 weeks due to school life and travel so I will be working on it next week.

Tyler: Since the last group report, I have been working on fine tuning the environment to make it more closely match reality, and I have been working on reward shaping. I realized I needed to switch the environment to be in local coordinates so the state is consistent regardless of direction. I also realized instead of trying to train for the highest speed possible, I need to train it to have a consistent but positive speed. This way, it has a more stable goal instead of the unstable version of trying to go faster and faster.

Sean: I have been working on implementing the embedded side of our project. I incorporated controls for our Bittle robot into our C++ application. We are now able to move the Bittle's servos and read from the IMU. I also adjusted our Stretching Agent to interface with the Bittle. This agent repeatedly moves the legs of the Bittle to their maximum positions.

Nathan: I have been working on the embedded side of the robot to generate more stable values for the pitch and roll, as well as preventing the yaw value from drifting. I have integrated a new IMU with 9 DOF which gives us access to a magnetometer which will be used to prevent yaw drift. I am currently working on integrating the magnetometer values into the complimentary filter.

Yi Ting: Before Spring break, I have finished up all the implementation part in logger. With the help from Amy, I was able to fix the compilation errors from the code and thus push into git so that Amy can start testing on the code. This week, I could proceed by working on either the lab questions or presentation poster once we discuss what needs to be included with Dr. Rover.

Nayra:

- **Pending issues** *(If applicable: Were there any unexpected complications? Please elaborate.)*

Python training: Reward shaping is a long and tedious process. The behavior of the model can vary greatly depending on the reward function. I am therefore worried about the reward function and end results, and I will continue to be worried until it works.

Loading Python Model into C++: The method to load the python model into C++ required a transition from a Makefile to a cmake file. Configuring the different dependencies needed for the embedded side in the cmake file presented some issues when compiling from a laptop versus a pi.

- **Advisor Input/Signature:**

  Please select one of the options below and sign.

  _____ I am pleased with the progress the team is making.

  _____ The team's progress could use some minor improvements which I will discuss with them.

  _____ The team's progress has some major concerns that I will discuss directly with Dr. Bigelow

  bigelow@iastate.edu , 515-294-4177

  Signature:

_____

Diane Rover 1:33 PM

Regarding the progress report, I am satisfied with your progress. Thanks. --Dr. Rover