Implementation of Basic Machine Learning and Iterative Algorithms into a Self-Tuning PID System

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In control systems engineering, control theory is the branch of engineering that deals with applying inputs to a system to get a specific output. A pertinent element of control theory is the application of PID, a type of closed-loop feedback algorithm, to give a dynamic output in response to a specific input in order to reach a given setpoint, used in a wide variety of settings–examples include the smooth cruise control in cars or the slow temperature control of an in-home thermostat. However, these systems require the fine-tuning of the values of P, I, and D in order to provide a functional controller with smooth changes in output that do not stress the tolerance of the system. In this project, the goal was to make a PID tuning system applicable directly to dynamic physical inputs. Although there have been algorithms made in the past to provide P, I, and D values when given certain inputs, most are dependent on an infinitely precise mathematical backbone, which in engineering is rarely the case. Initially, using systems on a robot as a testbed, generic PID systems were set up. This was followed by the creation of a generic Java-based function that would systematically choose P values and correct for them according to a quantified measure of the discrepancy of the system from what would be attributable to an ideal P value, which was then repeated for the I values. This novel algorithm is applicable in small-scale tuning for individual PID controllers, or on larger scales in manufacturing to increase quality control and account for the wear-and-tear on individual machines.