



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

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Project Title An Investigation into the Optimization of Control Systems	
Abstract Objectives/Goals The objective of this project was to determine the best control algorithm for a system where energy and time is important. The project considered the more prevalent PID and Fuzzy logic controllers against a control, the bang-bang controller in a heating simulation program. It was then hypothesized that the fuzzy logic controller would be the "best" controller because it imitated human intelligence. Methods/Materials The algorithms were written in BASIC in the Excel environment, with the data being easily accessible and easily manipulated. Within each program, the heating simulation was constant that is the assumed initial temperature, desired temperature, maximum output, etc were the same for every program. Once the basic theory of each system was coded, the programs were executed to provide data for each controller. Results The results yielded conformed with the nature of each controller. The simulation for the bang-bang resulted in oscillation. The simulation for the PID resulted in less oscillation and stabilization. The fuzzy logic simulation resulted in maintaining the desired with no overshoot. The data was further analyzed by the efficiency matrix. The matrix provided a score based off of total energy usage, oscillation, and time, and by comparing the individual scores against the control Bang-Bang controller, it became evident that the Fuzzy Logic Controller was the most effective in this context, validating the initial hypothesis. Conclusions/Discussion It is important to realize that this experiment sought to compare three different controller theories in the most unbiased manner. The efficiency matrix allowed for an objective comparison, but the supremacy of the Fuzzy Logic controller is not always the case. The PID algorithm itself could be optimize to approach the results of the Fuzzy Logic controller. At the same time, because these algorithms are often integrated onto microcontrollers, the size of the individual controller programs must also be taken into account. Given all these constraints, the generalized rule is that the "optimal" control system is very much based on the context.	
Summary Statement This project sought to compare different control algorithms (Bang-bang, PID, and Fuzzy Logic) in an objective fashion.	
Help Received	