The Smart Eraser

ECE 186A - Senior Design I

Fall 2018 - Dr. Stillmaker

Date: Friday, October 19, 2018

Project Manager: Heather Libecki _____

Team Member: Chris Quesada _____

Team Member: Juan Colin _____

Technical Advisor: Dr. Kulhandjian _____

I. Smart Eraser Description

Our project, the Smart Eraser, is an automatic whiteboard eraser. The main deliverable of this project will be an eraser which can move left-to-right on a track, and up-and-down on a linear motion system attached to the track. This eraser will be able to detect where markings are on a whiteboard through the use of a camera and an image-processing program. The camera will send the image of the whiteboard to a microcontroller which will process the image, detect where the markings are, and convert their locations to a coordinate system that the mechanical aspects of the eraser will be able to read. The eraser will then find the quickest route to erase all of the markings before returning to its stand-by position. Finally, the eraser will be able to detect the presence of a person through the use of the camera and motion-detection technology. This will check if there is a person moving in front of the whiteboard, and if there is, the result would be an immediate termination of the process the Smart Eraser was carrying out; this is to ensure the safety of those around the Smart Eraser while it is operating.

II. Impact of the Smart Eraser

The Smart Eraser aims to assist teachers and students who want to focus more on the material being taught and less on the clean up afterward. Have you ever been in a classroom and your teacher fills the whole whiteboard with notes and various examples, only to use precious class time to erase it everytime they need more space to write? With the Smart Eraser, teachers could leave that tedious task to the machines. In between examples, a teacher would be able to clear the board with the press of a button, and then continue teaching without worry.

Our project would require a railing system to connect to a whiteboard, as well as a place to mount the camera to be used for image processing. With California State University, Fresno in mind specifically, each classroom already has a projector mounted on the ceiling which points toward the whiteboard at the front of the classroom. The Smart Eraser would utilize this mounted space to place the camera, and wall mounts would be used to put the track system on the board itself.

At the beginning of this project, research was done to see if there were any similar models or products that already existed which accomplish what the Smart Eraser would do. Various âĂIJautomatic whiteboard eraserâĂİ projects were found, but they were focused more on the mechanical movement of the eraser, and less on the brains behind one that could detect where it needs to go in a minimal amount of time. Therefore, the Smart Eraser will be unique in its capabilities to detect not only where it needs to go on the whiteboard, but also how to get those markings erased in the shortest time possible.

III. Budget Estimate

Component	Est. Price
DE1-Soc FPGA Development Board - Terasic	$175
CNC stepper motor driver - STEPPERONLINE	$67.90 ($33.95)
Carriage with Stainless Steel Balls; for use with 115RC Linear Tack - Accuride	$67.16 ($33.58 x2)
115RC 47in Linear Motion Aluminum Track Systems -Accuride	$62.68 ($31.34 x2)
Nema 23 CNC 2.8A Stepper Motor - STEPPERONLINE	$52.00 ($26.00)
1080p POE Camera - sv3c	$38.99
Dry Erase Board (prototype) 36" x 24" - VIZ-PRO	$31.90
Stepper Motor Encasing - D.Y Engineering	$25.98 ($12.99 X2)
5 Meter GT2 timing Belt (6mm width) - Mercury	$17.98 ($8.99 X2)
6.35mm GT2 40 Teeth Pulley Flange - uxcell	$14.38 ($7.19 X2)
Nema 23 Stepper Motor Steel Mount Bracket w/ Screws - HobbyUnlimited	$10.99
Dry Erase Whiteboard Block Eraser - Expo	$8.90
PCB for H Bridge (for Stepper Driver) and Stepper Motors, possible LCD screen	Unknown
Various Wires and Connection Cables	Unknown
Total Rough Budget	**$573.86**

TABLE I: Estimated costs of components for project

IV. Project Schedule

Member Assignment	End Date	Description
All	A	Complete Smart Eraser Project Proposal to be submitted to DPS Telecom for review.
All	B	Finalize the specifics of the budget.
All	C	Create the Project Charter rough draft to be turned in.
All	D	Draft a more detailed blueprint of the physical Smart Eraser deliverable.
All	E	Revise the Project Description; complete for future reference.
All	F	Draft the flowchart to show the logical relationships between all connected devices within the project.
All	G	Complete bi-monthly update presentation for Senior Design class.
Juan C.	H	Complete a block diagram detailing the specific connections between the devices within the project.
Chris Q.	I	Research communication and protocols to be used.
Heather L.	J	Research the camera and how it will send data through the ethernet cord.
All	K	Complete bi-monthly update presentation for Senior Design class.
Heather L.	L	Research the microcontroller to be used (DE1-SoC).
Chris Q.	M	Research the image processing program and what programming language to use to best suit the project's needs.
Juan C.	N	Research the mechanical system and the power connection it requires.

Member Assignment	End Date	Description
All	O	Complete bi-monthly update presentation for Senior Design class.
Chris Q.	P	Test the microcontroller after researching the ports needed for the project.
Heather L.	Q	Test the microcontroller after researching the ports needed for the project.
Heather L.	R	Research the coordinate system that will be used to convert pixels in an image to movements within the mechanical system.
All	S	Complete bi-monthly update presentation for Senior Design class.
All	T	Complete the final draft of the Project Charter.
All	U	Present Project Charter to Senior Design class, professor, and academic advisor.

TABLE II: Senior Design Semester 1 - Research Phase.

Member Assignment	End Date	Description
Chris Q.	A	Develop the code for the image processing program.
Juan C.	B	Configure the power system for the mechanical parts of the Smart Eraser.
Juan C.	C	Build the mechanical system the eraser will be attached to.
Heather L.	D	Develop the coordinate system.
Heather & Chris	E	Develop the algorithm to determine the quickest path to erase markings on the board.
All	F	Integrate the microcontroller with the mechanical system.
All	G	Test the newly formed microcontroller-mechanical system.
Heather L.	H	Connect the camera to the microcontroller ports.
Chris Q.	I	Test the image processing program with the camera.
Chris Q.	J	Create the motion-detecting program.
All	K	Integrate the motion-detecting program with the camera and microcontroller-mechanical system.
Heather L.	L	Test the motion-detecting program.

TABLE III: Senior Design Semester 2 - Implementation Phase.

V. Lab and Other Resources Needed

VI. Project Team Bios

VII. Smart Eraser Description

VIII. Economic Analysis

IX. Advisor Recommendation