TYL 08: Lord of the Bridges

Electrical & Mechanical Engineering

POPSICLE STICK BRIDGE BREAKER

Team Members: Abdulrahman Jijakli, Breena Hughes, Eutrope Saguo Kaptue, Garrett Klein, Jim Florek, Joseph Ruesewald, Tyler Williams
Sponsor: Department of Mechanical Engineering
Faculty Advisor: Dr. Nael Barakat

INTRODUCTION

Abstract
The purpose of this project is to design and build a device that automates the registration and tests of the Alief grade schools' Popsicle Bridges built by students as part of a competition and organize all input and output data in a way that emphasizes tested attributes for each bridge, and assigns ranks.

Background
The popsicle bridge competition is an annual event that attracts many grade schools which that has drastically grown in the last few years. Due to the increase in size, the current hand cranked testing methods are insufficient because of the time it would take to test. It also lacks the accuracy of sensors. Therefore, the goal of this project is to automate the registration, testing, and results calculation process for any number of participants in the competition.

Operation Sequence

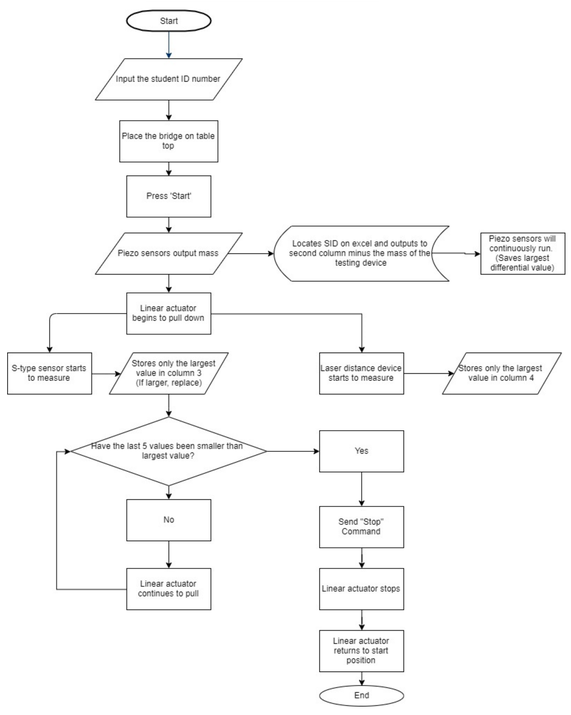

Figure 1: Proposed device logic

The proposed device, as seen in figure 1, is designed to test the bridge to a complete failure. The device will exert one eights inch displacement per cycle, increasing the pressure on the bridge gradually, while storing stress data from the load sensor. The sensor will assist in automating the device by monitoring change in stress values and stopping the test at the appropriate time. All needed data will be displayed to the user at this point.

PROJECT CONCEPT

Main Parts of the Selected Concept Design
A popsicle bridge will be placed on top of the table then pulled down by a linear actuator connected to an S-type sensor, seen in figure 2. This setup will create a tension or a force on the bridge that steadily increases by 1/8 of an inch every cycle. Once a bridge can no longer hold the applied force the system will automatically shut down. Below is the custom tabletop that was designed. It has 3 different distances for separation based on the 3 age levels varying distances for their bridges. Mounted on Top of the bridge is a mass called the 'truck' and it is connected to the actuator for the additional force to be applied.

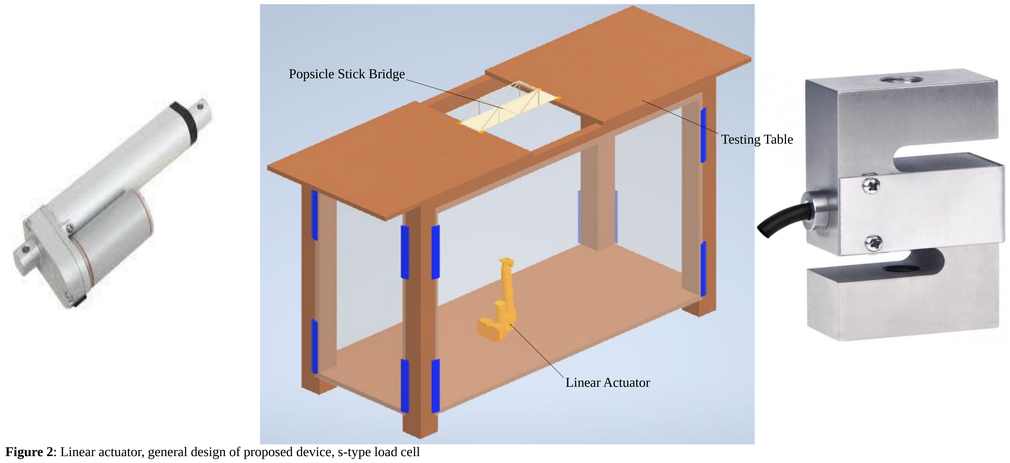

Figure 2: Linear actuator, general design of proposed device, s-type load cell

REGISTRATION AND OUTPUT

The registration process was done in synchronization with a sister team. For this part, students will receive a QR code at the beginning of the competition. After scanning the QR code, Students will be able to access the online registration that is linked with a Google Sheets page. This will then output to a local Excel sheet which will receive updates from the device. At the end of each test, the device will update the local Excel sheet which will copy and sort into the three varying test conditions. Each test will independently rank the competitor and then output back to the sheets. This test will give a minimize chance of any fraudulent activity happening to the competition. Below is a QR code, figure 4, linked to a sample of what the registration may look like as well as the logic for the code, figure 3.

Figure 3: Programming logic

Figure 4: Example QR code

CIRCUIT DIAGRAM

The power for the system will come from a 120 Volt outlet. Both the Raspberry Pi and the linear actuator will be plugged in with built in transistors in the plugs. The S-type sensor will be powered by the Raspberry Pi. Since the sensor is analog, there will be an analog to digital converters. Shown below is the Raspberry Pi pin-out diagram, figure 5, and power diagram, figure 6.

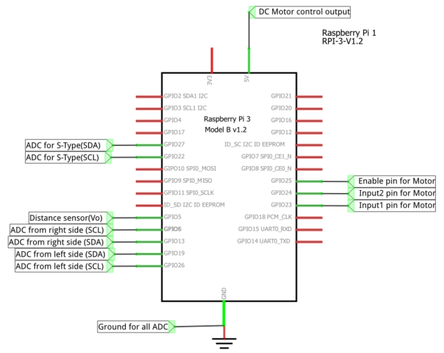

Figure 5: Pin-out diagram for raspberry pi

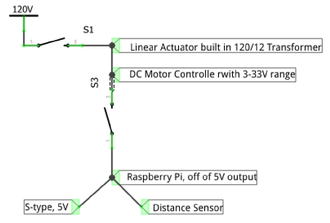

Figure 6: Power diagram for proposed device

Competition Results

Table 1 shows the resulting data from several different bridges being tested. This will be what the contestants see during and after the competition. Timestamp, team ID, team name, school name, and competition level will be entered during the registration process. Mass of the bridge will be entered at the competition at a weigh in station and weight held will be entered in automatically by the device once the contestants bridge has been tested. Lastly, the weight/mass column is an automatic compilation that will tell the outcome of the competition. This is preferable to highest weight held determining the winner as weight/mass will incentivize students to build a bridge that not only holds a lot of weight but also has a low mass.

Table 1: Competition Results

Popsicle Bridge Competition

Timestamp	Team ID	Team Name	School Nam	Competition Lev	Mass of the Bridge (	Weight Held (I	Weight/Mass
3/29/2020 12:00:00	11001	Thundercat	Whitehouse	Highschool	1.642	420	255.7856273
3/29/2020 12:02:49	12001	Hedgehog	Arp	Highschool	1.489	324	217.5957018
3/29/2020 12:01:12	10001	Bobber	Troup	Highschool	1.657	204	123.1149616
3/29/2020 12:05:02	07001	MetroStars	Troup	Middleschool	0.981	120	122.324159
3/29/2020 12:03:56	07002	Purple Panther	Whitehouse	Middleschool	0.985	100	101.5228426
3/29/2020 12:06:24	06001	FC Dallas	Arp	Middleschool	1.012	97	95.84980237
3/29/2020 12:07:52	05002	Vikings	Whitehouse	Elementary	0.333	22	66.06606607
3/29/2020 12:10:30	05001	AC/DC	Arp	Elementary	0.345	15	43.47826087
3/29/2020 12:09:14	04002	Teilbethia	Troup	Elementary	0.328	12	36.58536585
3/29/2020 12:11:41	04001	Champions	Tyler	Elementary	0.318	10	31.44654088