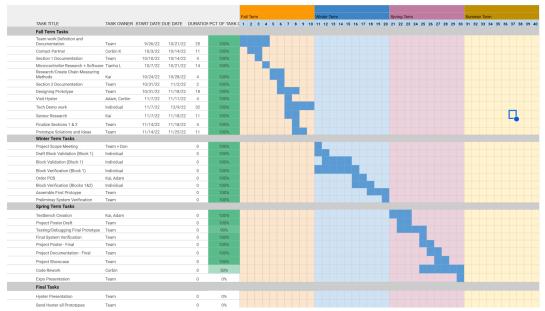The goal of this project is to create a chain elongation monitor for the Hyster-Yale Group that will automatically detect a worn lift chain and notify an operator to replace said chain. Chains, especially lifting chains, need to be frequently inspected to ensure they meet specifications. A 3% increase in a chain's length can reduce its lifting capacity by 15%. This can become a dangerous hazard if out-of-spec chains are not caught.

Currently, this inspection is either done by hand or by expensive third party devices, thus the creation of a cheap electronic alternative is very desirable. We plan to use three pairs of IR LEDs and IR receivers that will act as our sensors. These pairs will be situated in such a way that the IR "beam" will break when a chain link passes the sensor and reconnect in the gap between chain links. One pair will be used to measure the speed, while the other two will measure the "stretch" of the chain by recording the time difference between activations and calculating a length measurement.

In addition to the sensors, the device will consist of a power circuit to convert a Forklift's 24V power into 5Vs, a CAN communication circuit, and a microcontroller to calculate the elongation based on the sensors and send those measurements via the CAN Circuit to the Hyster Vehicle. We chose an ATTiny814 for our microcontroller as it is a relatively small and cheap microcontroller and is capable of performing necessary functions, such as basic calculations and time measurement.

Our project partner has specified that the device needs to meet four requirements:
1) The device needs to measure chain "stretch" (wear) within ±5% of the actual measurement.
2) The device, specifically the electronics, need to cost less than $15 or less at a production quantity of 15,000/yr
3) The device need to be robust enough to survive abrasive (high chain wear) applications
4) The device needs to communicate using the CAN communication protocol

TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION	PCT OF TASK C
Fall Term Tasks					
Team work Definition and Documentation	Team	9/26/22	10/21/22	25	100%
Contact Partner	Corbin K	10/3/22	10/14/22	11	100%
Section 1 Documentation	Team	10/10/22	10/14/22	4	100%
Microcontroller Research + Software	Tianho L	10/7/22	10/21/22	14	100%
Research/Create Chain Measuring Methods	Kai	10/24/22	10/28/22	4	100%
Section 2 Documentation	Team	10/31/22	11/2/22	2	100%
Designing Prototype	Team	10/31/22	11/18/22	18	100%
Visit Hyster	Adam, Corbin	11/7/22	11/11/22	4	100%
Tech Demo work	Individual	11/7/22	12/9/22	32	100%
Sensor Research	Kai	11/7/22	11/18/22	11	100%
Finalize Sections 1 & 2	Team	11/14/22	11/18/22	4	100%
Prototype Solutions and Ideas	Team	11/14/22	11/25/22	11	100%
Winter Term Tasks					
Project Scope Meeting	Team + Don			0	100%
Draft Block Validation (Block 1)	Individual			0	100%
Block Validation (Block 1)	Individual			0	100%
Block Verification (Block 1)	Individual			0	100%
Order PCB	Kai, Adam			0	100%
Block Verification (Blocks 1&2)	Individual			0	100%
Assemble First Protoype	Team			0	100%
Preliminay System Verification	Team			0	100%
Spring Term Tasks					
Testbench Creation	Kai, Adam			0	100%
Project Poster Draft	Team			0	100%
Testing/Debugging Final Prototype	Team			0	90%
Final System Verification	Team			0	100%
Project Poster - Final	Team			0	100%
Project Documentation - Final	Team			0	100%
Project Showcase	Team			0	100%
Code Rework	Corbin			0	50%
Expo Presentation	Team			0	0%
Final Tasks					
Hyster Presentation	Team			0	0%
Send Hyster all Prototypes	Team			0	0%

At the end of our project, we were able to meet 3 of the 4 project partner requirements with the accuracy requirement being the one that was not met. This is mostly due to not having enough time to finish experimenting and debugging the code. With better time management and planning, we would have been able to finish the development of our code and could have met the final requirement.