Jibebe Internship 2022

Progress report Week 4
Electric team

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Tasks completed last week

[#43] Torque calculation for the e-tricycle: Computations were done by the electric team to establish the torque that the motor could produce to determine whether the tricycle could handle high-torque loads such as disabled ramps. The calculations indicated that the chosen motor could provide sufficient torque. The calculations were also shared with the mechanical subsystem for analysis and feedback.

[#36] Revision of timelines: The electric team revised the timelines based on the feedback given by the supervisors to cater for the procurement delays.

[#30] Experimental characteristics of the motor: Due to the unavailability of a motor dynamometer, the team researched on the parameter and performance reports for the motor that was chosen. Analysis was done and a report is under preparation.

Below are snippets of the torque analysis computations

Calculations To Determine The Maximum Torque To Be Produced By The Motor

The expected maximum load given acceleration of 0.5m/s^2 and a carriage of 220Kg is is 500W.
To determine the maximum torque required for this application, then:

$$P = \tau\omega$$

$$\omega = \frac{2\pi n}{60}$$

Smaller Sprocket: 48.42mm

Larger sprocket: 17.5cm

Wheel: 50cm

$C = 2\pi r = \pi d$

Diameter of wheel = 0.5m

$C_{\text{of wheel}} = \pi \; x \; 0.5 \; = \; 0.5\pi \; m$

Distance (D) covered by the wheel is $0.5\pi \; m/rev$

The maximum speed of the tricycle is 4.5 m/s

Therefore, to obtain the number of revolutions per second for the wheel at maximum speed:

Speed in rps $= \frac{4.5m/s}{0{\cdot}5\pi m/rev} = \frac{9}{\pi} \; rev/s = \frac{9}{\pi} rps$

In rpm $= \frac{9}{\pi} \; x \; 60 \; = \; \frac{540}{\pi} rpm \; = \;$ 171.8873385 rpm

Method 1:

Large Sprocket Parameters:

Since angular velocity is the same for two axially connected wheels, then the rpm of the wheel is the same as the rpm of the large sprocket:

Rpm of wheel = $\frac{540}{\pi} rpm$

$C = 2\pi r = \pi d$

Diameter of large sprocket = 0.175m

$C_{\text{of wheel}} = \pi \; x \; 0.175m = 0.175\pi \; m$

Distance (D) covered by the larger sprocket is $0.175\pi \; m/rev$

Linear speed of larger sprocket = $\frac{540}{\pi} rev/min \; x \; 0.175\pi \; m/rev$ = 94.5 m/min = 1.575 m/s

The full document can be found in the electric folder under research reports.

Tasks in this week

- [#44] Battery and motor sizing for the Shujaa tractor.
- [#33] Calculations of the power requirements for the Shujaa Tractor.

Total estimation of weeks: 12

Week	Tasks	Reporting	Hrs	Month
5 - Requirements review				
5.1	Finalize on battery acquisition for the Tricycle	None	20	Feb
5.2	Finalize on motor and torque requirements for the Tractor	None	8	
5.3	Clarify best choice for motor orientation for use in Tractor to allow for automation	Team meeting to review the best course of action	5	
6 - Research				
6.1	Research and recommend best motor for our specific use case in the Tractor	Electric Team Meeting	20	Feb
6.2	Get experimental data for motors and run simulations for verification	None	20	
7 - Testing				
7.1	Alpha testing of newly arrived battery for the tricycle.	Electric Team Meeting	20	Feb
7.2	Testing of integration with other components of the electric subsytem	None	25	
8 - Deployment				
8.1	Deployment of the electric subsystem of tricycle to finalized Tricycle	None	20	March
8.2	Fixing of any issues that may arise during Integration	None	20	
9 - Testing				
9.1	Alpha testing of newly arrived components for the tricycle.	Electric meeting	16	March
9.2	Getting experimental resuts of the components and NDT to validate correct operation and performance under load	None	24	

10 - Integration				
10.1	Integration with other subsystem	Team meeting	40	March

11 - Testing				
9.1	Alpha testing of entire assembled tractor	Team meeting	40	March

12 - Deployment				
12.1	Deployment of Shujaa Tractor	Team meeting	40	April