ENGINEERING EXPERIENCE 4

PROCESS REPORT

Team 11 PHOENIX

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Preparing Works

1.We designed ten logos,and chose Phoenix EE4 Small Solar Vehicle - Team 11 as our final decision.

2.We built a website,which is aimed to promote the SSV .
http://thephoenixssv.wordpress.com/
We built a blog,which is for our Phoenix project.
http://users.telenet.be/jonas.de.beckker/phoenix/news.html

Now,we are still working on them,in roder to make them as good as possible.

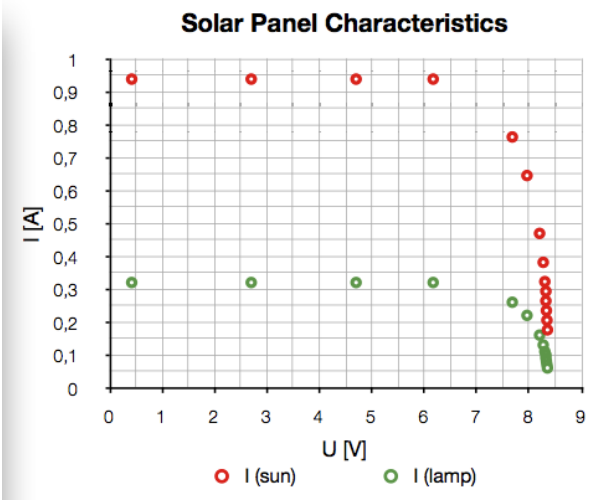
3.We made Breakdown Structure,Gant Chart and Plan of Approach.These made our work more clear and specific.

4.We signed a cooperation contract.This can help us work in a efficient way and avoid contradiction.

Measurements and Calculations

1.We measured the characteristics of the solar panel with equipment in the lab,and draw a characteristic curve of it.

	Measurements		Transformed to the expected sun rays
	U [V]	I [A]	0,88/I [A]
1	0,42	0,32	0,9387
2	2,7	0,32	0,9387
3	4,7	0,32	0,9387
4	6,17	0,32	0,9387
5	7,68	0,26	0,7627
6	7,96	0,22	0,6453
7	8,20	0,16	0,4693
8	8,27	0,13	0,3813
9	8,30	0,11	0,3227
10	8,32	0,10	0,2933
11	8,32	0,09	0,2640
12	8,33	0,08	0,2347
13	8,34	0,07	0,2053
14	8,35	0,06	0,1760



$$m = \frac{1}{\frac{N * U_r * \ln(\frac{I_{sc} - I}{I_s} + 1)}{U}}$$

Motor Data													
	Values at nominal voltage												
1	Nominal voltage	V	6.0	9.0	9.0	12.0	12.0	15.0	18.0	24.0	30.0	36.0	48.0	48.0
2	No load speed	rpm	9640	9980	8770	10400	9410	10300	9970	10700	10800	9800	9290	8380
3	No load current	mA	29.6	20.9	16.9	16.9	14.2	13.1	10.4	8.83	7.20	5.07	3.48	2.94
4	Nominal speed	rpm	7480	7350	6150	7820	6760	7620	7310	8060	8160	7090	6520	5620
5	Nominal torque (max. continuous torque)	mNm	4.81	6.33	6.42	6.36	6.31	6.29	6.25	6.23	6.18	6.15	6.03	6.10
6	Nominal current (max. continuous current)	A	0.840	0.757	0.673	0.597	0.533	0.465	0.374	0.301	0.241	0.181	0.126	0.115
7	Stall torque	mNm	21.5	24.1	21.5	25.5	22.5	24.5	23.5	25.2	25.1	22.3	20.3	18.6
8	Starting current	A	3.65	2.81	2.21	2.34	1.86	1.77	1.37	1.19	0.957	0.641	0.414	0.343
9	Max. efficiency	%	83	84	84	84	84	84	84	84	84	83	83	83
	Characteristics													
10	Terminal resistance	Ω	1.64	3.20	4.07	5.13	6.46	8.48	13.1	20.2	31.3	56.2	116	140
11	Terminal inductance	mH	0.106	0.222	0.288	0.362	0.445	0.584	0.890	1.37	2.10	3.68	7.29	8.95
12	Torque constant	mNm / A	5.90	8.55	9.73	10.9	12.1	13.9	17.1	21.2	26.2	34.8	48.9	54.3
13	Speed constant	rpm / V	1620	1120	981	875	790	689	558	450	364	274	195	176
14	Speed / torque gradient	rpm / mNm	452	418	410	412	422	422	428	429	435	443	462	454
15	Mechanical time constant	ms	19.1	18.8	18.7	18.7	18.7	18.7	18.7	18.8	18.8	18.9	19.1	19.0
16	Rotor inertia	gcm²	4.04	4.29	4.35	4.33	4.24	4.24	4.18	4.18	4.14	4.07	3.95	3.99

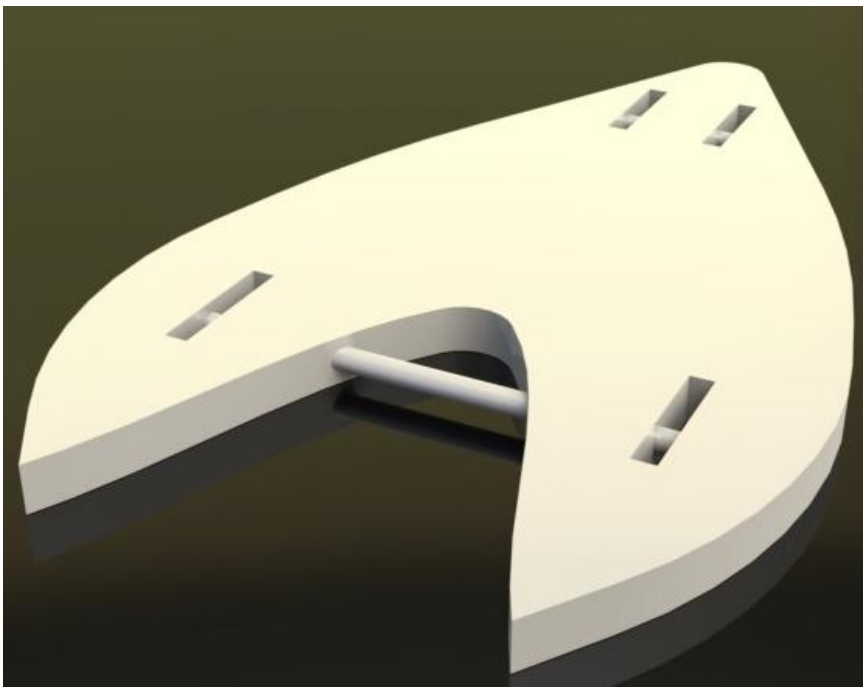
2.We calculated the"m"value with the formula
The average "m"value is 1,256.

3.We calculated the gear ratio,n= 8.53.

4.Our motor is "218799",and we looked for detailed information of our motor on MAXON MOTOR website.
http://shop.maxonmotor.com/ishop/article/article/218799.xml
Here is part of the data of our motor.
5.We weighed up and measured some of our components.
motor:53.23g solar panel:360g guiding wheel:21g
CD:6.4g
Bearing:1.5g axes:5.1 wheel:10g
Aluminum round tube: Φ=5 mm length= 305 mm
Bearing: innerΦ=5 mm outerΦ= 11 mm

Designs

We designed the basic shape of our solar car.



Problems and Adjustment

1.At very beginning,we considered the shape of the body to be square or rectangular.In this way,we would use four wheels and two of them would be motivated.At the same time,another formal came up.The shape also could be triangle,in this way,three wheels would be in need.On is in the front of the body and the others would be at the bottom.This triangle shape is lighter and easier to be set on the track.However,it is hard to fix wheel on the body. Finally,we choose a streamline shape,which is based on the triangle one.This one has less friction.We changed the three-wheel design into six wheels.Two wheels are at the front , two are at the bottom ,and we add two guiding wheels in the middle.

2.In order to decrease the weight and friction,we use small CDs instead of traditional rubber wheels.Each CD is 6.4g,it is much lighter.

3.We were trying to find a way to get more sunlight,for instance,using a mirror to help the solar panel absorb more sunlight,but it was too complex to realise and the additional weight was a big problem,so we had to give up this trial.Now,we plan to use a column to support the solar panel.They are connected with a rotating semicircle.So the panel can be easily adjusted to be against to the sun,and more sunlight can be gathered.

4.In order to lose weight,we are now trying to make a wooden frame to instead the plastic or steel frame.And we are also looking for some components made of aluminum or plastic to lose weight.

5.When we first calculated the gear ratio,the "n" value was around 4.That was much smaller than the reference value.We had to do it again.Finally,with the help of maple,we got to the "n"=8.53.It seemed to be alright.Now,the point is to design suitable gears.When we take the new value 8.53 into consideration,problems come up again.If we use a bigger small gear,the big gear is too big to attach to the solar car,but if we use a smaller gear,the big gear seems can function well,but the small gear is too small.We wonder whether fablab can make it so precise.If not ,we still have to solve the big wheel problem.