**School of Electrical and Electronic Engineering**



Embedded Systems Project

DESIGN REPORT #1

Title: ?

Group Number: ?

|  |  |  |
| --- | --- | --- |
| Group members name: | ID Number | I confirm that this is the group’s own work. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Tutor: Click here to enter text.

Date: Click here to enter a date.

Contents

[1. Introduction 1](#_Toc525895373)

[2. Motor characterisation 1](#_Toc525895374)

[3. Load measurements 1](#_Toc525895375)

[4. Gear ratio selection 1](#_Toc525895376)

[5. Summary 1](#_Toc525895377)

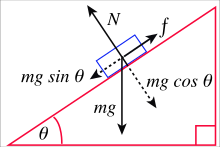
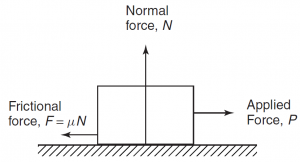
[6. References 1](#_Toc525895378)

**Load measurements:**

The aim of the experiment is to know the required force and hence the torque to move the buggy from stationary and at constant speed through across flat and inclined surface. By completing the load experiment and using the results to calculate the static and rolling friction coefficient, the force to move any buggy mass can be calculated, hence the torque. The Gear ratio can be selected as the selection is based on the compromise of both providing enough torque at the wheels for buggy to move through greatest resistance and still have significant speed. from the greatest resistance the voltage and current can be calculated from (4.??).

According to newton’s third law of motion; for every action, there is an equal and opposite reaction in the opposite direction of the force. So, the object will receive more opposing force if it weighs more, it pushes down more so exerts more force on surface. That given, every surface has a texture that is given by the coefficient so the result is friction, **F;**

)

****

On an inclined surface, weight is at an angle so has a force normal to the surface (3.3) and a force parallel to the surface, opposing the driving force at the angle of incline.

That means that using (3.2), (3.3) and (3.4 the driving force needed;

**Estimated Required force to move up the flat:**

|  |  |  |
| --- | --- | --- |
| On flat | Friction coefficient | Force (N) |
| Average Static | 0.064 | 0.785 |
| Average Rolling | 0.057 | 0.699 |

Figure {??}; Plot showing the force measurements of the ramp experiment on the flat surface against the weight

Figure {??} table of friction coefficient and corresponding calculated using (3.2) and predicted buggy mass 1.25 kg

Justification for accuracy of results:

The results agree well with theory. In figure ??, results agree with (3.1) and (3.2) as we see a constant increase of friction with weight. Furthermore, from (??), the best fit line is an approximate representation of , the trendlines show correct relationship between static and rolling coefficient with static being greater due to the need to provide a resultant force to accelerate to moving from stationary, according to newtons second law. Whereas at constant speed we only need to provide a force to balance friction.

|  |  |  |
| --- | --- | --- |
| Final inclined results | Friction coefficient | Force (N) |
| Static | 0.140 | 4.93 |
| Rolling | 0.059 | 3.87 |
| Chosen static | 0.064 | 3.93 |

**Estimated forces to move up the slope:**

At constant speed

From stationary

Figure ?? graph showing the coefficients of friction and corresponding force calculated using (3.5), predicted buggy mass 1.25 kg and angle 15.5 degrees

Figure {??}; Plot showing the force measurements of the ramp experiment on the inclined surface against the weight

Justification of accuracy of results:

Figure ?? also shows the relationship of (3.5) due to increasing force with mass and correctly shows that static is greater than rolling coefficient but not accurate data. Since the measurement of friction coefficient on the ramp is generally inaccurate shown by difference between 0.064 and 0.14, so the flat friction coefficient of static will be used instead. And the rolling coefficient will be used as it only has a difference of 3.5% from flat rolling coefficient of friction. In theory, the estimation of the flat friction coefficient is more accurate as results have a direct relation with friction coefficient (3.2) and the buggy was tested on the same surface on incline as the flat so the friction coefficients should be the same.

**Required torque: flat and slopes**

The required torque is now just a matter of using the relationship between the radius of the wheel and the force required;

**(3.8)**

Torque at a perimeter of wheel is described by above relationship.

The measured diameter of the wheel was 8 cm so using that, the forces from tables ?? and ??, and (3.8);

|  |  |  |
| --- | --- | --- |
| Torque per motor (Nm) | From stationary | At constant speed |
| On inclined surface | 0.0786 | 0.0775 |
| on flat surface | 0.0314 | 0.014 |