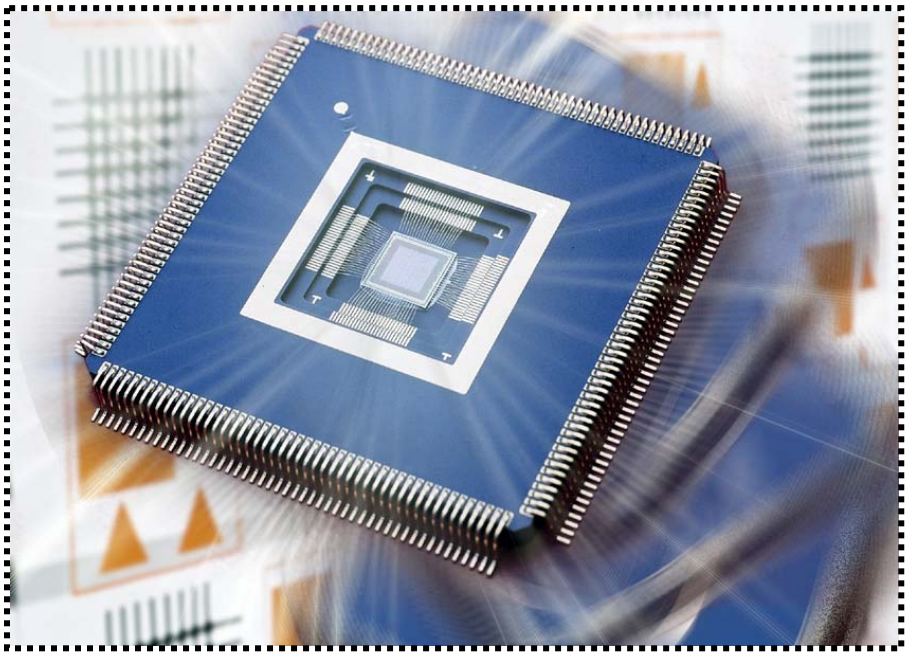
Mechatronics spring 2006 project by

Group 4

Claes Bertén
Bachman Kharazmi
Aron Håkansson
Henrik Wnilsson
Robert Lohninger



LUNDS UNIVERSITET
Lunds Tekniska Högskola

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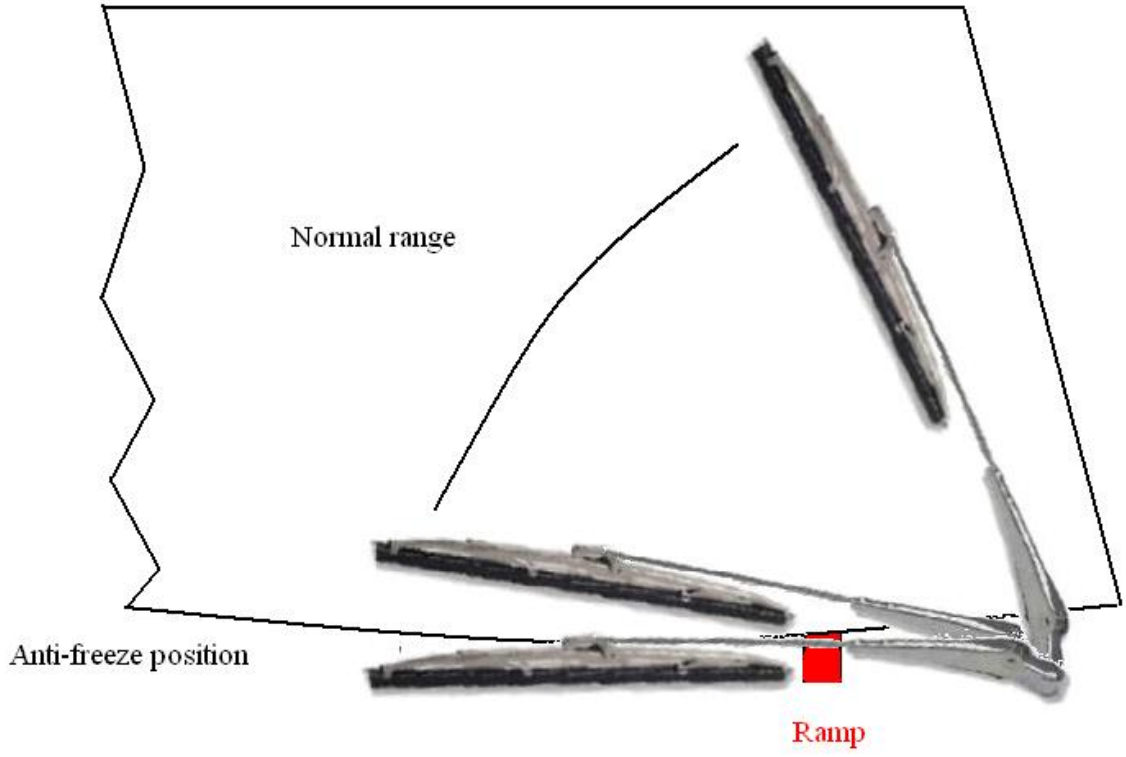
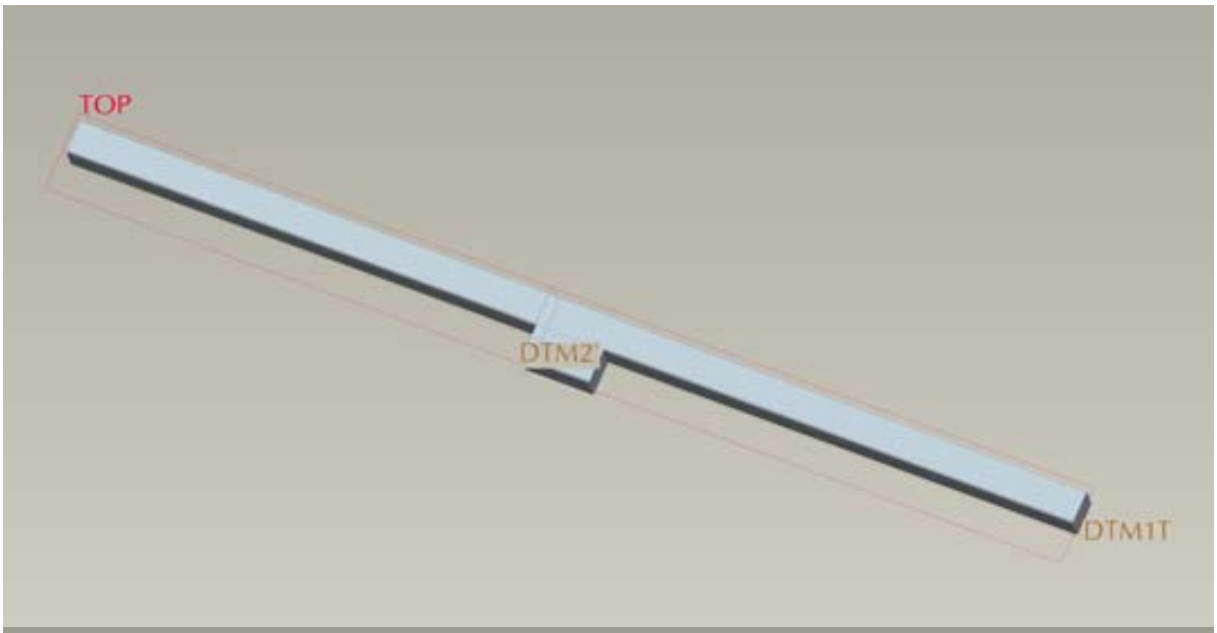
Mechatronical project

Assignment: Create a mechatronical solution that will prevent the wiper blades from freezing to the windshield

Solution: When you drive the car the windshield will be heated from the fans inside of the car so the wiper blade wont freeze so the problem is to make sure that the wiper blades aren´t frozen to the windshield when you start up your car.
After evaluating different solutions we decided to go for the ramping solution because we think it´s the best and perhaps the most cost effective solution.´

This is how it works: When you drive the car the wipers works just like on a normal car, they move between two endpoints. But when you turn the engine off and remove the keys from the ignition the wiper arm will move to a position that is located a couple of degrees below the normal lower endpoint of the wiper arm. The wiper arm will move up on a small ramp that is located just below the windshield this will make the whole arm to be lifted a couple of mm and the wiper blades will no longer be in contact with she windshield and it will be impossible for them to freeze together.
When you start the engine or turn the wipers on the wiper arm will move down from the ramp and it will be fully operable.

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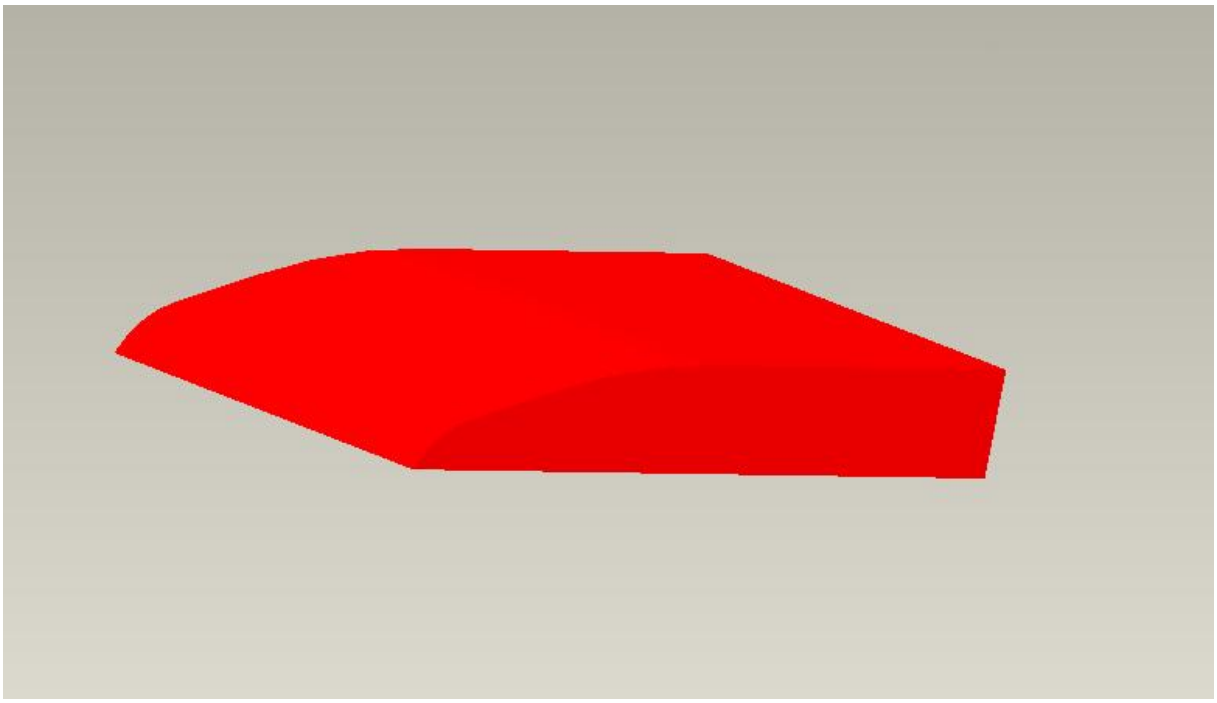


Target specification

We consider the product to make the following fulfillments from a customers viewpoint.

- The wipers must be able to work independently of the car engine.
- The solution should always be quiet.
- Failure of the anti-freeze system should not affect the wiping system.
- The anti-freeze system must work without any input from driver, fully automatically.
- The solution should not affect the aerodynamics in such way that it makes any noise or will increase the aerodynamic coefficient.
- It should not require regular maintenance.
- It should not disturb the drivers sight.
- The solution should work with standard wiper blades.
- The driver shouldn't need to change his usual behavior.

We consider the product to make the following fulfillments from a manufacture viewpoint.

- Low cost.
- Easily implemented in current production.
- Easy and quick to assemble, replace and mount.
- The product should be environmental friendly.
- Independent of left/right steering.

Concept evaluation

Concept evaluation			
Concept: **Integrated heating cables**		**Date:** 2006-02-27 **Participants (sign):** AH, BK,RL,CB,HN	
Product description: Heating cables integrated in the windshield will start heating as soon as the doors are unlocked and if the Intelligent Climate Detection System (ICDS) has detected a high probability of frozen wipers.			
Criteria		**Grade:**	
Customers view	The wipers must be able to work independently of the car engine	Yes / No (1 / 0)	**1**
	The solution should always be quiet.	Yes / No (1 / 0)	**1**
	Failure of the anti-freeze system should not affect the wiping system.	Yes / No (1 / 0)	**1**
	The anti-freeze system must work without any input from driver, fully automatically.	Yes / No (1 / 0)	**1**
	*)The driver shouldn't need to change his usual behavior.	Yes / No (1 / 0)	**0**
	The solution should not affect the aerodynamics in such way that it makes any noise or will increase the aerodynamic coefficient.	Yes / No (1 / 0)	**1**
	It should not require regular maintenance.	Yes / No (1 / 0)	**1**
	It should not disturb the drivers sight.	Yes / No (1 / 0)	**1**
	The solution should work with	Yes / No (1 / 0)	**1**

	standard wiper blades.		
	The product should be environmental friendly.	Yes / No (1 / 0)	**1**
Manufacturers view	Low cost.	Yes / No (1 / 0)	**0**
	Easily implemented in current production.	Yes / No (1 / 0)	**0**
	Easy and quick to assemble, replace and mount.	Yes / No (1 / 0)	**0**
	Independent of left/right steering.	Yes / No (1 / 0)	**1**
		Summary: 10	

Continuing with the concept (Yes / No): No

Comments:

*) Too expensive solution.

Concept evaluation

Concept: **Active elevation of wiper arm in off-mode.**	**Date:** 2006-03-31
	Participants (sign): AH, BK,RL,CB,HN

Product description: Wiper arm is elevated when not in use. The elevation is executed by a mechatronic device, so it can`t freeze on the screen.

Criteria		**Grade:**	
Customers view	The wipers must be able to work independently of the car engine	Yes / No (1 / 0)	**1**
	The solution should always be quiet.	Yes / No (1 / 0)	**1**
	Failure of the anti-freeze system should not affect the wiping system.	Yes / No (1 / 0)	**1**

	The anti-freeze system must work without any input from driver, fully automatically.	Yes / No (1 / 0)	**1**
	*)The driver shouldn't need to change his usual behavior.	Yes / No (1 / 0)	**1**
	The solution should not affect the aerodynamics in such way that it makes any noise or will increase the aerodynamic coefficient.	Yes / No (1 / 0)	**1**
	It should not require regular maintenance.	Yes / No (1 / 0)	**1**
	It should not disturb the drivers sight.	Yes / No (1 / 0)	**1**
	The solution should work with standard wiper blades.	Yes / No (1 / 0)	**1**
	The product should be environmental friendly.	Yes / No (1 / 0)	**1**
Manufacturers view	Low cost.	Yes / No (1 / 0)	**1**
	Easily implemented in current production.	Yes / No (1 / 0)	**1**
	Easy and quick to assemble, replace and mount.	Yes / No (1 / 0)	**1**
	Independent of left/right steering.	Yes / No (1 / 0)	**0**
		Summary: 13	

Continuing with the concept (Yes / No): No

Comments:

*) Too expensive solution.

Concept evaluation

Concept: **Heating wires in the wiper blades.**	**Date:** 2006-03-31 **Participants (sign):** AH, BK,RL,CB,HN

Product description: The rubber will warm up when there's current through the wires and the heating will be turned on when doors are unlocked and the temperature is below zero degrees.

Criteria		**Grade:**	
Customers view	The wipers must be able to work independently of the car engine	Yes / No (1 / 0)	**1**
	The solution should always be quiet.	Yes / No (1 / 0)	**1**
	Failure of the anti-freeze system should not affect the wiping system.	Yes / No (1 / 0)	**1**
	The anti-freeze system must work without any input from driver, fully automatically.	Yes / No (1 / 0)	**1**
	The driver shouldn't need to change his usual behavior.	Yes / No (1 / 0)	**1**
	The solution should not affect the aerodynamics in such way that it makes any noise or will increase the aerodynamic coefficient.	Yes / No (1 / 0)	**1**
	It should not require regular maintenance.	Yes / No (1 / 0)	**1**
	It should not disturb the drivers sight.	Yes / No (1 / 0)	**1**
	The solution should work with standard wiper blades.	Yes / No (1 / 0)	**1**
	The product should be environmental friendly.	Yes / No (1 / 0)	**1**
Manufacturers view	Low cost.	Yes / No (1 / 0)	**0**

	Easily implemented in current production.	Yes / No (1 / 0)	**1**
	Easy and quick to assemble, replace and mount.	Yes / No (1 / 0)	**1**
	Independent of left/right steering.	Yes / No (1 / 0)	**1**
		Summary: 13	

Continuing with the concept (Yes / No): No

Comments:

It will be too expensive to manufacture these wiper blades and problems with the elasticity in the rubber material.

Concept evaluation

Concept: **Ramp solution to elevate the wiper blade**	**Date:** 2006-03-31 **Participants (sign):** AH, BK,RL,CB,HN

Product description: When the ignition is turned off, the wiper blades goes into a parking mode. This mode is obtained by elevating the blade with a ramp.

Criteria		**Grade:**	
Customers view	The wipers must be able to work independently of the car engine	Yes / No (1 / 0)	**1**
	The solution should always be quiet.	Yes / No (1 / 0)	**1**
	Failure of the anti-freeze system should not affect the wiping system.	Yes / No (1 / 0)	**1**
	The anti-freeze system must work without any input from driver, fully automatically.	Yes / No (1 / 0)	**1**
	The driver shouldn't need to change his usual behavior.	Yes / No (1 / 0)	**1**

	The solution should not affect the aerodynamics in such way that it makes any noise or will increase the aerodynamic coefficient.	Yes / No (1 / 0)	**1**
	It should not require regular maintenance.	Yes / No (1 / 0)	**1**
	It should not disturb the drivers sight.	Yes / No (1 / 0)	**1**
	The solution should work with standard wiper blades.	Yes / No (1 / 0)	**1**
	The product should be environmental friendly.	Yes / No (1 / 0)	**1**
Manufacturers view	Low cost.	Yes / No (1 / 0)	**1**
	Easily implemented in current production.	Yes / No (1 / 0)	**1**
	Easy and quick to assemble, replace and mount.	Yes / No (1 / 0)	**1**
	Independent of left/right steering.	Yes / No (1 / 0)	**1**
		Summary: 14	
Continuing with the concept (Yes / No): Yes			
Comments:			

Summary of the Concept evaluation

Integrated heating cables	**Summary: 10**
Active elevation of wiper arm in off-mode.	**Summary: 13**
Heating wires in the wiper blades.	**Summary: 13**
Ramp solution to elevate the wiper blade	**Summary: 14**

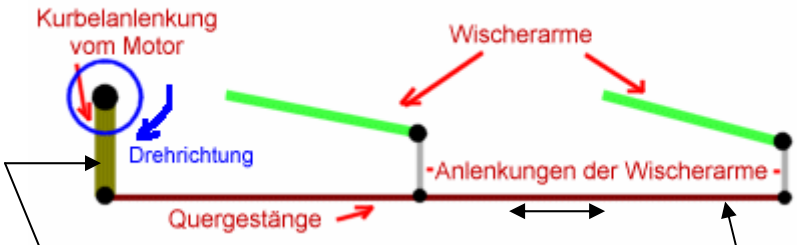
The ramp solution has got the highest grade and therefore we pick this solution to continue our project.

Electrical part

To activate the wiper blades ordinary DC-Motors are used. The power (12V, DC) is provided either from the battery or mostly from the electric generator, during driving. There are two states in which the wiper blade can remain:

- parking mode: wipers are on the ramp
- driving mode: wipers lie on the screen to be in a position to start wiping very quickly when needed

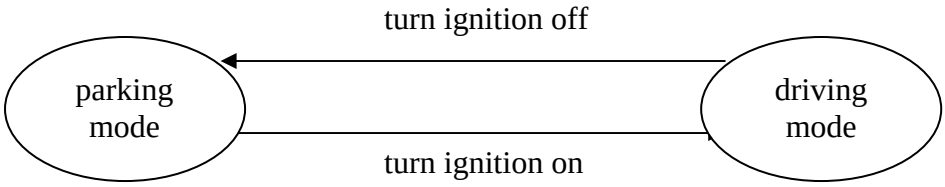
When the ignition is turned on, the wiper blades automatically go in the driving mode, and when the ignition is turned off, they go back to the parking mode. So we need a signal connection between the wiper-switcher, dc-motors and position-sensor. It's impossible to switch on the wipers when they are still in the parking mode!!!!! And it's also important to have some kind of protection mechanism, for example when Motor M1 brakes, so you still can use the wiper blades as normal blades.
There is one DC-servo motor (M1) which moves the blades in the parking mode and one DC-Motor (M2, see picture) to activate the wipers in the driving mode. The motor M1 moves the device, containing Motor M2, bar either a bit to the left or right to go in or leave the parking mode. This is necessary, because with only one Motor M2 it is impossible to switch between the two states.
Motor M2 is mounted on a plate, on the plate is a cograil and on motor M1 is mounted a cogwheel. Cograil and cogwheel are connected to move both motor M2 and bar. All the devices are combined in a box, which is waterproof, and protected from outer disturbances.



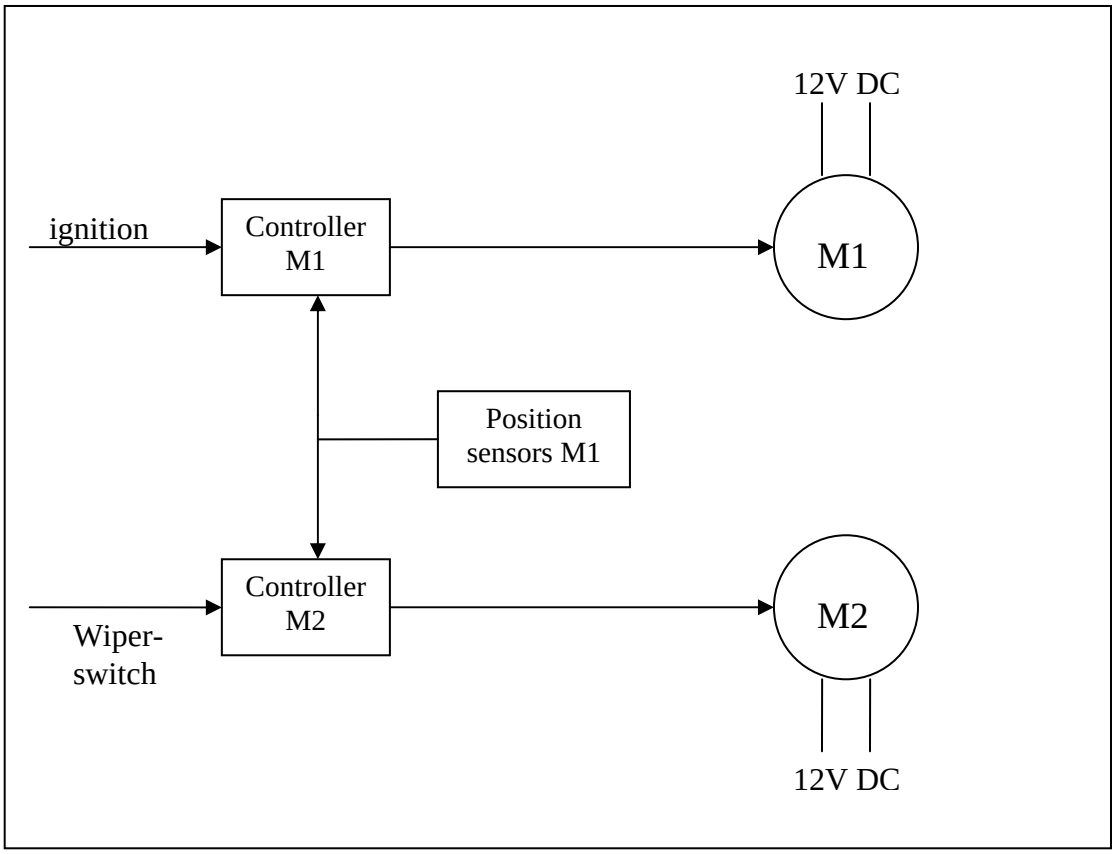
Wiper blades … Wischerarme
Bar, leverage … Quergestänge
Linkage … Anlenkung

M2

State-diagram



signal-flow diagram



The position sensor, mounted on the moveable plate, detects whether the device is in parking mode (position 1) or in driving mode (pos 2). When you turn the ignition on, you'll get a signal from the position sensor and the controllers decide what to do. At position 1, M1 is activated and brings the device into wiping-mode (position 2). During this time it is impossible to switch on the wiper-blades. After that, when the ignition or the engine is on, the wiper device will still remain in the wiping mode and it is only possible to switch on the wiper blades during this time. So you are not able to turn on the blades wiping, when it's in parking mode, because this would cause damage to the blades. After switching off the ignition, the wiper-device goes back into parking-mode.
What is, if motor M1 is broken? When you turn the ignition on, and after some time the position sensor still detects position 1, then a helping device (for example: electromagnet) will help to bring the blades into driving mode, and the blades remain in this state until the motor M1 is repaired. So you still can use the blades as normal blades.

Parts

- DC servomotor M1: Voltage: 12V
  Permanent magnetic
- DC motor M2: Voltage 12V
  Permanent magnetic
- Sensors: capacitive or resistive touch-sensors

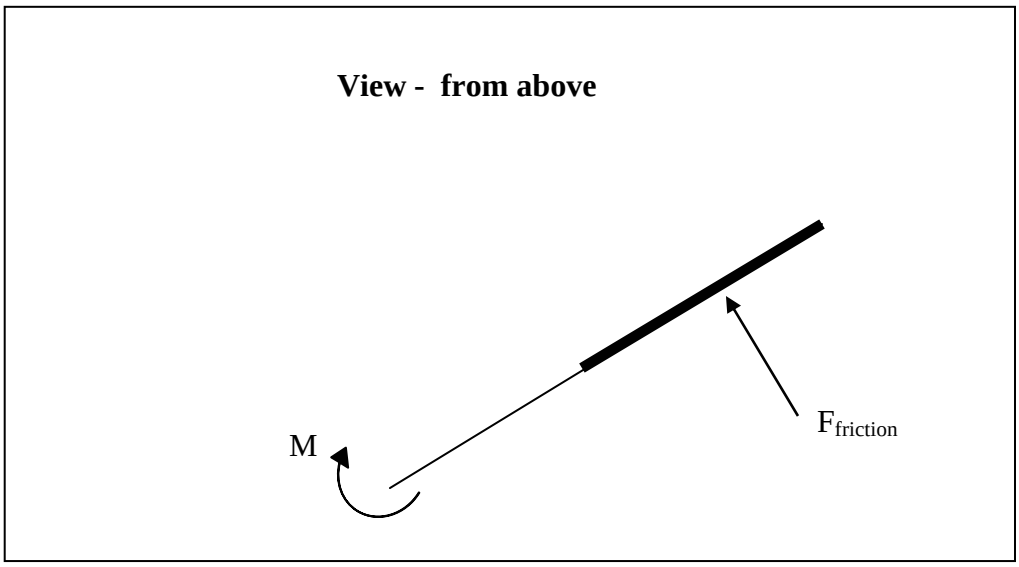
Material selection

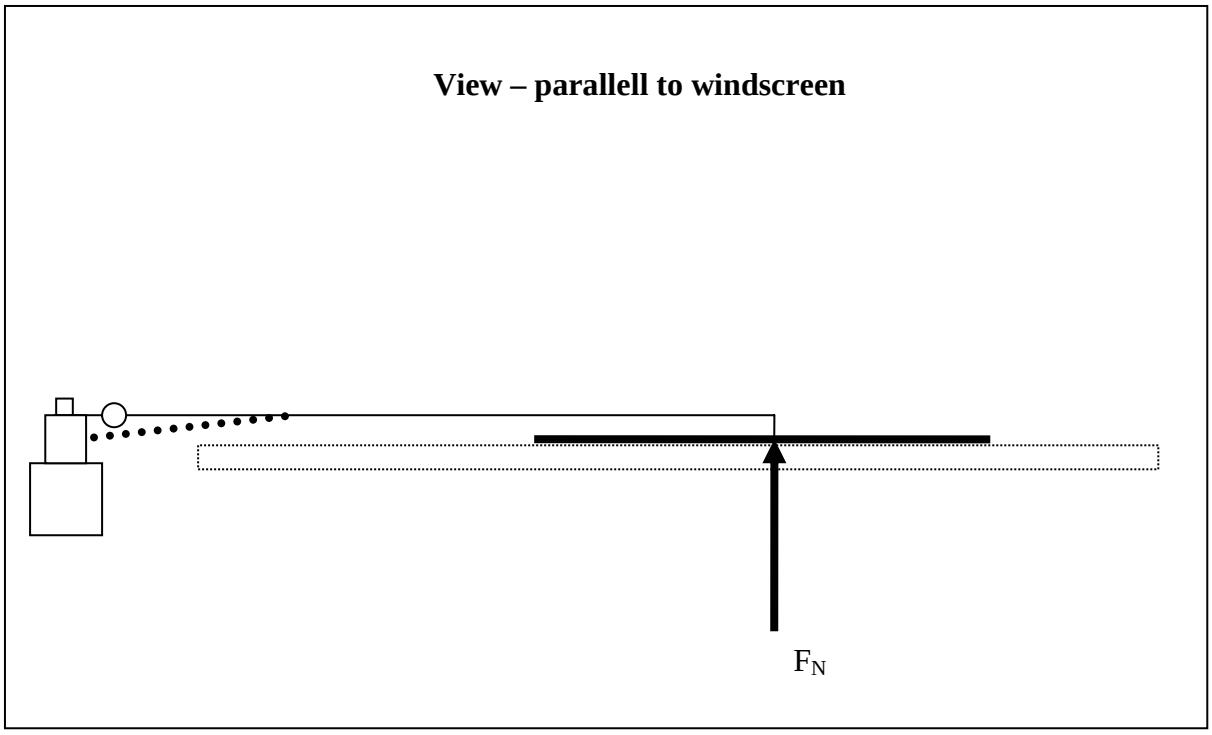
The ramp construction are to be used every time you use the wiper blade function. Because of this there is a risk of both the surface on the ramp and the one on the wiper blade in contact with the ramp being worn out. This is a problem mostly of estetical reasons. Nobody wants parts of their car covered with scratches. To avoid this problem you cover the ramp with a plastic material that generates a low friction when the wiperblade slide upon it. Also the part of the wiper blade that touches the ramp could be covered with the low friction material. The foundation of the ramp on wich the low friction material is attached are to be made of plastic. This is because it is the cheaper alternative to metal and does not suffer from corrosion. However if the car has got a “metallic” look which many modern cars do nowadays a metal ramp could be more suiting considering the estetical aspect.

The character of the low friction material shoul be like teflon, used as a substitute for butter, i.e. a lubricating substance, in cookware. The foundation of the ramp should be made of a hard plastic material alternatively a non-corrosive iron alloy. Both these alternatives should be low cost because there are almost no demands on special properties on the materials.

Modeling of forces

The forces acting on the wiper are mostly dependent on the coefficient of friction between the rubber and windscreen and on the spring force in the contact spring in the wiper ankle link.





Due to the construction of the solution no additional forces of importance will be engaged as a result of implementing the anti-freeze technic.