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March 23, 1999

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
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Re: ENSC 370 Project Windshield Anti-Fog System Functional Specifications

Dear Dr. Rawicz,

The attached document, *Windshield Anti-Fog System Functional Specifications*, summaries our project in various aspects. Our project is to design a safety device that will help avoid possible car accidents due to the foggy situation on the windshield.

The functional specifications discusses the functionality of the overall system and the details of each subsystems. The subsystems include the Sensor subsystem, the Controller subsystem, the Power subsystem, and the Ventilation subsystem.

ABEE Technologies Inc. consists of four motivated and innovative engineering students, including Edlic Yiu, Edwood Yiu, Angela Lee and Benjamin Lee. Please feel free to contact us via e-mail at ensc370-abee@sfu.ca should you have any questions on our document, or should you wish to comment on our project.

Sincerely,

Edlic Yiu, Team Leader
ABEE Technologies Inc.

Enclosure: *Windshield Anti-Fog System Functional Specifications*

The **Windshield Anti-Fog System**

Functional Specifications

Submitted by: *ABEE Technologies Inc.*
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Submitted to: Dr. Andrew Rawicz
School of Engineering Science
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EXECUTIVE SUMMARY

Our goal, at ABEE technologies Inc., is to provide a safer environment to the driver. To accomplish this goal, our project is to develop a Windshield Anti-Fog System (WAFS) that is used to prevent fog appearing on the windshield. When a driver starts the vehicle, the system will be activated spontaneously to monitor the front glass. If the foggy situation appears, the WAFS will start the blower automatically and air will be distributed to the windshield. As a result, fog will disappear gradually, which improves visibility for the driver. Consequently, the accident rate should be reduced since the driver can concentrate on controlling the vehicle without adjusting the ventilation system to eliminate fog.

The implementation of the WAFS is divided into four subsystems: the Sensor Unit, the Controller Unit, the Power Unit, and the Ventilation Unit. The Sensor subsystem is attached inside the vehicle to detect the foggy situation on the windshield. If vapor appear on the front glass, the Controller and Ventilation subsystem will work together and perform the required tasks on the blower. As well, the Power subsystem is used to provide electrical power to all units.

This document introduces various functions of the Windshield Anti-Fog System. In addition, the operations of different subsystems are discussed.

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1. Introduction

The invention of vehicle reduces the time for travelling. However, there are hazards that diminish the pleasure of driving, such as the foggy windshield. The Windshield Anti-Fog System (WAFS) comes to a rescue for the foggy situation. When fog appears on the front glass, the WAFS will start the blower automatically and air will be distributed to the windshield. As a result, fog will disappear gradually, which improves visibility for the driver. In other words, drivers can concentrate on controlling their vehicle without worrying the appearance of fog.

Towards achieving the goal, functional considerations have to be made before the implementation. The WAFS is divided into four subsystems: the Sensor subsystem, the Controller subsystem, the Power subsystem, and the Ventilation subsystem. This document provides the functional specifications for all aforementioned subsystems, and includes the system performance and several ways of testing.

2. SYSTEM DESCRIPTION

2.1. Overall Functionality

The Windshield Anti-Fog System (WAFS) can be employed in any kind of vehicles, such as cars, buses, and trucks, to avoid fog on the front glass. This system will be activated to monitor the windshield when the car starts. The vapor detecting process is performed by the sensor subsystem. When the sensor subsystem identifies the appearance of vapor on the windshield, the controller and ventilation unit will work together and start the circulation system to blow the front glass. As the vapor disappears, the original configuration of the ventilation system is restored. The power of the whole system is supplied by the power unit, which obtains electricity from the car battery.

The sensor subsystem is placed close to the windshield, and the rest of the WAFS is installed inside the ventilation panel of the vehicle. Since the sensor unit is small, this subsystem does not occupy much space. As a result, the visibility of the driver will not be interfered.

The prototype device will demonstrate the following features:

- **Ability to sense the foggy situation on the windshield**
- **Ability to start the ventilation system when vapor appear**
- **Ability to eliminate the foggy situation on the windshield**
- **Ability to restore the original configuration of the ventilation system when the foggy situation disappears**

Figure 1 displays the correlation of the four major subsystems.

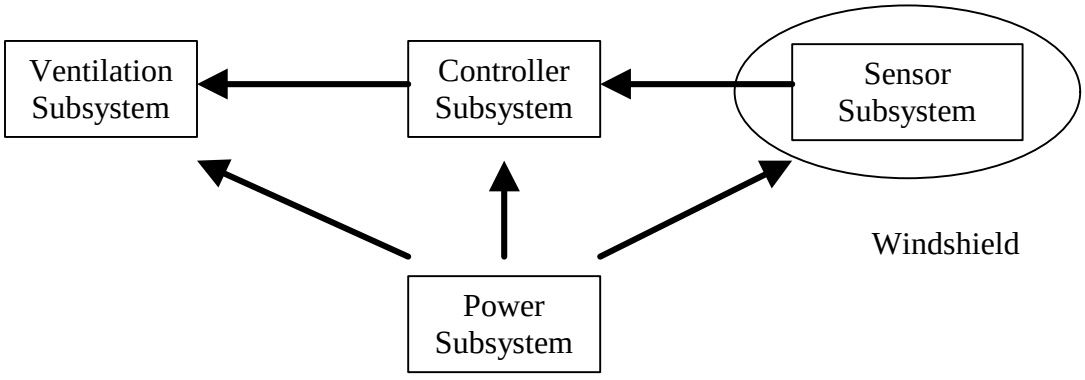

Figure 1. Correlation among Subsystems

2.2. Sensor Subsystem

This subsystem contains the sensors and the signal conditioning stages necessary to obtain an appropriate input for the controller unit. While the sensors detect the intensity of the fog, the signal conditioning stages amplify and digitize the data. The sensor subsystem will produce the digital data, which represents the intensity of the fog on the windshield. The design of the sensor subsystem is still currently in progress, and will be determined such that the whole windshield is covered.

The functions of the sensor subsystem are summarized below:

- **Detect the appearance of fog on the windshield**
- **Detect the intensity of fog on the windshield**
- **Amplify and digitize the output data**

2.3. Controller Subsystem

The controller subsystem is responsible for activating the ventilation subsystem based on the information provided by the sensor subsystem. Using the information from the sensor subsystem, the controller subsystem is able to determine the intensity of the fog on the windshield. When the fog is above the pre-programmed threshold values, the controller subsystem will issue commands to the ventilation subsystem.

The functions of the controller subsystem are summarized below:

- **Scan the input from the sensor subsystem**
- **Compare the input with the threshold values to determine the appearance and intensity of the fog**
- **Determine the blowing level of the automobile ventilation system**
- **Issue commands to the ventilation subsystem**

Figure 2 illustrates the flowchart of the controller subsystem.

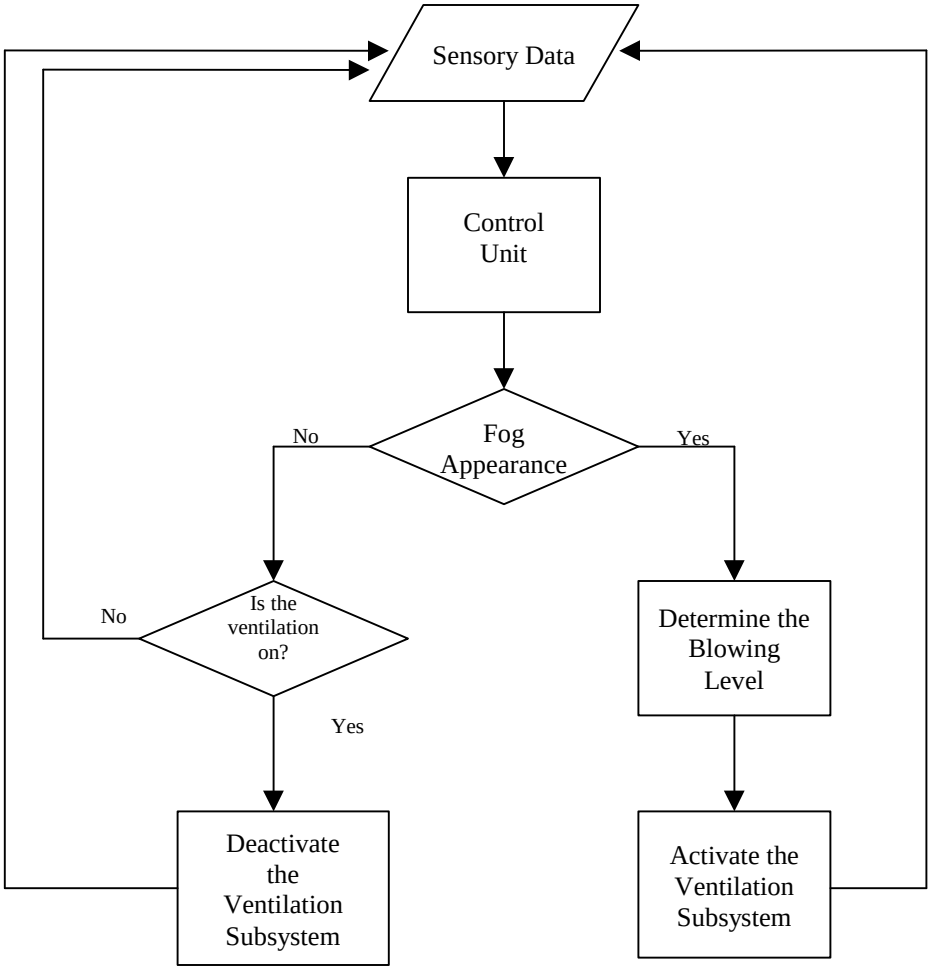

Figure 2. The Flowchart of Controller Unit

2.4. Ventilation Subsystem

This subsystem provides the circulation system in an automobile with the ability to execute the commands from the controller subsystem. It activates and adjusts the blowing level of the circulation system in an automobile according to the commands sent from the controller subsystem. As the vapor disappears, the original configuration of the circulation system is restored.

The functions of the ventilation subsystem are summarized below:

- Blow the front glass
- Restore the original configuration of the circulation system in an automobile

2.5. Power Subsystem

The WAFS is installed inside the vehicle; as a consequence, the power subsystem will obtain electrical power directly from the automobile battery. The power unit will then supply power to the whole system. At this stage, the power consumption level for each subsystem is still under investigation.

3. System Performance

3.1. Requirements

3.1.1. Physical Requirement

The sensor subystem should be small in size so that it will not interfere driver's view when placed close to the windshield.

3.1.2. Environmental Requirements

The WAFS shall meet the following environmental requirements.

Table 1: WAFS Environmental Requirements

Operating Temperature	-20°C to 40°C
Heat Dissipation	Minimal
Humidity	Full range of atmospheric humidity

3.1.3. Electrical Requirements

The WAFS shall meet the following electrical requirements.

Table 2: WAFS Electrical Requirements

Voltage	12 Volts maximum
Power	10 Watts maximum

3.2. Safety Requirements

The WAFS shall meet the following safety requirements.

3.2.1. Enclosure

The enclosure shall have no sharp corners or edges and be tightly installed inside the ventilation panel so that it would not pose danger to the mechanics. The sensor subsystem should be invisible to driver such that the driver will not be interfered.

3.2.2. Electrical Isolation

All parts including the moisture sensor and the blower shall be shielded, and placed out of reach of the driver and the passengers.

3.3. Reliability Requirements

The WAFS shall meet the following reliability requirements.

3.3.1. Accuracy

The system response should be over 99%, meaning that 99 out of 100 times the assigned task should be performed correctly.

3.3.2. Durability

The physical life of WAFS should be as long as the vehicle's physical life. The system should withstand vibration.

3.4. Potential System Limitations

The WAFS may be limited by the following factors:

- The accuracy to detect fog on the windshield may not be 100 percent because there is no such sensor, a sensor to detect moisture on a surface only, in the market.
- The durability may not be as long as the vehicle because the vibration of the vehicle may cause damage on the WAFS.

4. PRODUCT TESTING

To make our WAFS work properly, a number of tests will be carried out to ensure its functionality, limitations and requirements. Like a model within a car, we are going to test the WAFS in a closed environment, i.e. a box. A piece of glass on one side of the box is assumed to be the windshield. An air blower is setup in the box facing the glass, acts as the ventilation system. The box will be sealed tight to prevent temperature and humidity changes in the closed environment.

Here is a list of tests that we are going to perform on the WAFS.

- Test to see if the sensor can receive different levels of input signals and so to control the respective speed of the blower.
- Test if the device can create interrupt to the ventilation system and return to the normal stage when the fog is disappeared.
- Different temperatures and humidity levels for inside and outside the closed system will be applied to test the functional characteristic of the device.
- Test the responses of the system by applying different atmospheric conditions. For example, sunny, raining, snowing, etc.
- Test the time it takes to eliminate the fog on the windshield with different fan speed.

5. Budget

The following table illustrates the estimated cost of our project. The cost may subject to change as the design process goes.

Table 3. Estimated Budget

Required Materials	Estimated Costs
A/D Converter	$20
Micro-controller	$15
Operational Amplifier	$5
PCB Board	$10
Relay	$9
Sensor	$29
Test Setup	$20
Estimated Total	$108

6. Funding

Our team is applying for the Wighton Development Fund, offered by Dr. Rawicz, to cover most of the project cost. We also got $35 from SFU Engineering department and we will collect the remained sum from ourselves.

7. Schedule

The expected completion date will be April 1, 1999. The scheduling details are outlined in the timeline. We are right on schedule up to this point, nothing is changed comparing to the proposal. The progress of our project would be updated to Dr. Andrew Rawicz through our progress report.

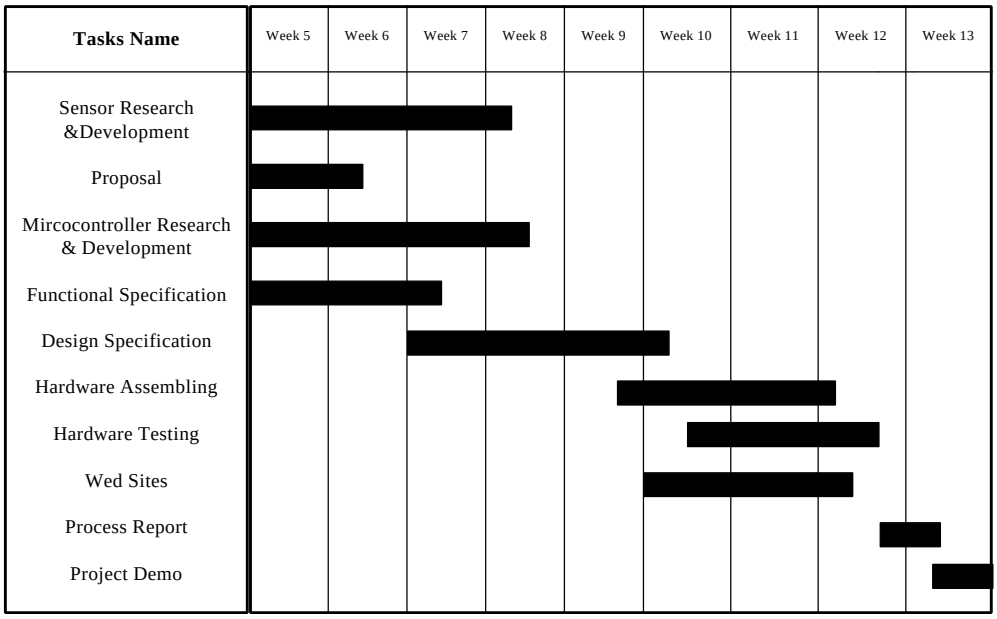

Figure 3. Gantt Chart for Various Tasks

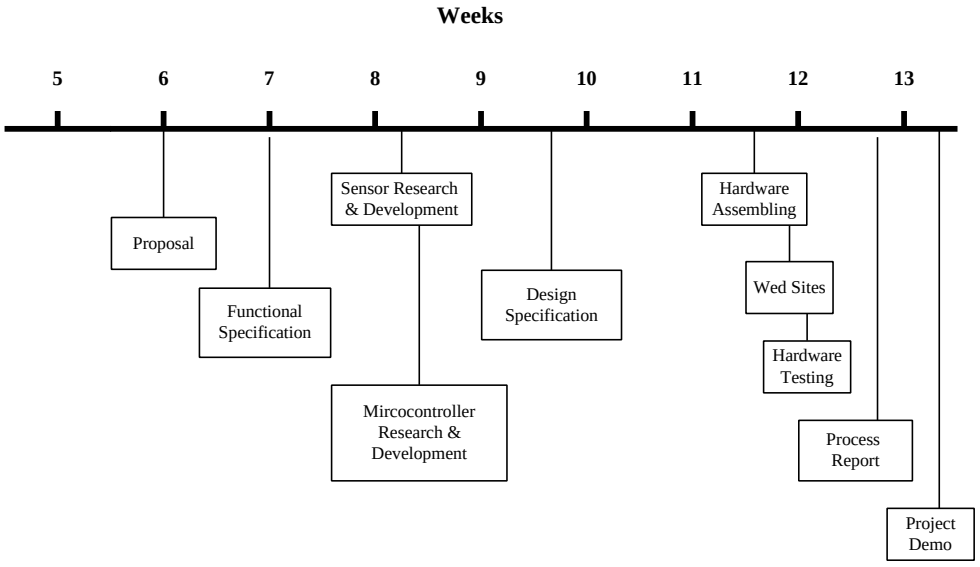

Figure 4. Milestones Chart for Various Tasks

8. Conclusion

We have discussed in this document the functional considerations of building a windshield anti-fog system. The WAFS shall be built according to the function specifications described here. We wish that we can prove our concept, explore the importance of car safety, and enhance a new feature in vehicles by building a device with these considerations.