NYU POLYTECHNIC SCHOOL OF ENGINEERING

Automated Weather Window

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Overview

- Problem Statement
- Problem Solution
- Goals
- Cost, Design, Theory
- Advantages and Disadvantages
- Conclusion

Problem Statement

It is not uncommon for a parked car to have its windows open and unattended when it begins to precipitate, exposing the interior of the car to the weather. Even more frequently, a car with closed windows will be exposed to direct sunlight, rapidly increasing the interior temperature to uncomfortable levels.

Problem: Temperature

Estimated Vehicle Interior Air Temperature v. Elapsed Time

Elapsed time	Outside Air Temperature (F)					
	70	75	80	85	90	95
0 minutes	70	75	80	85	90	95
10 minutes	89	94	99	104	109	114
20 minutes	99	104	109	114	119	124
30 minutes	104	109	114	119	124	129
40 minutes	108	113	118	123	128	133
50 minutes	111	116	121	126	131	136
60 minutes	113	118	123	128	133	138
> 1 hour	115	120	125	130	135	140

Courtesy Jan Null, CCM; Department of Geosciences, San Francisco State University

Problem: Temperature

- The average person will be comfortable at 72 ° F
  - A car in direct sunlight with closed windows will rapidly surpass this temperature within 20 minutes

- This is also a very dangerous issue for passengers that may have been left in the vehicle
  - On average, a child dies every 9 days
  - Hundreds of pets die per year due to vehicular heat stroke

Problem: Precipitation

- Many people leave their windows, sunroof or convertibles open while leaving their car parked

- Car upholstery and electronics can be damaged through rain exposure

Problem Solution

- The Automated Weather Window adjusts the window when it detects undesirable conditions
- The windows/sunroof will open slightly when the temperature in the car is too high in order to ventilate the car
- The windows/sunroof will close if left open when there is precipitation to protect the interior

Solution Features

- Automated window system will intermittently check the internal temperature and weather conditions
- Temperature:
  - When internal temperature exceeds 80°F, the side windows and sunroof will automatically open 0.5”
- Precipitation:
  - When rain or snow is detected, the side windows and sunroof will automatically close

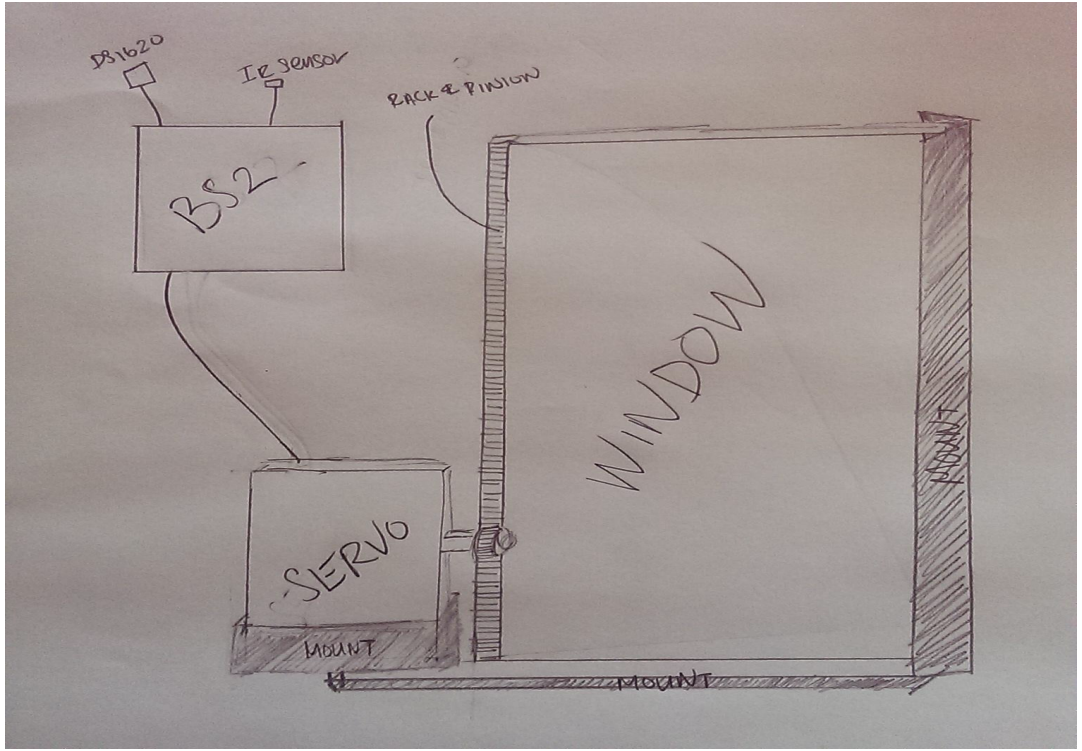
Goals

- Create a proof of concept
  - IR sensor must react to water being placed on plexiglass and engage servo motor to close the window
  - DS1620 must engage servo motor to open window 0.5” when temperature is at or above 80°F
    - IR sensor must take precedence over servo

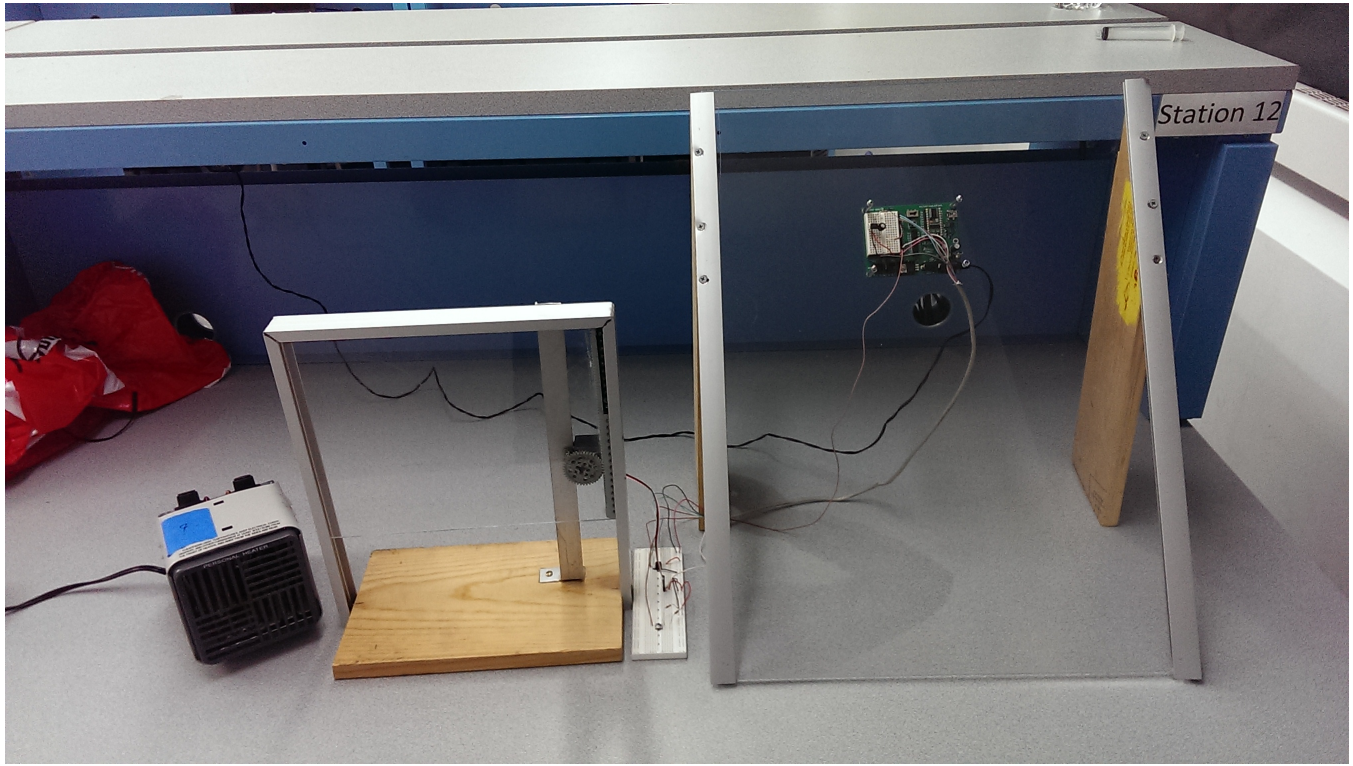
Bill of Materials

		Bill of Materials			
Item Number	Part Number	Part	Part quantity	Cost	Total Cost
1	350-00017	IR LED	1	$2.16	$2.16
2	604-00002	DS1620- Digital Thermometer	1	$5.39	$5.39
3	350-00039	IR Reciever	1	$2.69	$2.69
4	900-00025	Parallax Servo Motor	1	$15.29	$15.29
5	150-01020	10000 Ω Resistor	3	$0.06	$0.18
6	150-02210	1000 Ω Resistor	2	$0.06	$0.12
7	28850	Board of Education development board	1	$89.10	$89.10
8	BS2-IC	Basic Stamp 2 microcontroller	1	N/A*	N/A*
9	1/8th-in thick	Plexiglass	2 sheets	$3.50	$3.50
10	800-00016	Wiring (3" length)	10	$0.18	$1.80
11	N/A	Screws	4	$0.01	$0.04
12	400-00002	NO Push Button	1	$0.45	$0.45
					$120.72

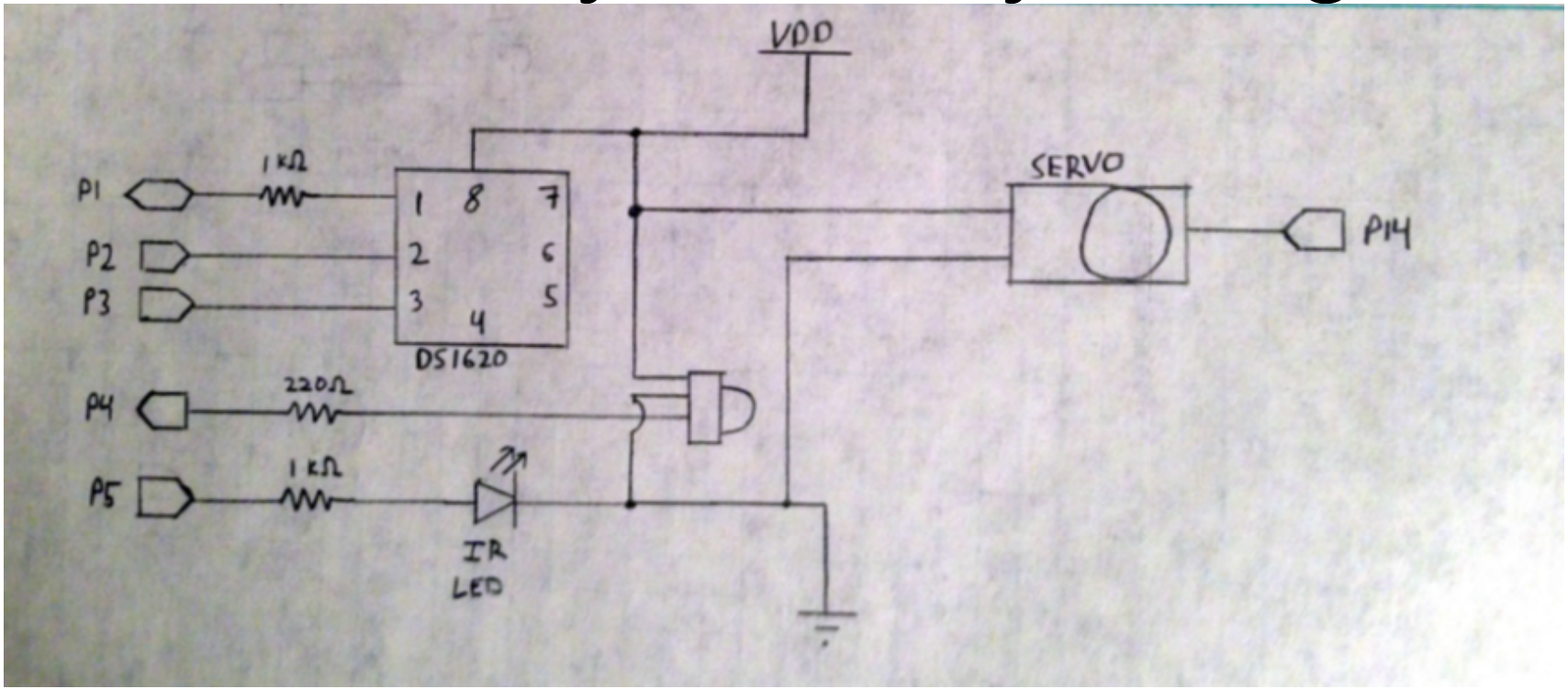
Preliminary Model Design



Prototype

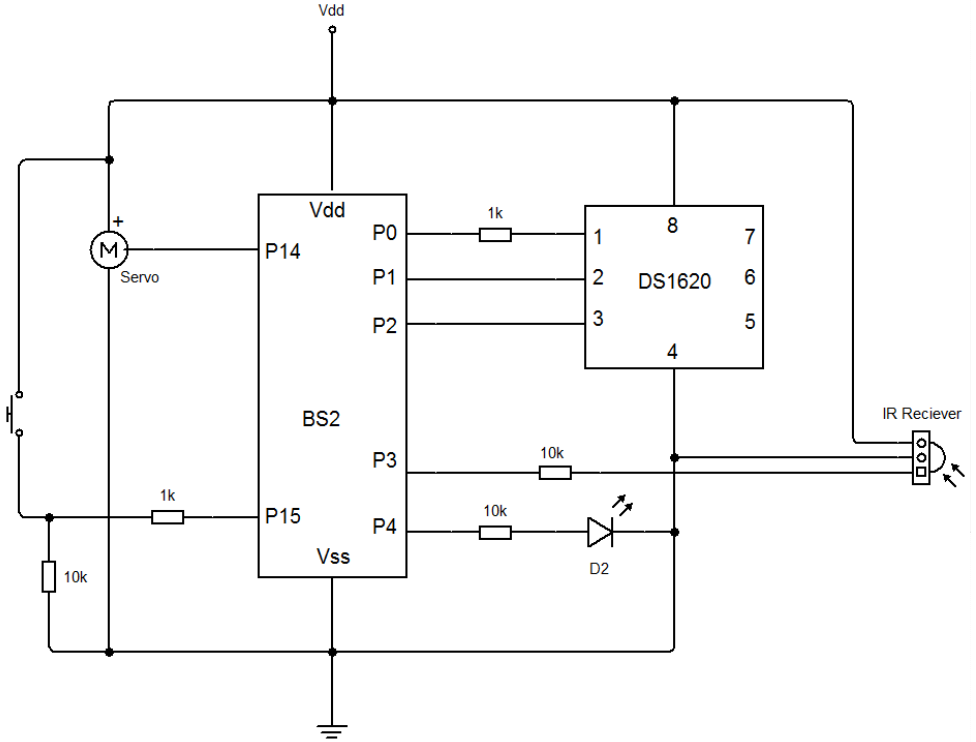


Preliminary Circuitry Design



Final Circuit Design

- Normally Open Switch to simulate ignition key presence
- Infrared receiver and LED paired with Parallax BS2 Pins 4 and 3, respectively
- DS1620 Paired with Pins 0, 1, and 2



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Programming

```
'Mechatronics Final Project
'The Automated Weather Window
'Cyril Bernardo, David Fijas, Pawel Sawicki

' {$STAMP BS2}
' {$PBASIC 2.5}



'------Input/Output Definitions------

'For the Digital Thermometer
DQ CON 0      'Data input/output between BS2 and DS1620
clk CON 1     'Sends clock signal to DS1620
reset CON 2   'Used to engage/disengage the DS1620

'For the IR Ciruit
irrec PIN 3   'The input from the IR Reciever
led CON 4     'Controls the IR LED

'For the Servo
servo CON 14
counter VAR Byte 'Counter for moving servo up and down

'For the switch
keyin PIN 15    'Switch represents if user has keys in ignition
```

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Programming

```
'For the switch
keyin PIN 15    'Switch represents if user has keys in ignition

FOR counter=0 TO 100          'This initialization opens the window so that the prototype can be tested.  In a real scenario
PULSOUT servo,650             'these three lines of code would not be in the program.
NEXT

'------Variables------

'For the Digital Thermometer
WrCfg CON $0C ' write config register (obtained from source 1)
beginc CON $EE 'Start conversions (obtained from source 1)
readtemp CON $AA 'Used to tell DS1620 to read in the temperature (obtained from source 1)
tempin VAR Word 'Stores the temperature obtained from the DS1620
tc VAR Word 'Converts the temperature input into degrees C
tempref CON 270 'Reference temperature of about 80 degrees F put in degrees C (multiplied by ten to match input for
                'example 20.5 degrees C would show up as 205 for an input)
win VAR Bit 'Records if the window has been opened or not

'For the IR Circuit
irin VAR Bit 'Stores the input from the IR Receiver
precip VAR Bit 'Records if there is precipitation or not
```

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Programming

```
'------Initialization------

'Setting up the Digital Thermometer
 HIGH reset ' alert the DS1620
 SHIFTOUT DQ, clk, LSBFIRST, [WrCfg, %10] ' use with CPU; free-run
 LOW reset
 PAUSE 10
 HIGH reset
 SHIFTOUT DQ, clk, LSBFIRST, [beginc] ' start conversions
 LOW Reset

'Starting assuming that there is no precipitation and the window is closed
precip=0
win=0
'------Main Program------

DO

'Checking if keys are in the ignition
  DO WHILE(keyin=1) 'If keys are in the ignition, system will not check temperature nor precipitation
  DEBUG CLS,CRSRXY,0,0,BIN keyin
  LOOP
```

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Programming

```
'Obtaining the temperature from the DS1620

  HIGH reset ' alert the DS1620
  SHIFTOUT DQ, clk, LSBFIRST, [readtemp] ' give command to read temp
  SHIFTIN DQ, clk, LSBPRE, [tempIn\9] ' read it in
  LOW reset ' release the DS1620
  tc = tempin * 5 ' convert to tenths
'Checking the IR Circuit to see if it is raining

  FREQOUT led, 1, 38500 'Flashes IR LED at 38500 Hz for 1 ms
  irin = irrec 'irin records the input from the IR receiver.  It will record a 0 if there is precipitation

 'Checking if precipiation is occuring
 IF irin=0 THEN

  FOR counter=1 TO 200  'Counter ensures that enough time has passed for motor to reach it's designated position
    PULSOUT servo, 1150 'Rotates motor to close the window
    PAUSE 20
  NEXT
  precip= 1   '1 means that precipitation is occuring
  win=0 '0 means that the window has now closed
  PAUSE 2000 'Waits 2 seconds before it checks the system again to see if it is raining
 ELSE
  precip= 0 '0 means that there is no precipitation
 ENDIF
```

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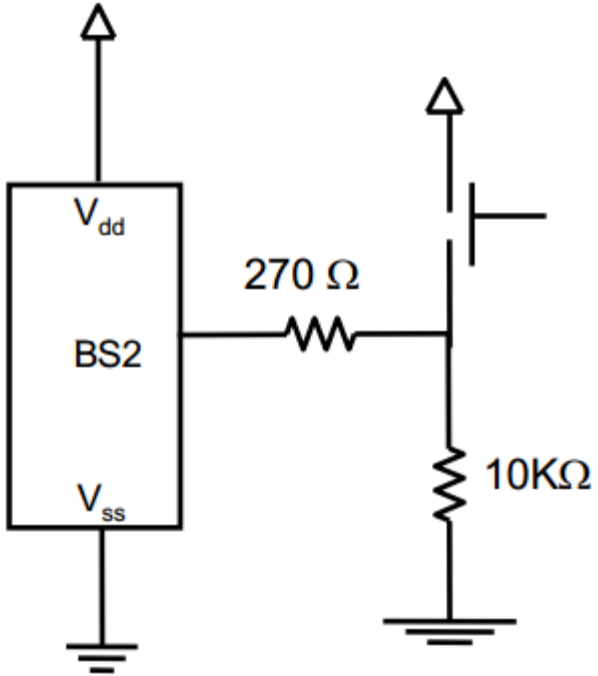
Programming

```
IF tc > tempref AND precip=0 AND win=0 THEN 'Temperature has to be above the reference temp, no precipitation can
'be occuring and the window must already be shut

 FOR counter=1 TO 200 'Counter ensures that enough time has passed for motor to reach it's designated position
   PULSOUT servo,850 'Rotates motor to open window
   PAUSE 20
 NEXT
 win=1'Tells the system that the window has been opened
ENDIF


LOOP
```

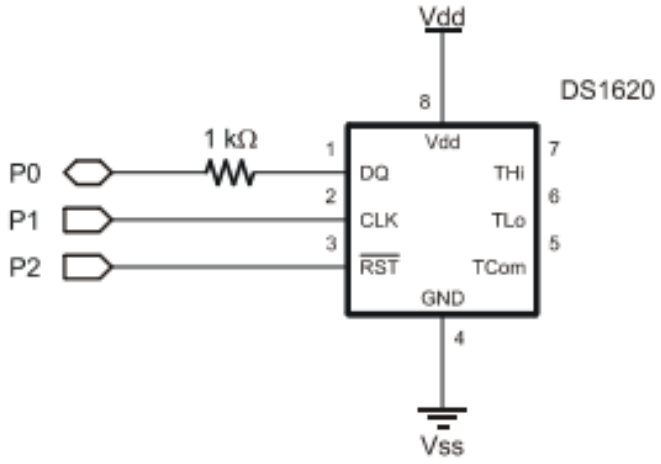
Theory – Switch/Pull Down Resistor



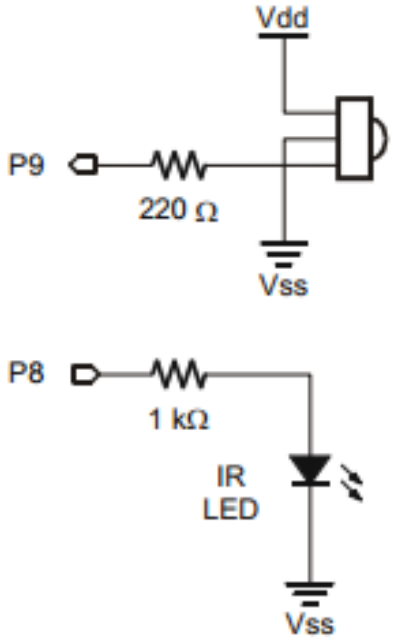
- When switch is not pressed, BS2 input is “pulled” to ground
- When switch is pressed, BS2 input is brought up to 1
- Prevents floating input

Theory – DS1620 (Digital Thermometer)

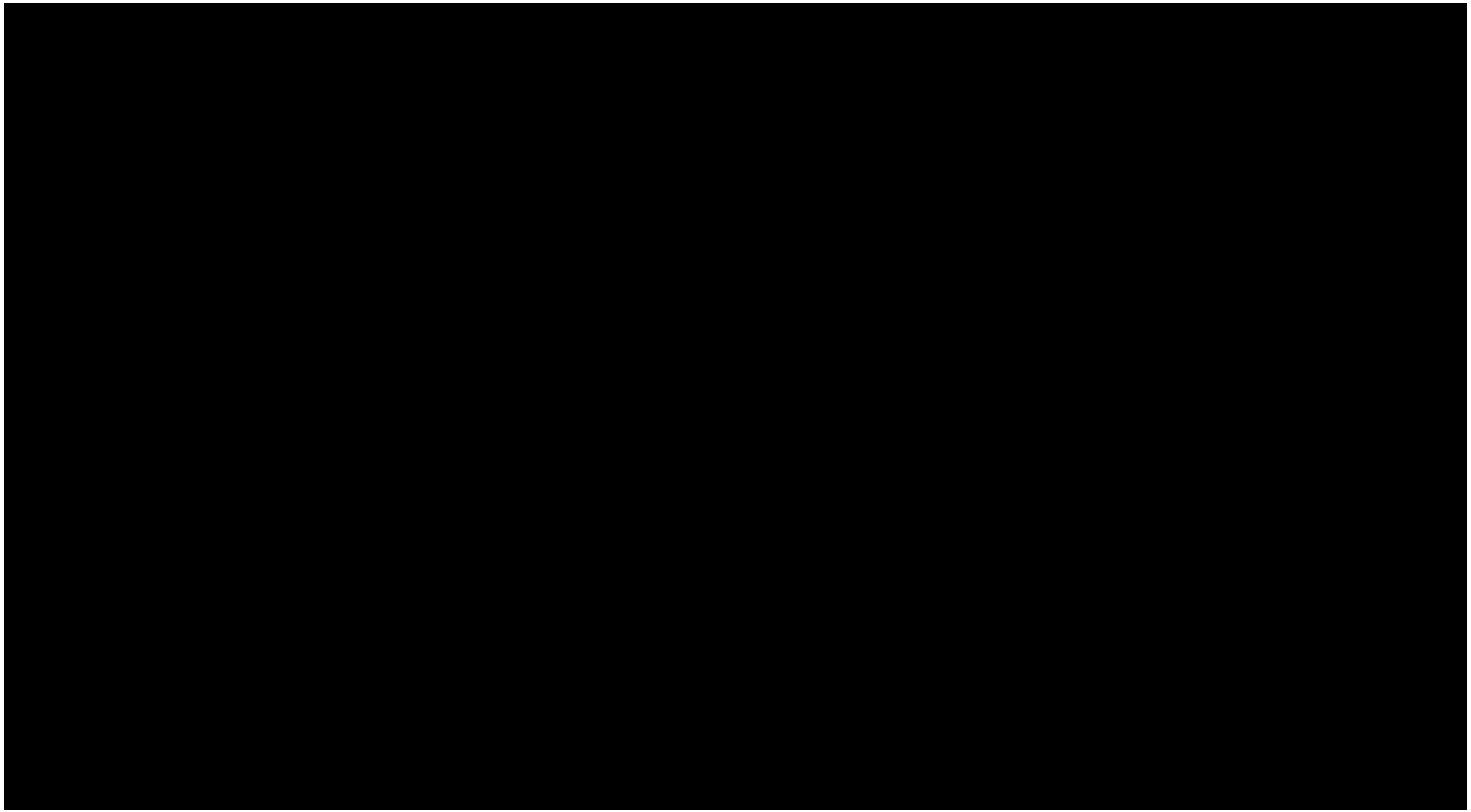
- DS1620 accurately reads temperature surrounding chip
- Can compare found temperature to a reference temperature
- When found temperature exceeds the reference, BS2 chip will activate servo and open window



Theory – IR Circuit



- IR LED rapidly flashes at 38500 Hz
- If this light strikes the IR receiver, it returns a 0
  - Otherwise returns 1
- If water strikes plexiglass, it causes the IR Light to reflect to the receiver
- Under this condition, BS2 will activate servo to close window



Mass Production Costs

- In cars equipped with a rain sensor/power windows/thermometer, there will be no cost to mass produce

- Otherwise, will require an estimated increase of approximately $85 to put in the needed circuitry

Implementation

- This solution would be implemented into current vehicles that have rain sensors and power windows
  - No extra materials would be required, only the program to connect the sensor inputs to the window motor outputs

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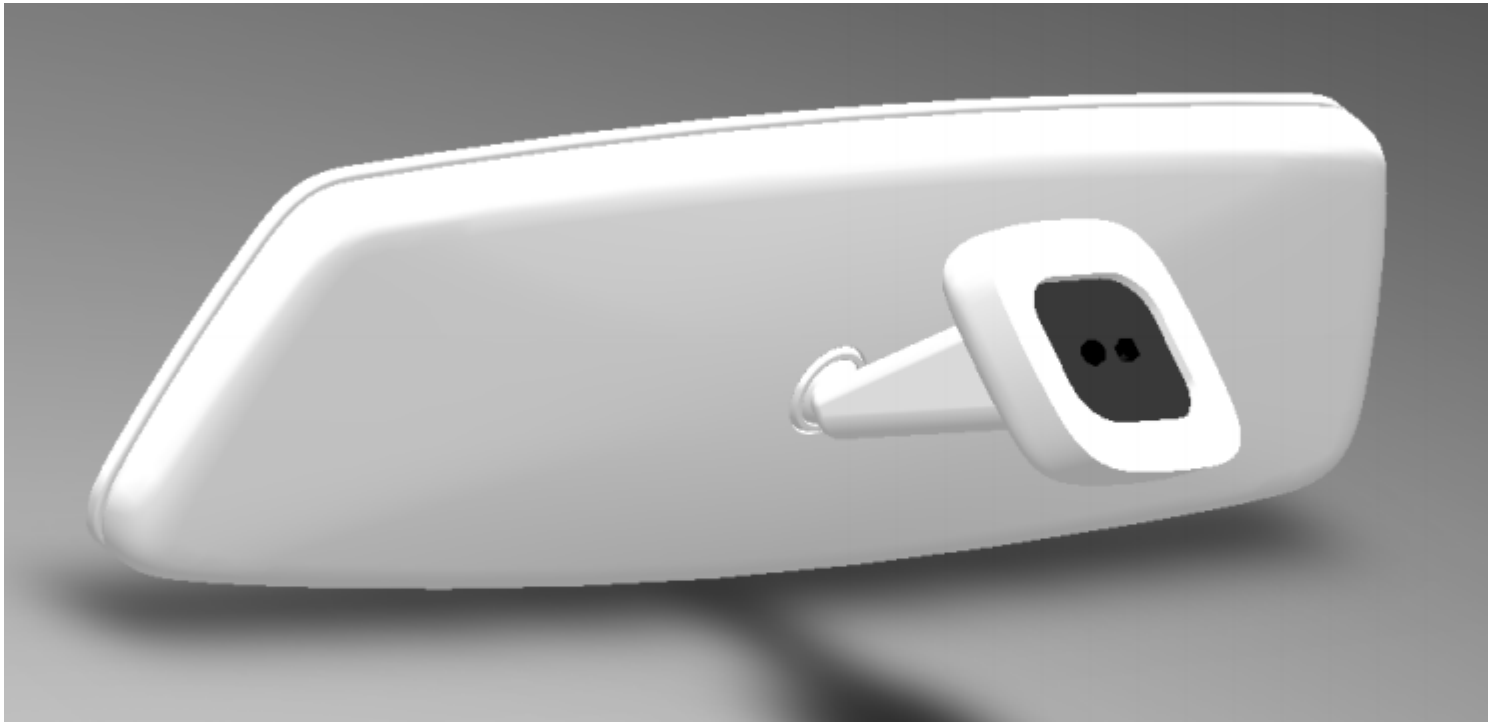
Implementation



Advantages

- Added protection to the car
- Can save a child/pet's life on a hot day
- No increased cost in cars already equipped with a rain sensor/power windows/thermometer

Disadvantages

- Currently technology is only in higher end vehicles

- Could increase possibility parents/pet owners leave child/pet behind

Conclusions

- This system will work in any car that has a rain sensor and power windows
- Cost effective to implement
  - Free in technologically updated vehicles
  - Cheap cost to older car models
- Could save the lives of children and pets

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