UMassAmherst
The Commonwealth's Flagship Campus

Smart Wiper Toolkit

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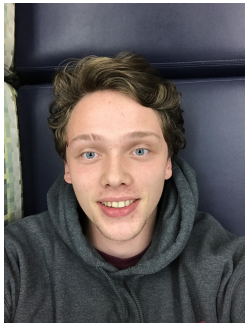
Team 22: Smart Wiper Toolkit

Chris Pandiscio

Haoxian Lin



Michael Shliselberg

Problem Statement

- In a world where we get distracted so easily, it is scary for drivers to not notice the situation they are in. Reducing any modes of failure could potentially save a life. A specific issue is rain. If a driver is unfortunately distracted by their phone or some other worldly reason, and they look back to see their windshield masked in rain, they might not have enough time to clean before an accident could take place. We propose a smart windshield wiper toolkit that can be installed on most modern day cars to automatically control the wipers based on how strongly it is raining. Additionally such a tool needs to be priced competitively so that the average person can afford such a tool.

Effect on Groups and Individuals

- Used car owners will be able to get a feature only available on current generation of cars
- Analogous to bluetooth in older cars
- Drivers will have one less thing to worry about
- One less action to be distracted by
- No more “packages” or “Groups”, just features

Existing Solutions

- Big name car manufacturers such as Toyota and Ford on several models have a feature of automatic wipers (costs extra)
- Purchase Rain Sensors as sole devices, but NO toolkits exist for personal installation for the wipers

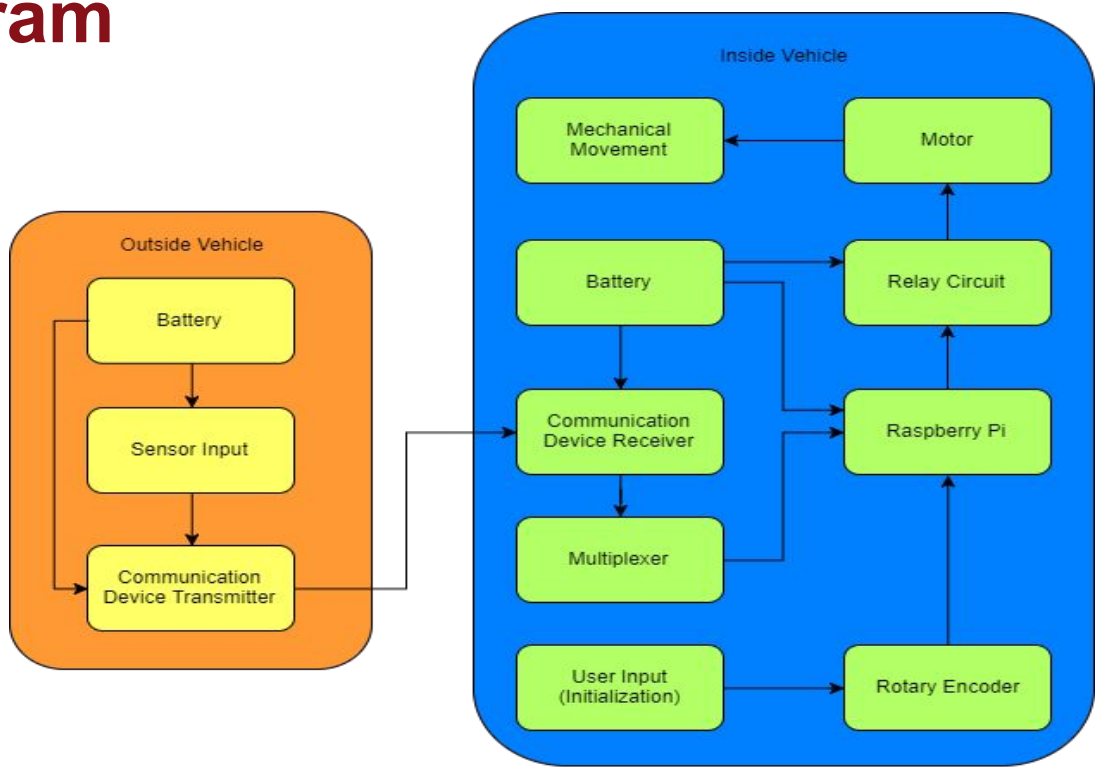
Our Solution

- Our solution is a device that users can install themselves to the vehicle to automate windshield wipers
- Package includes sensors to detect rainfall as well as device to interact with windshield controls arm
- Uses rain sensors outside the vehicle to take measurements to eventually transmit to device within the car
- Calibration system through rotary encoder for angles of the arm that fits individual cars
- Automatically controls lever(arm) for the system

Specifications

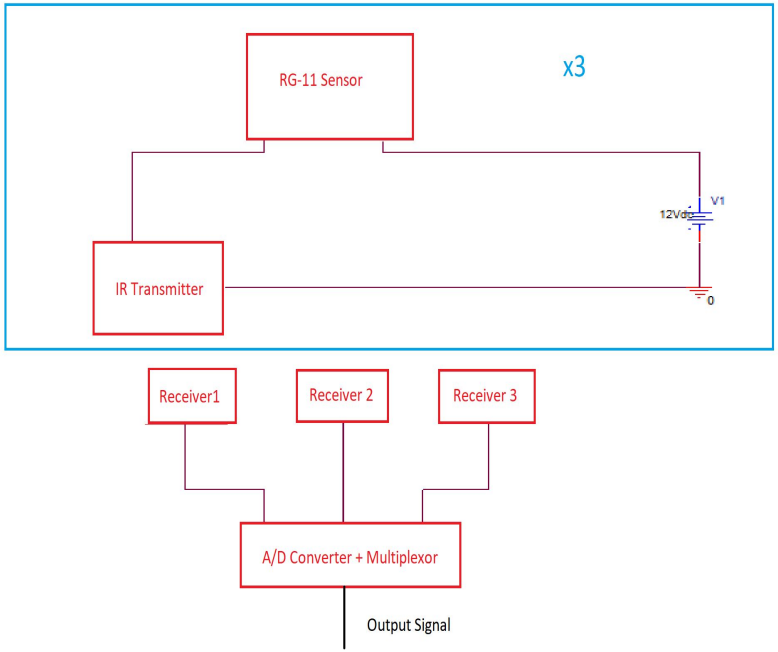
- Connect to a variety of models of cars made between 2000 and 2017 that use a lever based mechanism to control the wipers.
- Detect rain in at least 4 settings (Off, Low, Medium, High)
- Work in stormy conditions and car-speeds less than 75 MPH
- Can be installed by average drivers in 30 minutes

Block Diagram



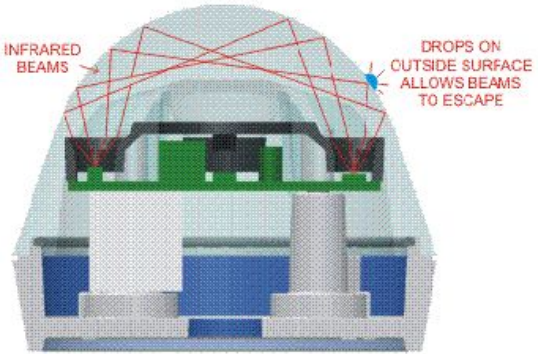
Detailed description of each part will be in the following slides

Sensor System



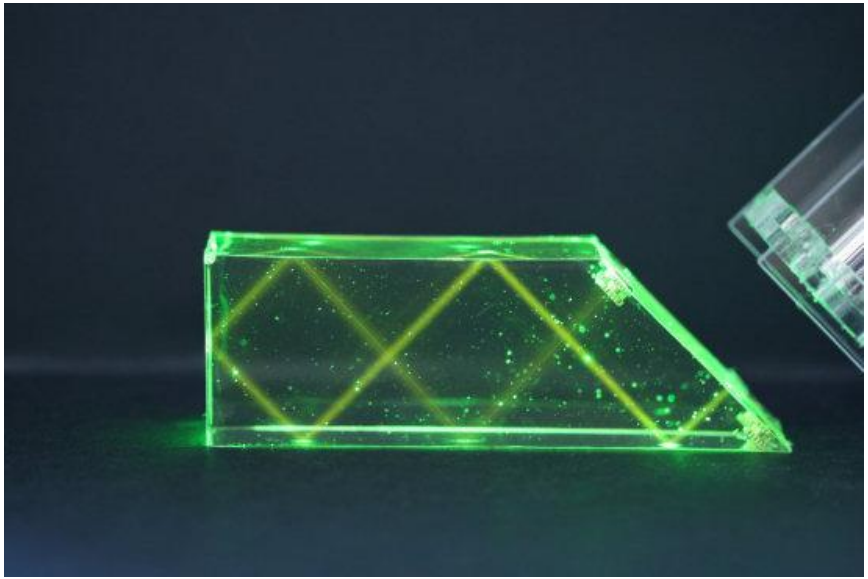
- Three sensors total: low, medium, high rain detection
- Converts sensor signals into state information

Rain Sensor (RG-11)



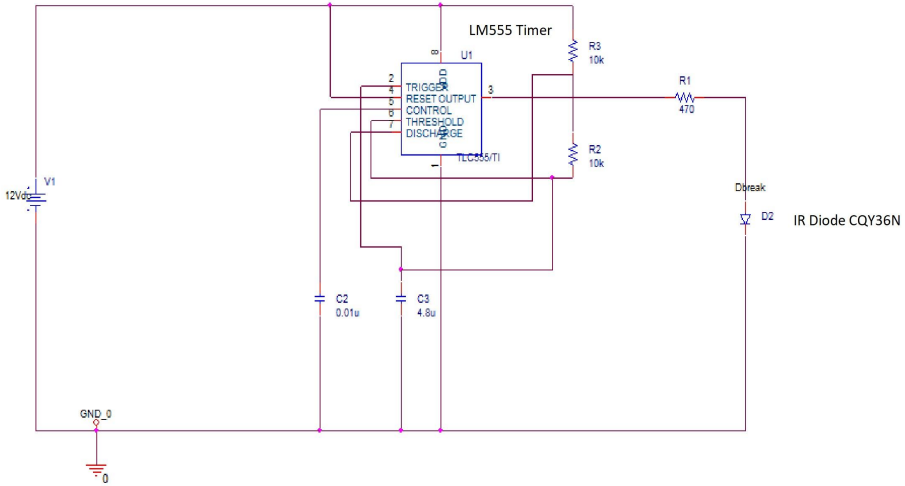
- Mounted on top of car (Outside)
- Use 3 (1 per setting)
- Emits IR beams and detects scattering
- DSP and specialized circuitry eliminates ambient light and dirt
- Sends information via relay circuit

Design Alternatives - Rain Sensor



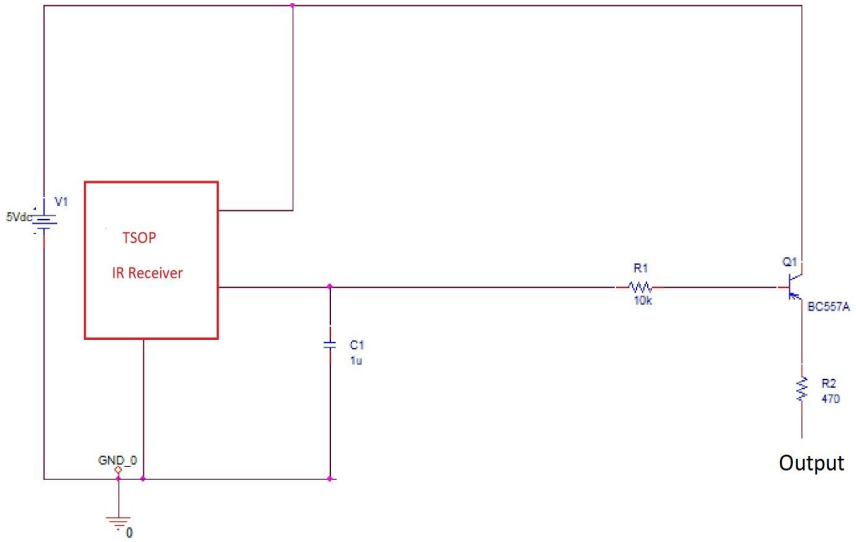
- Use IR in same manner as demonstrated above.
- Using our own sensors could help if the chosen model does not work as expected.
- Also this will reduce costs ~$100
- Issue with this, we would have to find a solution regarding sunlight interference.

IR Transmitter



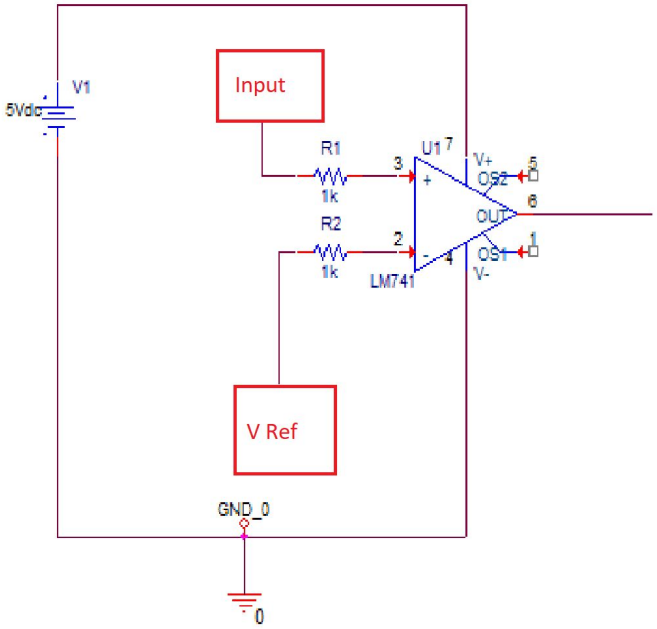
- Transmits triggered signal from sensor
- Three different frequencies corresponding to each sensor (30k, 40k, 56kHz)
- Uses LM 555 timer in Astable mode
- Proper frequency established with formula $f=1.44/[(R2+2*R3)*C3]$

IR Receiver



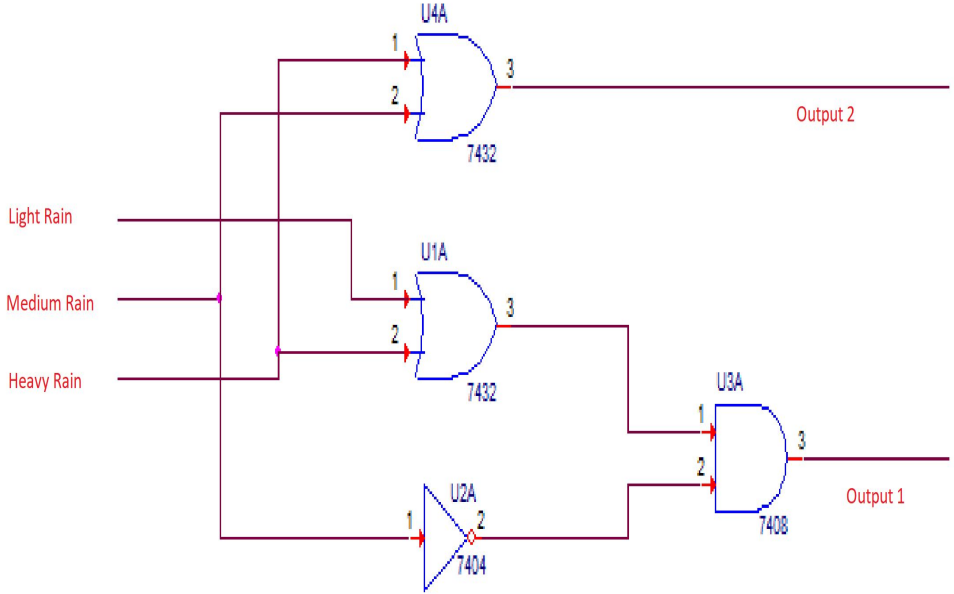
- Receives triggered signal from transmitter
- Utilizes TSOP17(30,40,56) to detect transmitter signal
- Outputs either a specified voltage (TBD) or 0 V

A/D Converter (Comparator Circuit)



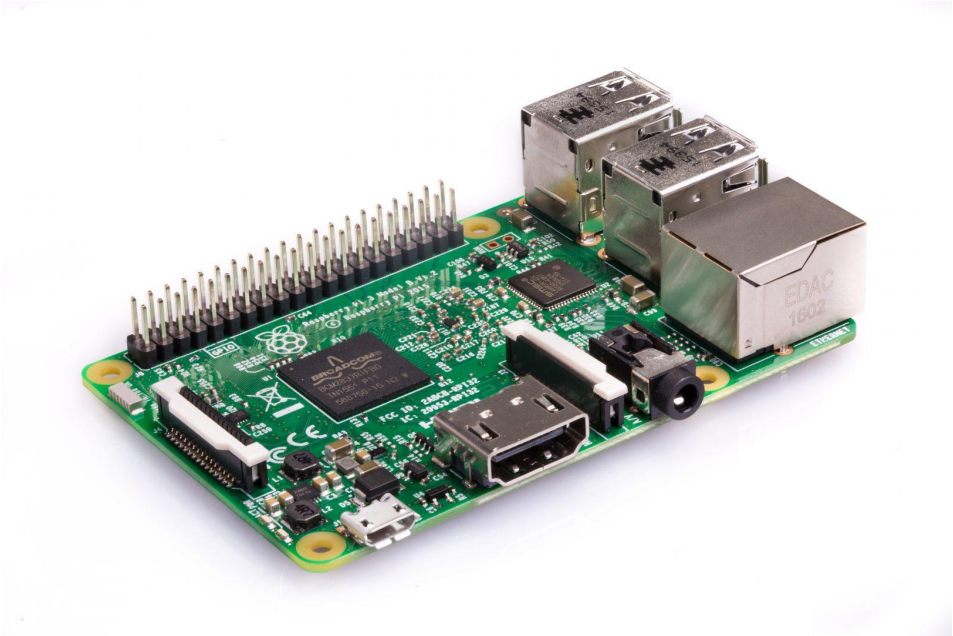
- Takes signal from Receivers
- Converts voltage to either 5V or 0V (Digitizing signal)
- Uses LM741

Multiplexor (Combinational Logic)



- Takes digitized inputs from receivers
- Outputs one of four states
- Utilizes SN74(04,08,32)
- 00 - Off, 01 - Light, 10 - Medium, 11 - Fast (wiping)

Microprocessor (Raspberry Pi Model 3)



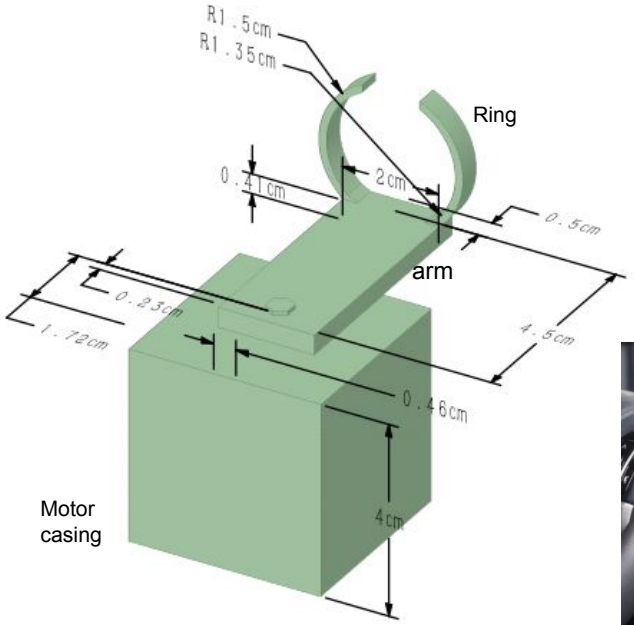
- Takes in multiplexed signal to determine rain levels
- Takes in information from the rotary encoder to determine output for relay circuit
- Translate rain sensor output into movement on actuator

Specification for the actuator

- Be able to attach to windshield wiper arm on most cars
- As small as possible to avoid distraction
- Be able to provide 0.35Nm(3.57kg Cm) of torque
- Accuracy of at least 2.5 degrees(based on tolerance of measured cars).
- Calibratable to suit cars with different settings angles
- Easily attached or detached for user input overwrite

These Specifications are based on internet data and real life measurements on cars including: Honda Civic 2017, Toyota Prius 2016, volkswagen jetta 2004...

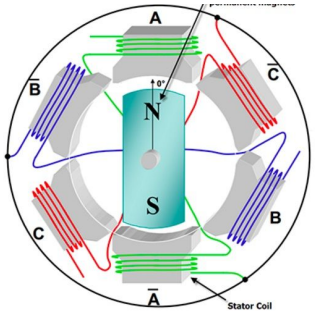
Design Prototype



- Device will be placed behind/below control lever
- The ring is looped around the control arm
- Stepper motor inside of rectangular casing
- Motor and arm are detachable
- Radius/shape of “Ring” can varies based on model of the car.
- Length and shape of the mechanical arm is also variable to compromise with different steering wheel design(eg.I and Z shapes)

Stepper Motor

42BHH48-150K-24



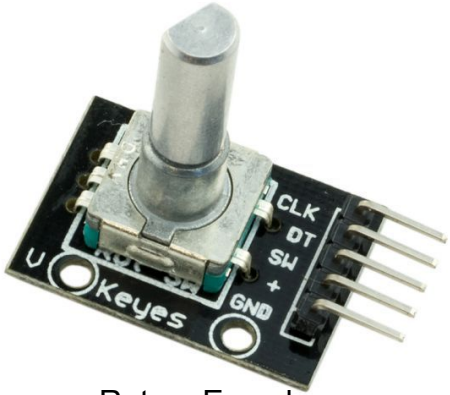
- Inside of motor casing
- Connected to arm
- 32mmX48mmX24mm
- Step angle: 1.8°
- Holding Torque (kg.cm): 5.5
- Voltage (V): 8
- Current (A): 0.5

Motor Driver

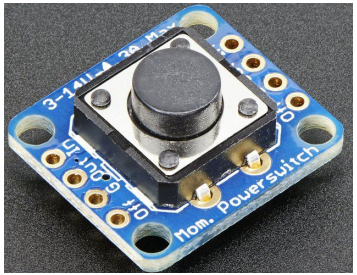
KR09014

- Bridge between Low power computing unit and high power motor
- Max Current output: 2A
- Voltage output: 5V~35V
- Raspberry Pi friendly

Calibrator



Rotary Encoder



Button

- Rotary Encoder and Button connected to raspberry Pi
- Movement of Rotary Encoder translate to movement of motor
- Button pressed for saving stepper motor location to memory
- Consecutive presses on Button correspond to setting 1,2 and 3
- Long Pressed For reset
- Calibrator modules are detached after initial Calibration

Parts List

1.	RG-11 Sensors x3	$147
2.	Raspberry Pi Model 3b	$35
3.	MicroSD Card	$17
4.	Card Reader	$9
5.	Canakit Power Supply	$10
6.	Stepper Motor	$13.95
7.	Motor Driver	$0.694
8.	12V Battery	$12
9.	5V Battery	$6
10.	Small Electronics	<$10
11.	Plastic Casing and arm	<$15
	Total	<$275.64

MDR Deliverables

- Have sensors and communication working.
- Be able to connect to at least one model of vehicle.
- Rotary Encoder working.
- System will be able to detect and actuate accordingly for at least one setting of rain.
- Raspberry Pi correctly taking in inputs and sending corresponding outputs.

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ECE sdp of other group:

http://www.egr.msu.edu/classes/ece480/capstone/spring10/group06/Documents/ECE480_Design_Team6_Final_Report.pdf

Rain sensor:

http://www.myturbodiesel.com/wiki/rain-light-sensor-retrofit-and-installation-vw-diy/: 1k0 955 559 af

best, around 150 dollar, inside of the windshield, stable, reliable

http://www.dx.com/p/raindrops-sensor-module-blue-black-199859#.Wep1GmiPJhG

low price, 3.91 dollars outside of the car, in direct contact with moisture, rust, reliability is low

https://www.aliexpress.com/item/Car-Rain-Sensor/821397016.html alternative for 1k0, lower pricce

http://hydreon.com/wp-content/uploads/sites/3/2015/documents/rg-11_instructions.pdf

$59 optical sensor, mounts to car exterior, only detects differential change in water, has digital output

windshield arm:

http://www.autopartswarehouse.com/sku/Replacement/Wiper_Switch/REPA361302.html?apwcid=gglpla&gclid=Cj0KCQjwvabPBRD5ARIsAIwFXBnHhX2XbLSYtuJi4mHHd4ZXhibGlxvqr