A

Project Report

On

**“Design of Power Window Mechanism for Car”**

Presented By

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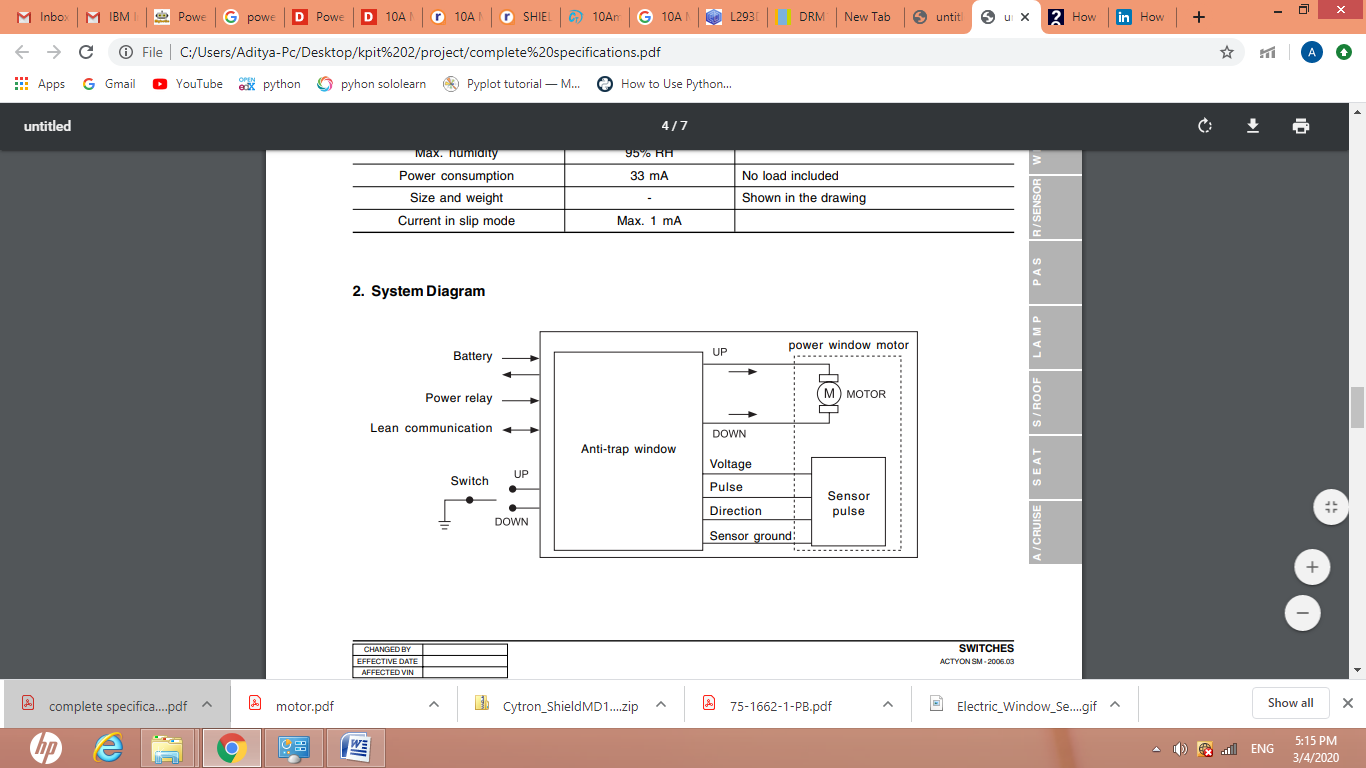
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**CHAPTER 1**

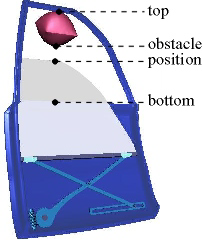
**Introduction**

* 1. **Introduction**:

Power windows  are automobile windows which can be raised and lowered by pressing a switch or button . Power windows mostly work on the principle of electricity or battery that is controlled by switches and a number of wires. Power windows work only when the car is on start mode.Power window also consist anti trap operation If there is resistance of 100 N while the window is operating with the auto up function, the window is lowered approx. 150~180 mm to prevent personal injury.

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**Fig 1 Power Window System Diagram**

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**Fig 2 Anti pinch System**

* 1. **Literature review:**

***1.Experimental Study of Automated Car Power Window with “Preset” Position Muazzin Mupit and Amir Akramin Shafie 1University Kuala Lumpur Malaysia France Institute****:*

In today’s automotive industry, many features are added in power window system. For instance, Anti Trap System, with immediate reversal of the window in the event of entrapment. Thus, it gives full and reliable protection for children’s hand, neck and any obstacles as well. The aim is to develop an innovative mechanism to enable the user to control the degree of opening power window position with preset position. This experiment involved design and development of PIC program, electronic circuit design and modification on existing power window mechanism. In this experiment, microcontroller PIC16F877A is applied as a medium to achieve the goal. Generally, it will control the degree opening window whenever the user or motorist required, plus anti-entrapment features on window lifting control system. Therefore the user will be able to open and close the power window within the selected position and feel free while maneuvering their vehicles

***2.Design and hardware development of power window control mechanism using microcontroller by Roushan kumar Assistant Professor, Department of Electronics,Instrumentation and Control Enginnering[2008****]* :

The research paper emphasizes on the design and real time implementation of microcontroller based power window control used as a control system for moving a power window panel. The purpose of power window control system is to raise and lower door glass with the help of a switch and its operation is controlled by the use of following sensors LPG sensor, LOR sensor and position sensor to replace the use of hand-turned crank handle. Power window system consists of driver motor, power electronic and control system. The control unit senses both hard and soft obstructions and deactivates a motor that moves the glass when any obstruction is detected. The controller also senses obstructions on start-up of the motor and regulates the speed of the window panel by pulse width modulating motor signals. In other way the controller senses obstructions by maintaining data which is related to motor operation in three different memory buffers that are regularly updated upon receipt of pulses that are related to motor speed. It increases the safety of the automobile as well as increases human comfort inside the vehicle. Such applications are fire safety in the vehicle, over temperature detection, sensing of LPG leakage. Hardware implementation includes some basic input switches, sensors connected to the microcontroller and the LEOs and LCO are used to show the status of output. Input sensors used for this research are LPG sensor, LOR sensor and position sensor, output is the functioning of the motor. The implementation work is carried out using AVR ATMEGA 16 microcontroller..

**1.3 Market analysis**:

The increasing sales of passenger cars directly impact the growth in the global automotive power window motor market. This is because most of the modern passenger cars are offered nowadays equipped with power window system.

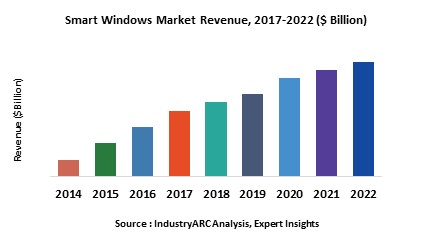
The demand for safety and occupant’s convenience is a key driver fostering the adoption of advanced automobile safety systems. Nowadays, safety and convenience features are not limited to premium vehicles but are also provided in midlevel and entry-level vehicles.

**1.3.1 Increasing Adoption of Antipinch Technology In Power Window System:**

The major factors driving its growth in automatic segment in the automotive anti-pinch power window system market is rise in vehicle electrification and growing awareness toward advanced safety features. Passenger cars were the largest user of automotive anti-pinch power window systems due to rapidly growing automotive industry, especially in emerging countries including India, China, Brazil and South Africa, which are generating significant demand for anti-pinch power window. Europe and North America collectively accounted for more than 69% in the global automotive anti-pinch power window system market in 2016, owing to increase in manufacturing of passenger cars in countries, such as China, India, U.S. and Mexico. Rise in passenger car export in developing countries such as India, Brazil and South Africa is driving the growth of market. Stringent government regulations towards vehicle safety in these regions are expected to further drive its market. Europe was the largest market for automotive anti-pinch power window systems in 2016 and is further expected to witness an increase in demand due to rising demand of luxury passenger cars.

**1.3.2 TOP VENDORS LEADING THE MARKET**

* AISIN SEIKI
* Bosch
* Continental
* DENSO
* Valeo

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## 1.3.3 Segmentation by application and analysis of the automotive power window motor market

* Passenger car
* Commercial vehicle

The automotive power window motor market is witnessing growth in the passenger car segment due to the rising integration of automotive power window motors in several passenger cars.

## 1.3.4 Segmentation by geography and analysis of the automotive power window motor market

* Americas
* APAC
* EMEA

The adoption of advanced automobile safety systems such as such as the power window system and the introduction of safety and convenience features in mid-level and entry-level vehicles are driving the growth prospects for the power windows in cars market in the APAC region.

**Chapter 2**

**Swot Analysis**

|  |  |  |
| --- | --- | --- |
| **Sr.No** | **Advantage** | **Disadvantage** |
| **1.** | It allows the driver to control the windows with just the touch of his fingers. | Many a times, the window regulator also known as the window track, might stop functioning. This causes a power window failure. |
| **2.** | It allows people with hand injuries or other physical complications to easily operate the windows. | Power windows might also stop working because of a broken motor, a broken cable pulley, or a broken switch. |
| **3.** | Drivers can easily control the windows even while driving | Worn off window regulators might also be a reason behind a dysfunctional power window. |
| **4.** | The master power panel in the front also allows the driver to operate all the windows simultaneously, without leaving his seat. This feature is very helpful in case there are children in the back seat. | As stated earlier, the power window assembly uses a powerful motor. This motor is made up entirely of smaller parts. If one element becomes defective, you’re bound to have power windows that stick and barely roll up or down. |
| **5** | **The power windows are equipped with an intelligent anti-pinch device** | The more high-tech the car is, the more expensive the repair is as well. That’s why expensive vehicles also require that you save up some money for both unexpected repairs and maintenance. The power window assembly is no exception. |

**CHAPTER 3**

**Requirements Analysis**

* Power window circuit is classified into five main parts :

• OFF board Power Supply

• ON board power supply

• Atmega 16 Board

• Motor Circuitry Board

• Sensors interfacing

**3.1.High Level Requirements:**

|  |  |  |  |
| --- | --- | --- | --- |
| Requirement no | Requirement description | Hardware requirements | Software requirements |
| 1 | Motor | DC Motor | **-** |
| 2 | ECU Motor Driver Unit | Watchdog and diagnostic functions charge pump driver | **-** |
| 3 | ECU Motor sensor Unit | Hall sensor | **-** |
| 4 | Timer | Watchdog Timer | **-** |
| 5 | Local Interconnect Network | LIN 1.3/2.0/2.1 | **-** |
| 6 | Simulation | - | MATLAB |
| 7 | Window Regulator(gear and leer mechanism for sliding window up and down) | Regulator | **-** |
| 8 | Sensor | 1.LPG Sensor  2. LDR Sensor | **-** |
| 9 | Microcontroller | Atmega 16 Board | **-** |
| 10 | switching the direction of the motor | 2N30SS transistor | **-** |
| 11 | bridge rectifier circuit | 1 N4007 diodes | **-** |
| 12 | voltage regulator IC are used to provide constant 12V for off voltage power supply | LM78 12 and LM780S | **-** |
| 13 | voltage dc power supply | 5 V | **-** |
| 14 | Light Dependent Resistor | LDR Sensor | **-** |
| 15 | To check test cases | - | Proteus |
| 16 | To check code | - | AVR Software (Codeblock) |
| 17 | Motor Driver Shield | L293D Motor Driver Shield |  |

**3.1.2 System Requirement:**

|  |  |  |
| --- | --- | --- |
| **Sr.No** | **Parameter** | **Value** |
| 1 | Weight of Window | 5 Kg |
| 2 | Voltage Rating | 12 V Max |
| 3 | Rated Torque | 5kg-m |
| 4 | No Load Current | 2.5 A |
| 5 | No Load Speed | 50-100 rpm |
| 6 | rpm Rated Current | 5 A |

**3.1.3 Electric Specification:**

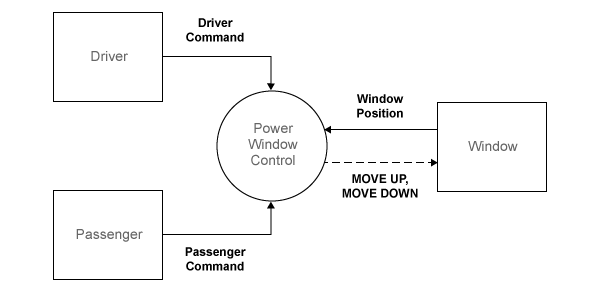
|  |  |  |
| --- | --- | --- |
| **Item** | **Specific Value** | **Remark** |
| Rated voltage | DC 12 V | Operated normally within this range |
| Operating voltage range | DC 9 V ~ DC 16V | Auto up function is inactive within 9 V ~ 10 V |
| Operating temperature range | -35°C ~ +75°C | Data storage and manual operation is possible within 7 V ~ 9 V |
| Storage temperature range | -40°C ~ +85°C | Stops motor if exceeding 16 V |
| Max. humidity | 95% RH | **-** |
| Power consumption | 33 mA - | No load included |
| Current in slip mode | **Max 1mA** | **-** |

**CHAPTER 4**

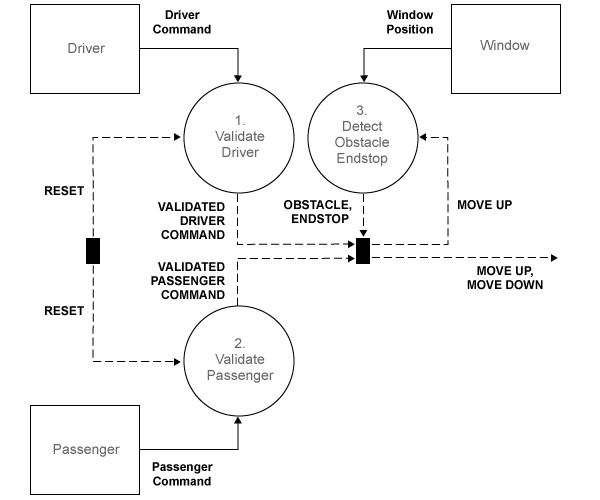
**Diagrams**

**4.1 Structural Diagram:**

#### 4.1.1. Context Diagram: Power Window System

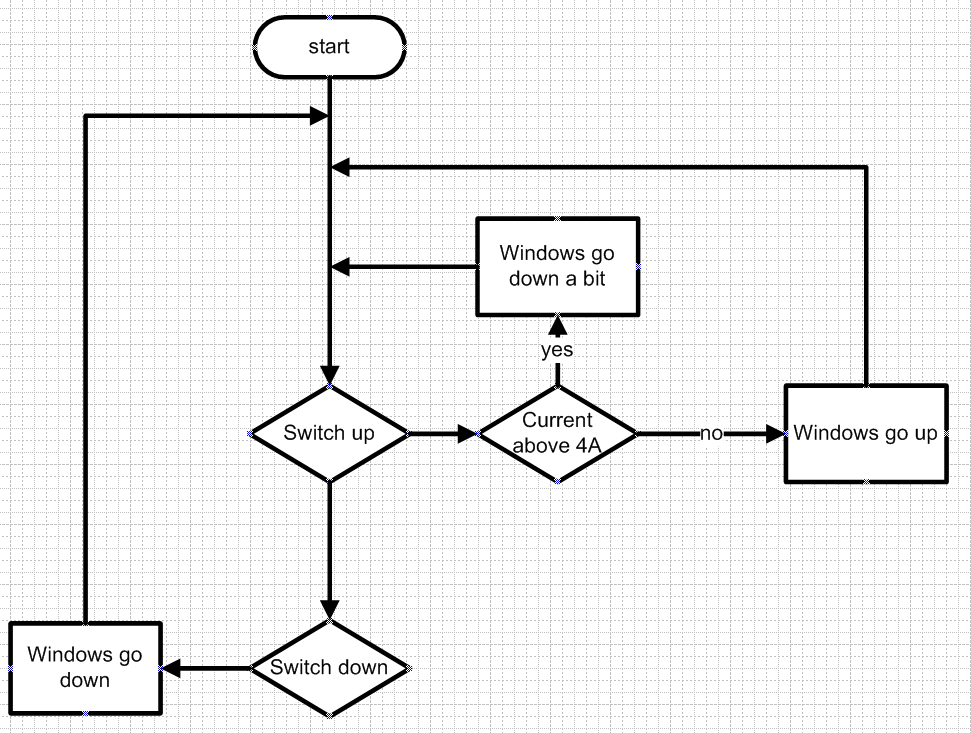


#### 4.1.2.  Power Window Control

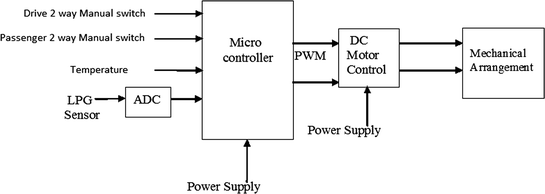


**4.2 Behavioural Diagram**:

4.2.1: Flow chart of basic power window system:



4.2.2 Power Window Functional Module:



**CHAPTER 5**

**Testing**

**5.1.1 Test cases**

|  |  |  |  |
| --- | --- | --- | --- |
| TEST CASE ID | Purpose of the Test | Expected Output | Actual Output |
| **1** | Window Upward time | 3.27 Seconds | 2.88 Seconds |
| **2** | Window Downward time | 3.20 Seconds | 2.62 Seconds |
| **3** | Motor Torqur | 20.01-30kg.cm | 30 Kg-cm(2.9N-m) |
| **4** | Motor Speed(RPM) | 51-100 | 85 |
| **5** | Motor Load Current | <7A | 5A |
| **6** | PWM duty cycle | 0-255 | - |
| **7** | Maximum PWM Frequency | 10KHZ | - |
| **8** | VIOH (Logic Input-High Level) | 3-5.5V | - |
| **9** | IMAX (Maximum Continuous Motor Current) | 10A | - |
| **10** | IPEAK (Peak Motor Current)\* | 15A | - |
| **11** | Motor Stops | >16V | 16V |

**5.1.2 Self-diagnosis**:

The ECU motor diagnoses of itself to stop the motor or reset the hardware if there is malfunction in the system or supply voltage.

• Service person may not know whether the ECU motor is in self-diagnosis or not.

• If **there is an error in RAM checksum after wake-up** : Hardware reset -auto Up deactivated, (very unlikely in a real world) Re-initialization

• **If the voltage is low (less than 5V) :** Hardware reset- motor stops, (both auto/manual deactivated) Reactivated when the voltage is returned to normal

• **If the motor rotates more than 10 times to the upper direction after initialization**: (idling for more than 10 times than the memorized position) Motor stops, initialization erased No auto up, Reactivated after initialization

• **If the motor rotates more than 400 times to the lower direction after initialization:** Motor stops, initialization erased No auto up, Reactivated after initialization

• **Abnormal program running** **:** (very unlikely in a real world)Hardware reset by monitoring program motor stops (both auto/manual deactivated) Replace motor