Automatic Vacuum “Beater Bar” Height Adjuster
Widget Works: Innovative Solutions for a Busy World

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Abstract
The majority of upright household vacuum cleaners require manual adjustment to effectively clean various carpet heights. This adjustment mechanism has limited and discrete settings which do not entirely encompass all common carpet heights. Team 21 decided to address this problem by designing and implementing a fully automatic height adjustment mechanism. This was accomplished by incorporating a spring-actuated suspension. Our first scale model and prototype both firmly communicate the functionality of our design.

Problem Definition
Observing that current vacuums utilize poorly located adjustment knobs and levers that require frequent and inconvenient manual adjustment, Team 21 set out to eliminate this cumbersome and repetitive task. This would be accomplished by implementing an automatic adjustment system with performance that exceeds that of current consumer-level vacuums.

User Survey:
1. Is your vacuum effective at cleaning a wide range of surfaces?
2. How important is it for your vacuum to clean a wide range of carpet and bare floor types?
3. Do the various mechanisms for height adjustment function smoothly and properly?
4. Would you be interested in an automatic spinning brush height adjustment?

Results of Survey
The potential market for an inexpensive vacuum incorporating our improvements was established by polling current vacuum cleaner users. Question 1 shows that 35% of consumers believe their current vacuum functions poorly. This means there is a large potential market for a superior product at a low price point.

Question 4 shows that there is a high level of interest in a self-adjusting vacuum product.

Benchmarking
Current best in class vacuums from many price ranges were benchmarked and their key performance metrics were identified. The most expensive models tested featured provisions for manual adjustment of beater bar height. The results showed that these manual adjustment mechanisms failed to account for all ranges of carpet heights. Our test surface proved to be very unforgiving, revealing performance shortcomings in every standard model tested. The most demanding (and loudest) test used .177 caliber lead pellets (can be seen in Figure 1), these were very heavy, small, and aerodynamic, causing some vacuums tremendous difficulty.

Discussion
Team 21 selected and implemented a spring loaded suspension system to automatically adjust vacuum height. The resulting system is inherently robust, reliable, and maintenance-free. This system requires no adjustment of any kind on part of the user. The prototype system itself is inherently simple, smooth, and reliable. The adjustment mechanism has limited and discrete settings which do not entirely encompass all common carpet heights. Team 21 decided to address this problem by designing and implementing a fully automatic height adjustment mechanism. This was accomplished by incorporating a spring-actuated suspension. Our first scale model and prototype both firmly communicate the functionality of our design.

Final Design and Prototype
Team 21 constructed and benchmarked a functionally modified Dirt Devil Vacuum (Table 2). Taking this inexpensive vacuum and removing parts of the support systems beneath it, we then mounted a pivoting wheel carrier and preloading spring. Conducting our benchmarking protocol again on the prototype we were pleased to note that performance on all fronts was significantly improved. Especially encouraging was the ease with which the prototype cleaned the abrupt transition between linoleum and high pile carpet. It dramatically exceeded the performance of vacuums that cost many times more. It excelled at effectively vacuuming the entire test surface and was markedly simpler to use, without need for manual adjustments at every surface transition.

Results/Conclusion
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Acknowledgments
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References
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United States Patents Referenced:
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