



Flipper

The Persistent Vehicle

(self-overturning mechanism)

by

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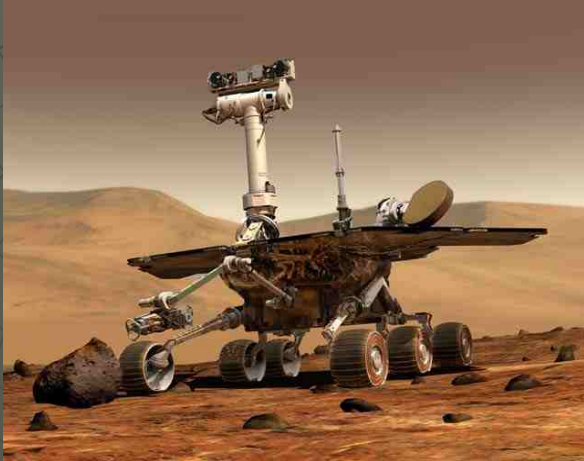
Overview

- ◆ Concept
- ◆ Applications
- ◆ General Idea
- ◆ Tools
- ◆ Components
- ◆ Cost Estimate
- ◆ Demonstration
- ◆ Possible Upgrades
- ◆ Conclusion

Concept

- ◆ Autonomous vehicles are made to perform a task without human intervention
- ◆ Designs often don't take the unexpected into account
- ◆ Addition of a simple low cost mechanism can prevent billions in damages and save time

Examples



- ◆ If a Martian dust storm turns the Opportunity over, the multi-billion dollar mission is over...

- ◆ Armored trucks are designed with right angles so that they do not roll if something caused them to turn over.
- ◆ Why not make them capable of straightening out without an emergency crew?



General Idea

- ◆ 4-wheeled robot with a simple mechanism that helps it regain its upright position
- ◆ Accelerometer to detect disorientation
- ◆ Compass to correct its original course
- ◆ Potentially project saving capability



Components – Pico Servo

- ◆ Smaller and lighter than a standard servo
- ◆ Powerful enough to drive the key mechanism of the robot



Pico Servo

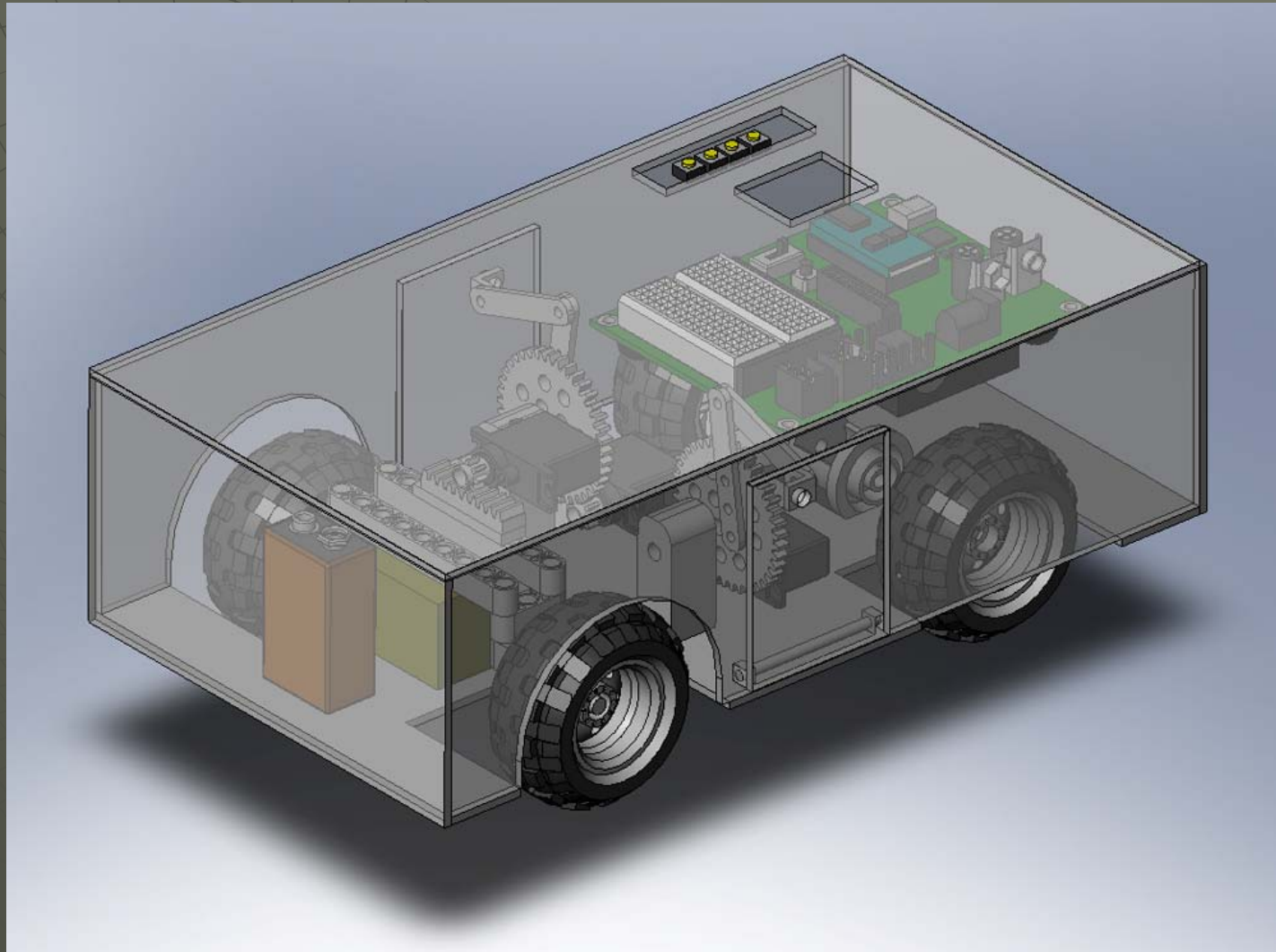
Accelerometer - Memsic Dual Axis

- ◆ Can sense gravitational (g) force of $\pm 3g$ on two axes (X, Y, but only X is needed for our purposes).
- ◆ Detects vehicle's orientation

Compass – Hitachi HM55B

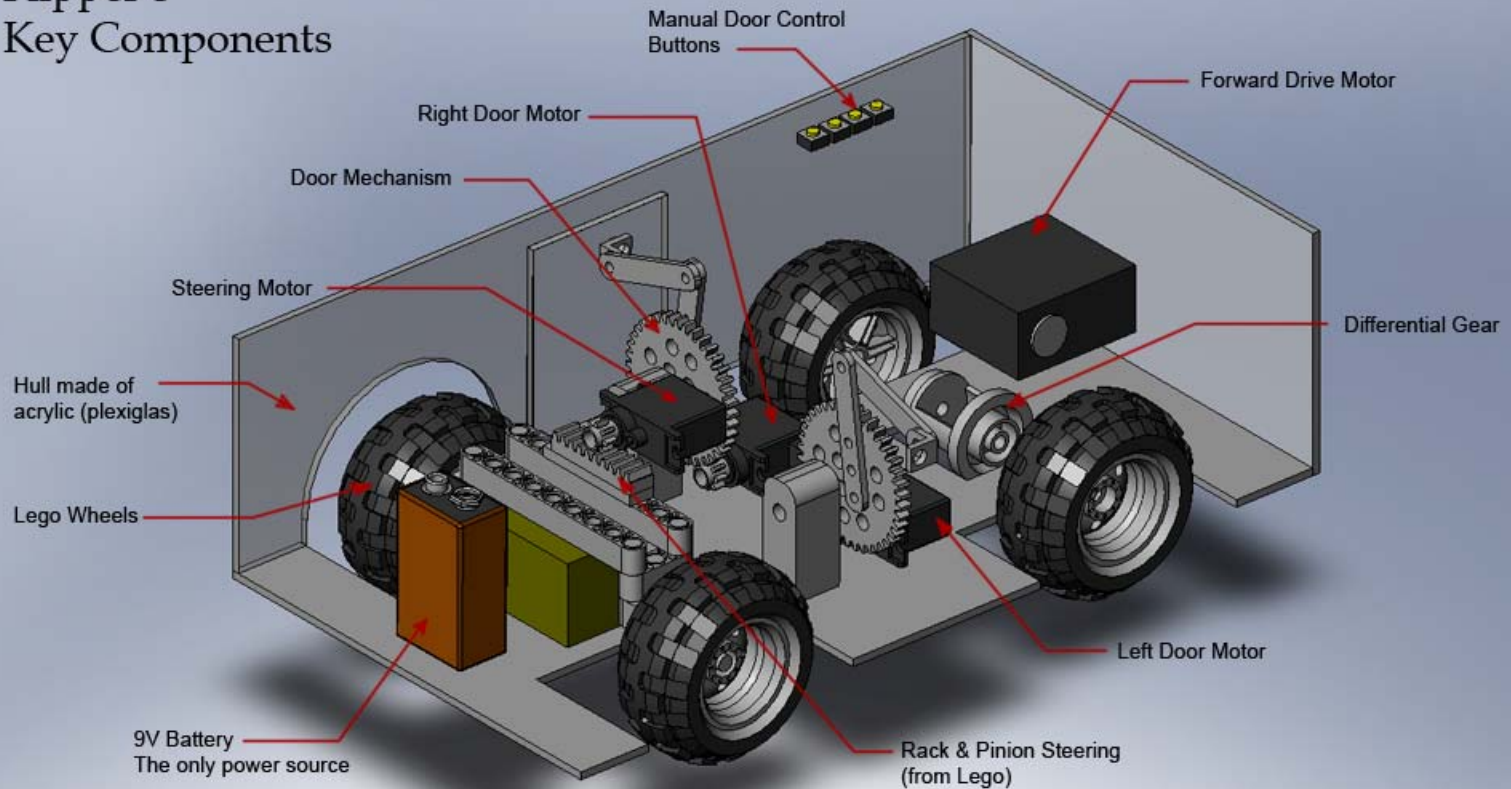
- ◆ Detects the robot's heading
- ◆ Target course is set when the robot is turned on

Schematic



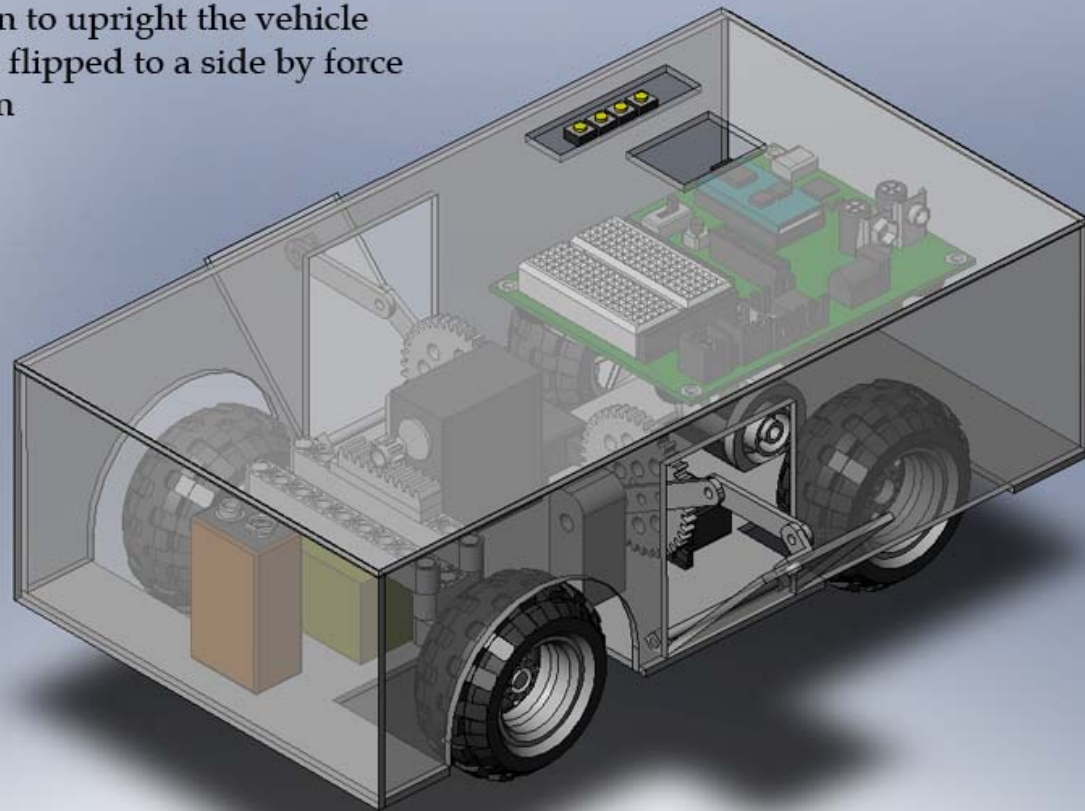
Key Components

Flipper's Key Components

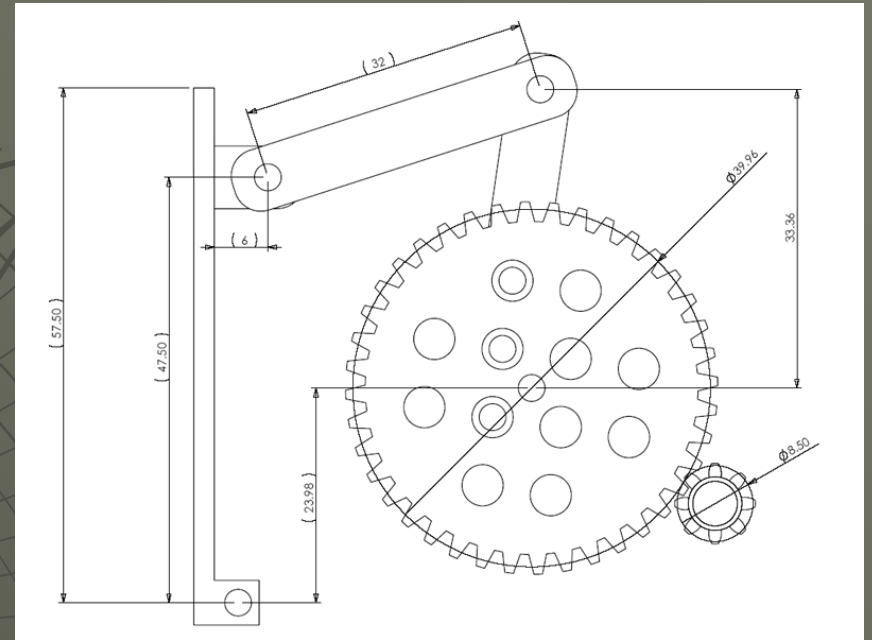
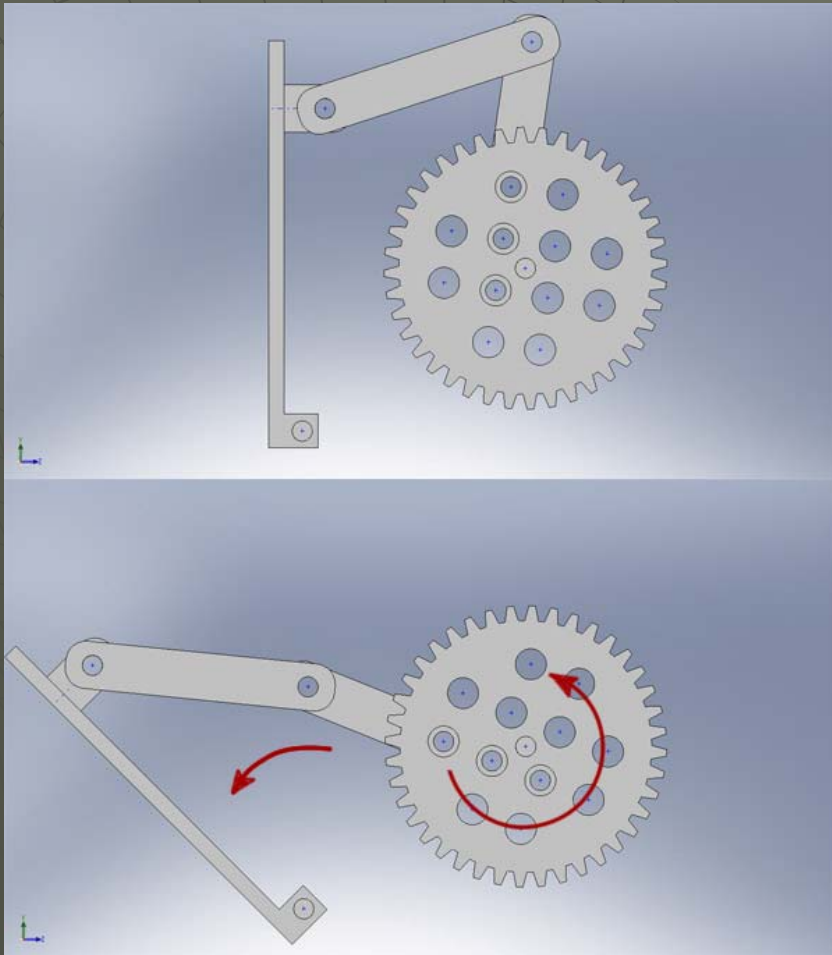


Operation

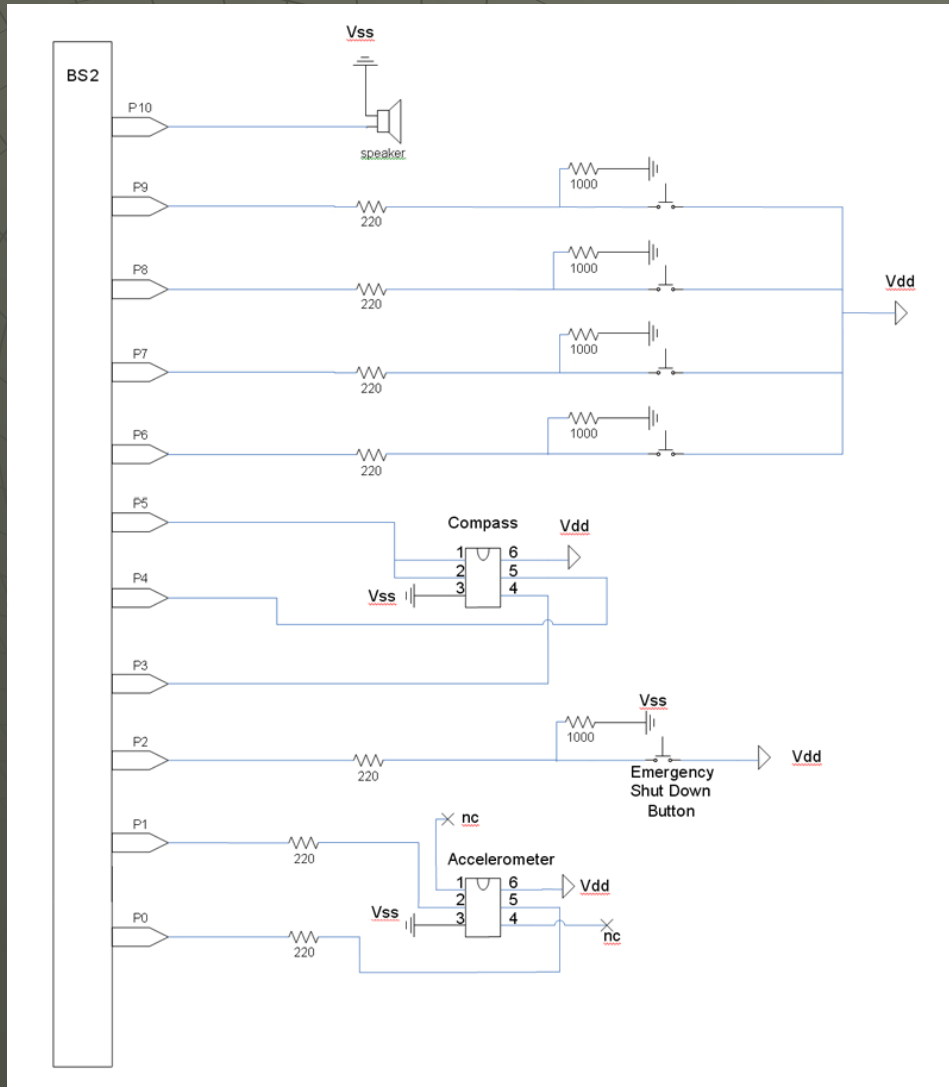
Side panels open to upright the vehicle once it has been flipped to a side by force of nature or man



Mechanism



Circuit



- ◆ Basic Stamp 2 Microcontroller
 - 11 pins are used
- ◆ Accelerometer
- ◆ Compass
- ◆ 5 Buttons:
 - 4 for manual door control
 - 1 for emergency shut down
- ◆ Speaker to make beeps
- ◆ Resistors:
 - 7x 220Ω
 - 5x 1kΩ

Cost Estimate

Basic Stamp & sensors	\$300
Acrylic plates	\$30
Custom machined parts	\$30
Lego gears and wheels	\$20
Extra servos	\$20
Glue	\$5
Bolts	\$5
Battery Connector	\$1
Joy of putting it all together	Priceless



Demonstration

Possible Upgrades

- ◆ Additional flipping mechanism on the roof
- ◆ Obstacle detection and avoidance using rangefinder
- ◆ Door position sensors
- ◆ GPS
- ◆ Paint job
- ◆ LCD display for showing current heading
- ◆ A purpose
 - Terrain mapping
 - Tour guide
 - Light cargo carrier

Conclusion

- ◆ Overcome the unexpected
- ◆ Save money for out of reach vehicles
- ◆ Ensure the job is completed
- ◆ The concept was proven to work