

Development of an Autonomous Car

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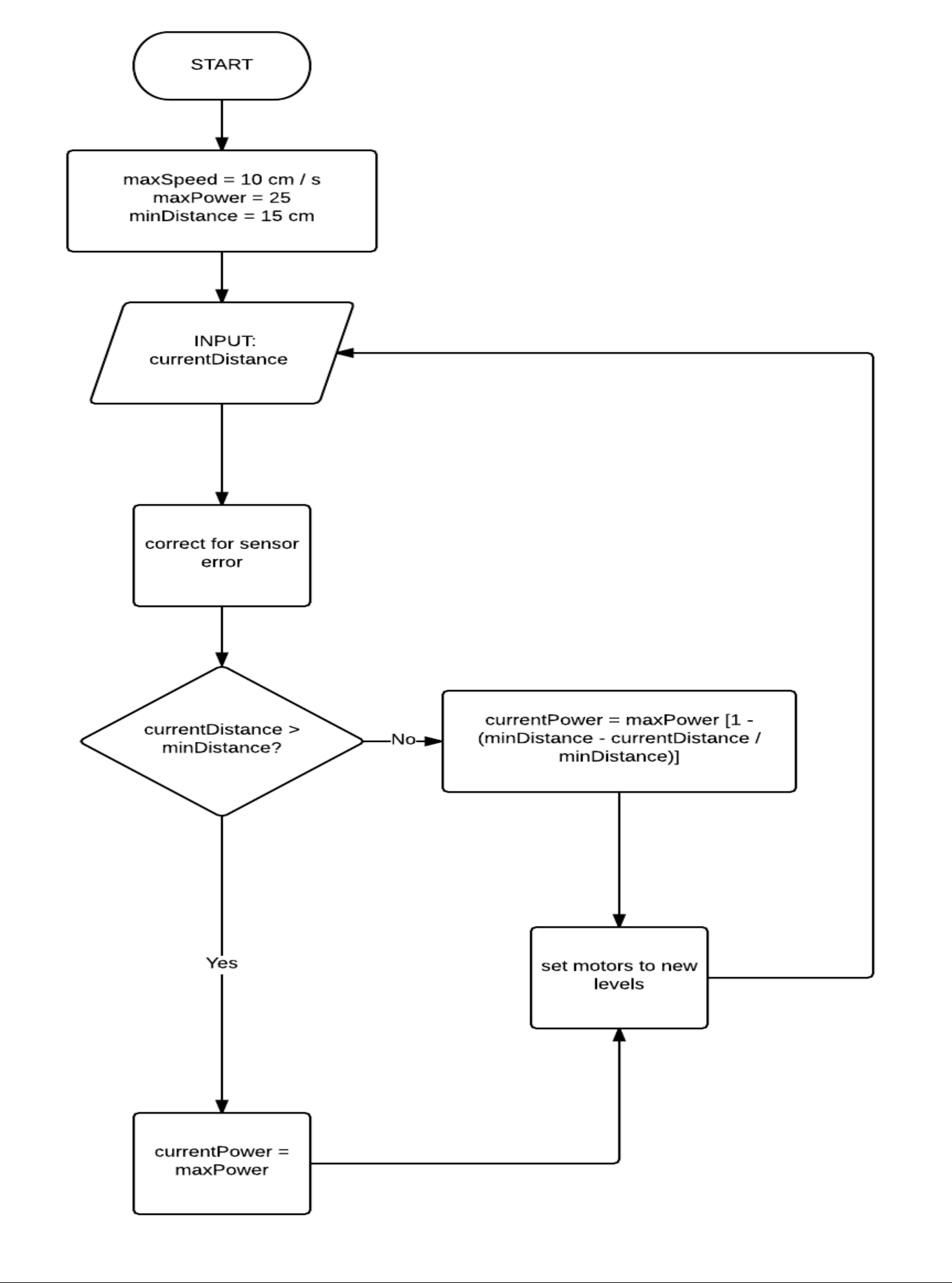
Background

- Autonomous control of cars has been vision of engineers
- Currently, cruise control allows for control of speed
- Driver still needs to monitor distance from other cars and facilitate passing of other vehicles
- Sensors allow for proximity warnings when another car is passing in blind spots and may even apply brakes, if needed
- Still no perfectly “autonomous” vehicle
- Grand Challenge of Engineering to enhance mass transit in urban areas.

Criteria

- Monitor speed and distance of vehicles
- Maintain vehicle speed limit of 10cm / sec
- Maintain buffer distance of 15 cm between vehicles
- Minimize correction times (< 1 second)
- Never surpass 10 cm/s

Logic Flowchart



Design Process & Testing

- The design team began by making a flowchart of the logic required to meet all of the criteria for the vehicle, as seen in the bottom left corner.
- Then, testing began to determine the accuracy of the sensors, mainly the ultrasonic sensor.
- Simultaneously, the robot parts were analyzed to brainstorm the structure of the vehicle.
- As the vehicle does not need to turn, only one motor was needed to operate the vehicle.
- Due to the limited building resources, only one front wheel was incorporated into the design, and the vehicle has a rear-wheel drive design.
- Various placements of the ultrasonic sensor were considered, but the team determined that having it in the very front over the front wheel was the best position for its function.
- An equation was derived to determine the power required to operate the vehicle at various distances from the car ahead of it.
- Finally, a code was created from the flow chart and equation, and a framework for the final car design was built.

ULTRASONIC SENSOR TESTING			
Trial Number	Distance Sensed (cm)	Actual Distance (cm)	Change (cm)
1	27	24	3
2	24	20	4
3	24	15	9
4	13	10	3
5	23	17	6
6	12	8	4
7	22	15	7
8	14	10	4
9	18	14	4

MOTOR SPEED TESTING		
Trial Number	Motor Speed	Robot Speed (cm/s)
1	50	21.0
2	30	13.6
3	20	5.97
4	25	11.5

Final Design & Performance

- The final design consisted of a single front wheel, with rear wheel drive.
- The ultrasonic sensor was placed at the front of the vehicle and an index card was placed on the back so as to provide a surface for the vehicles behind it to sense its presence.
- Immediately prior to testing, team had problems with the ultrasonic sensor controlling the deceleration of the vehicle
- During the final performance, the vehicle continued to have this problem.



Conclusions

- In order to improve this prototype, the design team recommends improving the ultrasonic sensor implementation.
- The placement of the sensor should be tested again in order to maximize its functionality.
- The battery level affects the power of the motors, so the power needs to be constantly adjusted in order to maintain the speed limit.
- Otherwise, the three-wheeled vehicle design worked well and the vehicle was structurally sound.

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