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<u>Automated Guided Vehicle Final Project</u>

Introduction

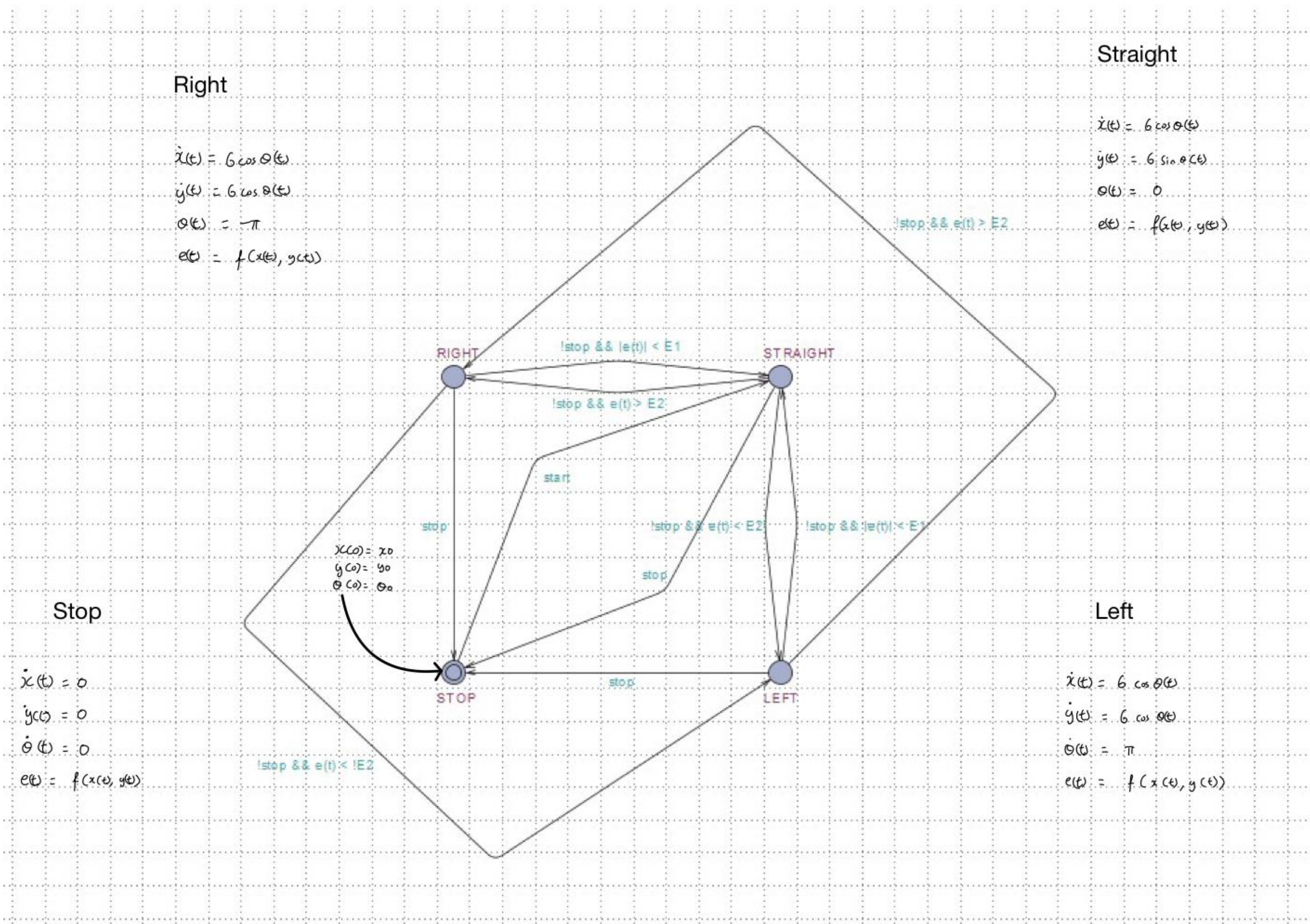
This project aims to determine the theoretical and experimental behavior of an automated guided vehicle system (AGV), which is a type of a hybrid automata system. Referring to Figure 4.13 in the textbook "Introduction to Embedded Systems by Lee and Seshia", the objective of this project is to improve and correct the AGV design in said figure while ensuring the AGV stays within the track and eventually reaches its goal. This project will be demonstrated through a technical report showcasing the experimentation and calculations of the predicted trajectory overlaying a 2-D plane and the track's dimension.

Methodology

<u>Assumptions of AGV:</u>

1. The AGV design must operate at a forward and rotational speeds within reasonable ranges.
2. The AGV is equipped with a forward sensor and sensors on both sides. The range of detection for these sensors are arbitrarily far.

<u>Design of AGV</u>



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Justification

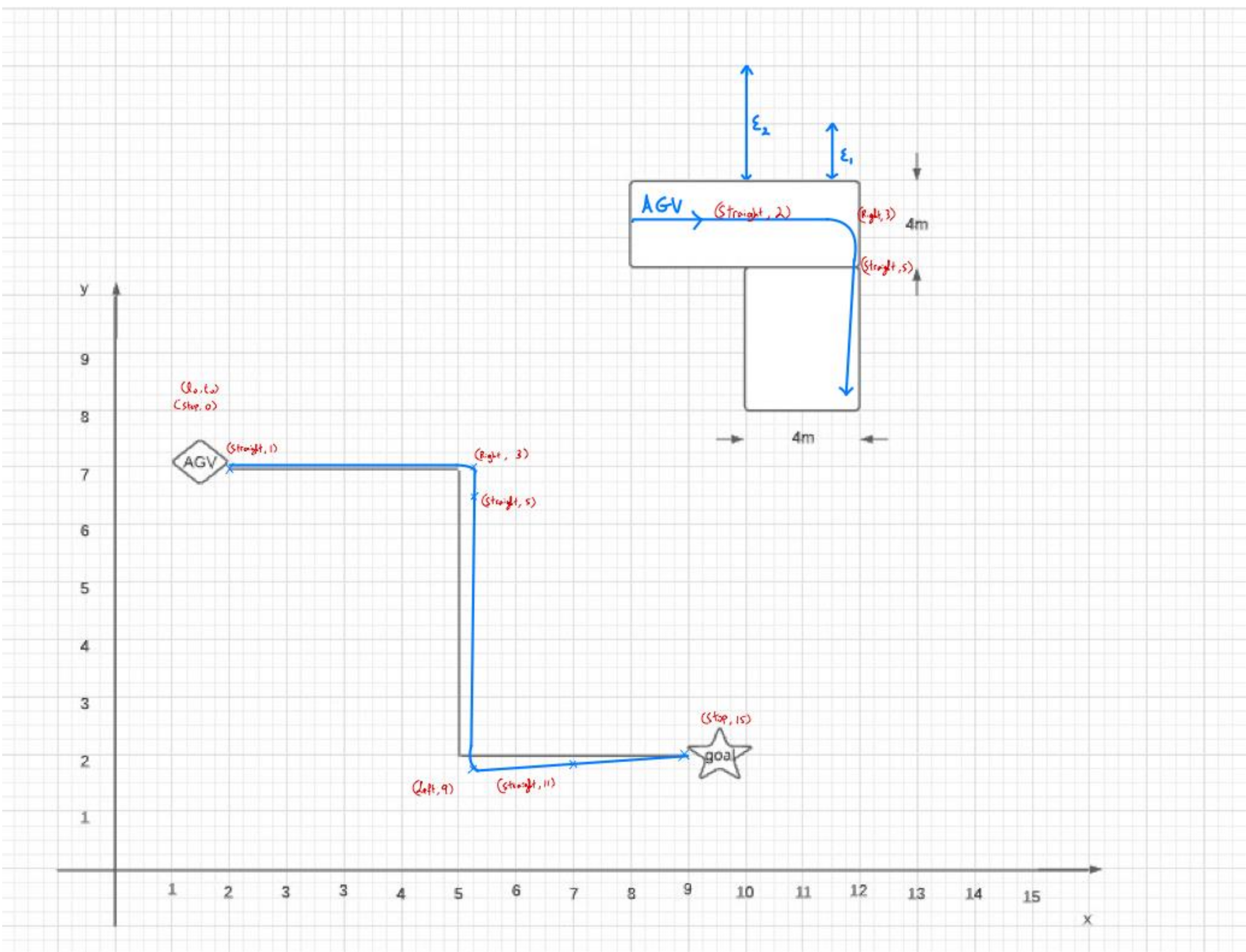
The improved design of the AVG above will meet its goal on the provided 2-D plain track with the assumption that the width of the track is 4 meters. In addition, the AGV will stay on track and will not veer outside of the track's boundaries. The following demonstrates the justification on why the above revised AGV design will meet its goal.

1. Reduced rotational speed of x(t) = 10cosϴ(t), y(t) = 10sinϴ to x(t) = 6cosϴ(t), y(t) = 6sinϴ
2. The track will be painted with a light reflecting color and it is assumed that there exists an array of photodiodes on the track. Therefore, implementing the front and side sensors, the AGV will be designed to detect the variation in current from the photodiodes, thus, e(t) < 0 estimates that the AGV is to the right whilst, e(t) > 0 estimates the AGV to be on the left. Hence, the AGV will not veer outside even the track's boundaries. The sensor output function will be as follows:

$$\forall t,\ e(t) = f(x(t), y(t))$$

Results

2D Plane Plotted Over the Track to Show the AGV Trajectory



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Calculations

(STOP, x = 0, y=0, ϴ=0) start→ (STRAIGHT, x = 6cos(1), y = 6sin(1), ϴ=0) → (RIGHT, x = 6cos(3), y = 6sin(3), ϴ=-π) → (STRAIGHT, x = 6cos(5), y = 6sin(5)) → (LEFT, x = 6cos(9), y = 6sin(9), ϴ=π) → (STRAIGHT, x = 6cos(11), y = 6sin(11)) → stop→(STOP, x=0,y=0, ϴ=0)

Conclusion

The AGV will meet the goal as demonstrated by the experimental trajectory of the path taken by the above designed AGV hybrid model. As shown in the trajectory, the AGV reaches its goal as there exist a reach such that $(l_{0,}t_0)$ → $(l_{n,}t_n)$ such that $l = l_n$, and $t = t_n$. Furthermore, the angular velocity of the design above is reduced to prevent the AGV from exiting the boundary of the track that is of width of only 4 meters.