CIS 330 Project Proposal

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Traffic and Transportation Engineering in Colorado Springs

Overview:

The Traffic and Transportation Engineering department of Colorado Springs is part of the city's broader infrastructure management system. Located southeast of Denver, Colorado Springs has historically faced challenges in updating its traffic systems to keep pace with the city's growth. Since the 1970s, the city's traffic management system has relied on traditional technologies and static systems, which have proven to be increasingly difficult for managing the needs of a growing population. Recently, Colorado Springs launched ConnectCOS, the first initiative in decades that incorporates Intelligent Transportation Systems (ITS) technology, such as traffic video detectors, cameras, and sensors, to improve traffic management. While ConnectCOS is a significant step forward, the city's traffic system still heavily relies on old infrastructure, and there remains an opportunity to further implement newer technologies to improve traffic flow and optimize the use of the existing ITS infrastructure.

The current traffic management system in Colorado Springs is based on a combination of programmed timing for traffic lights and video detectors. During peak traffic times, the timing of the traffic signals is adjusted based on historical traffic studies. However, this approach has not proven effective in real-time traffic management, as it does not fully account for variations in actual traffic flow. Video detectors, which are used to manage traffic during off-peak times, have a limited range of approximately 100-200 feet and are often insufficient for detecting the presence of vehicles. This can lead to situations where vehicles are forced to stop at red lights when no traffic is present or where traffic builds up unnecessarily due to misaligned signal timings.

The traffic system in Colorado Springs struggles with several issues that hinder the smooth flow of traffic. One major problem is that green light times are too short, causing vehicles to be stopped unnecessarily at red lights. In some areas, the poor timing of signals results in cars hitting red lights one after another, further increasing delays. At times, the signals take too long to change, leading to traffic building up on one street while the cross street remains clear with minimal vehicle flow. This poor timing also results in some vehicles stopping at the same red light multiple times because the traffic is not clearing the intersection fast enough. Additionally, the system still operates based on timers, causing lights to change even when there is no oncoming traffic. The video detectors currently in use have a limited range of about 100-200 feet and are only utilized during off-peak hours, which is insufficient for accurately managing traffic flow. During peak times, the system relies on programmed timings that are based on outdated traffic studies, which do not reflect the real-time conditions on the road, resulting in inefficient traffic management. Finally, the physical, hard-painted speed limit signs are static and do not provide the flexibility needed to adjust traffic flow based on changing conditions.

The proposed system will integrate digital speed limit signs that communicate with Waze and traffic signals to coordinate traffic flow. These digital signs will be equipped with Wi-Fi or direct wireless capabilities to connect seamlessly with Waze, allowing them to adjust speed limits based on real-time traffic data. Video detectors will be replaced with internet-connected devices at key intersections. These devices will communicate directly with Waze, receiving real-time traffic flow instructions to adjust the timing of red, yellow, and green lights. To support this system, the Traffic and Transportation Engineering department of Colorado Springs will use offsite servers, such as those provided by Amazon Web Services, to process data received from Waze. These servers will run algorithms to optimize traffic flow based on live traffic data, considering the location, direction, and predicted destinations of vehicles moving into the high-volume intersections. This data-driven approach will allow for dynamic traffic management, ensuring more efficient and responsive control of the city's transportation network.

Technological risks:

The success of this traffic control system relies on users opting into the Waze app, which many new cars already have, but older vehicles may not. The system will depend on city residents adopting the app for effective traffic management. Internet outages could disrupt the system, so backup cameras and timers will remain in place. Onboard processing of algorithms for each stoplight and speed sign would be more expensive than using AWS servers for real-time calculations. The system will only be feasible for high-traffic intersections and connector roadways due to data transmission costs. AWS will handle data transfer and traffic light communication, while implementing wireless speed signs is straightforward for vendors. If current signs can't be made compatible, intersections may need component replacements, which would be done gradually to avoid disruption. Traffic lights would be modified one at a time during off-peak hours to minimize safety risks. The old system would remain operational during transitions. The project requires an algorithm expert for programming and a data architecture team skilled in handling and transferring live data for computation.

Resource risks:

The project team for the traffic flow project is a small team, given the scope of the project is a model for a small 5 block section of the city. The system technicians and system analysts will be minimal for this project. The team may have issues obtaining a cloud data engineer and programmer with enough skill to build the database for the live traffic and the deep learning algorithms to calculate how to optimally manage traffic flow with the system. Once the properly skilled team is acquired, the team should not suffer any losses due to transfer or attrition due to the project being short term with an extended target of 9 months to develop the deep learning algorithm, data base, and API, then likely another 3 months for physical implementation for each 5-block section using an external vendor specializing in installation of the selected components. The deadline is short term due to the small scope of the project requiring limited implementation and resource acquisition. A small team should not require large facilities or support staff for the completion of this project, but access to computers and Wi-Fi will be required. The bulk of the computing will be done by AWS, so the computers for the project team will not need to be particularly expensive or specialized as opposed to the deep learning being processed onsite.

Organizational Risks:

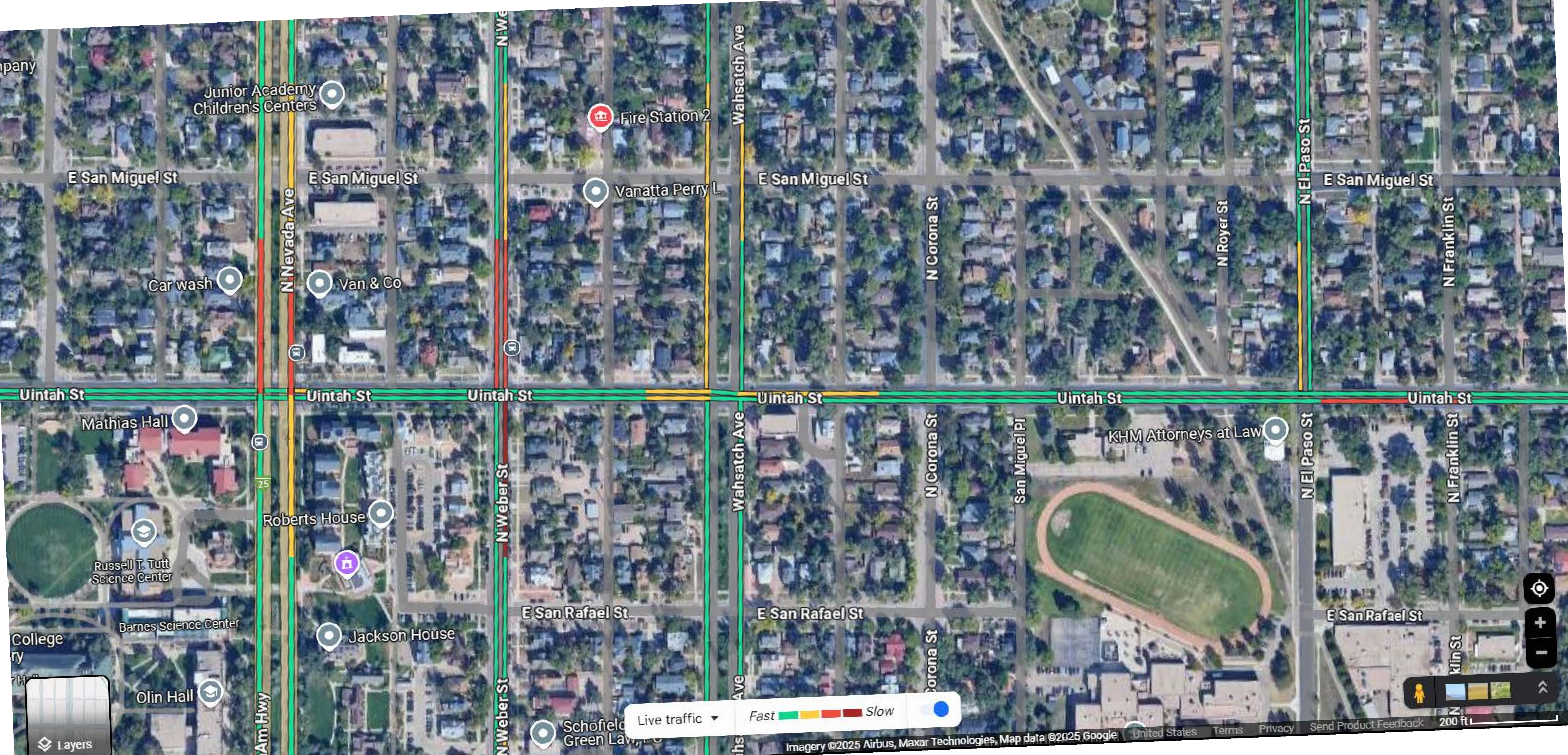
The Traffic and Transportation Engineering department of Colorado Springs would have to assess their workforce, cost, and their budget in order to go through with this project. Taking into consideration we would have to calculate the cost of having a software team develop the project, the cost of gathering resources such as new traffic lights and digital traffic signs, and the installation. Traffic lights and their installation are rather costly. Traffic lights can range approximately $250,000 to $500,000 for a single installation. Digital speed limit signs on average cost around $5,000 with an installation cost of $2,500 to $7,500 and at least 23 will be needed for a single intersection. Adding up the total cost will amount to $787,500 with annual maintenance of 8,000 which falls in the Traffic and Transportation Engineering department of Colorado Springs budget. The jobs would also likely be tampered with. Programmers would take the place of those who work to analyze the data taken from the live service cameras.

Schedule Risks:

Scheduling how long the project will take may be difficult to predict. The Traffic and Transportation Engineering department of Colorado Springs would first need to find programmers with adequate skills to develop the deep learning algorithm which could take up to a month or more. Once they begin development, the program may not be ready for another 9 months or even a year. The same recruitment issue would apply to the data specialist required to incorporate the live data from Waze into the API. Installation of new signs and traffic lights could also take up to several months. The project for a five-block section could take up to possibly a year and a half.

Conclusion:

The Traffic and Transportation Engineering department of Colorado Springs identified traffic flow issues at traffic light intersections in the city despite the city using current traffic management technology of traffic study patterns to develop timers and cameras to manage traffic lights during off peak times. This project proposes that the traffic flow issues be addressed using a new system that uses live traffic data from the Waze app to manage traffic flow. The project proposes a five-block intersection to implement a model of this product to test usability and check to ensure value is added by optimizing traffic flow.



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