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| **UTC Project Information** | |
| Project Title | MPC-620 – Visible and Thermal Imaging in a Deep Learning Approach to Robust Automated Pothole Detection and Highway Maintenance Prioritization |
| University | Colorado State University |
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| Funding Source(s) and Amounts Provided (by each agency or organization) | USDOT, Office of the Assistant Secretary for Research and Technology  $50,400  Colorado State University  $48,000 |
| Total Project Cost | $98,400 |
| Agency ID or Contract Number | 69A3551747108 |
| Start and End Dates | February 18, 2020 to July 31, 2024 |
| Brief Description of Research Project | Potholes are a primary pavement distress that can compromise safety and cause expensive damage claims. U.S. motorists suffer repair costs of $3 billion annually from damage caused by potholes. 2D image-based sensing presents as a low-cost option for rapid pavement data collection and for detecting potholes. However, quality of potholes detection using only visible images may be significantly compromised due to poor lighting, weather conditions (e.g., fog, rain), low contract to surrounding pavement. Thermal images are more robust to lighting and weather conditions and may offer additional unique features (e.g., temperature difference between pothole and surrounding pavement) that can be used for pothole detection. On the other hand, current practice for image-based potholes detection still mainly involves manual identification, which is time-and-cost consuming. Algorithms that can automate the processing of collected data and provide accurate and robust detection of potholes are needed to enable timely and cost-effective highway maintenance.  This project proposes the integration of both visible and thermal images captured by visible & thermal dual camera and the use of deep learning to enable robust, accurate and automated detection of potholes to help prioritize highway maintenance. The major objectives include: (1) Create a unique and valuable database of geotagged and labeled trios of visible, thermal and fused images for training pothole detection algorithms; (2) Develop deep learning algorithms for pothole detection, and investigate the impact of incorporating thermal and fused images on pothole detection accuracy and robustness; (3) Develop automated tools for pothole detection, pothole mapping and updating. |
| Describe Implementation of Research Outcomes (or why not implemented)  Place Any Photos Here | The developed pothole detection tool can be implemented by transportation agencies to automate the detection and mapping of potholes. The tool is designed to be user-friendly, requiring only the upload of images captured by a vehicle-mounted camera. Once processed, the tool detects potholes and provides GPS-based location data to prioritize repairs. This system can be integrated into existing maintenance workflows, reducing the need for manual inspections, improving repair efficiency, and ultimately extending the life of road infrastructure. |
| Impacts/Benefits of Implementation  (actual, not anticipated) | This research will improve road safety and reduce maintenance costs by providing transportation agencies with a more accurate and efficient way to detect and repair potholes. The automated detection tool, which combines visible and thermal images, ensures reliable pothole identification under varying conditions, particularly in regions with challenging weather. By streamlining pothole detection and mapping, agencies can allocate resources more effectively, prioritize repairs, and reduce the risks posed by deteriorating roads. This approach is scalable and cost-effective, making it accessible to agencies of various sizes. |
| Web Links   * Reports * Project Website | * MPC Final Report – [Visible & Thermal Imaging and Deep Learning Based Approach for Automated Robust Detection of Potholes to Prioritize Highway Maintenance](https://www.ugpti.org/resources/reports/details.php?id=1205) |