UNLV | ECONOMIC DEVELOPMENT

Researcher Exchange Program UNLV & Fraunhofer IVI

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Six-Month Progress Report

Reporting Period: September 1, 2021 – February 28, 2022

April 1, 2022

Table of Contents

Scope of Work

Infrastructure Support for Connected Autonomous Vehicle Operation

Current autonomous vehicle systems are equipped with numerous sensors which provide high resolution view of the surrounding environment. However, the view is limited to a local surrounding area which can be limited by various environmental factors, such as occlusion from buildings or other nearby vehicles. The limit to environmental perception is particularly challenging when working with large vehicles (such as trucks or buses) in close contact (shipping yards or bus depots). Therefore, connected autonomous vehicles (CAVs), which communicate with infrastructure to remove "blind spots" are desired.

The project task is to develop infrastructure supported perception for fixed locations to provide more consistent field of view and environmental perception for safe operation of autonomous vehicles in constrained environments. The project will consider the following main components

- Selection of appropriate sensing technologies for constrained environments (including camera, radar, lidar, or ultrasonic)
- Development of robust object detection and recognition algorithms for road users (e.g. cars, trucks, buses, and pedestrians) given a sensor package
- Definition of communication scheme for safe CAV control at low speeds (communication protocol and data transmission definition)

The results will include hardware modules for object detection/tracking and communication with a CAV. The hardware will be installed on the UNLV campus for a demonstration. The tasks of the applicant are:

- Research existing solutions which are available at UNLV and Fraunhofer IVI and identify any gaps in existing solutions (e.g. examine Robot Operating System (ROS) technology versus road side units designed by Fraunhofer IVI in other projects).
- Design a CAV showcase to highlight the research environment and educational ecosystem at UNLV and to make the university attractive for potential industry partners in the field of automated vehicles and self-driving cars. The showcase definition will be performed in cooperation with Fraunhofer IVI during the first months.
- Identify gaps in existing capabilities to design and develop an environmental sensor to extend the field of view of a vehicle sensing to see around occlusion-based blind spots (e.g. corners).
- Develop the CAV showcase at UNLV incorporating gap topic insight.

Section 1: Proposal Progress

Major Accomplishment: Demo Operational Design Domain (ODD) Defined
The ODD for the pedestrian safety demo was formally defined. The demonstration will consider a situation where a pedestrian will cross a street (Harmon St. on UNLV's campus) but cannot be detected by the CAV due to an occlusion (e.g. truck or banner). This is a dangerous situation for the pedestrian since the CAV will have no way to stop since it cannot see the pedestrian. The crosswalk area will be monitored by camera systems (one RGB and one thermal IR) to detect and track pedestrians, with predictions of future trajectory used to provide early warning of a crossing through the V2X protocols (SAE J2735E: PSM and BSM). The CAV will recognize the crosswalk message and automatically stop before the pedestrian becomes visible.

Major Accomplishment: Hire of Post Doc Project Lead
Dr. Arsal Syed, who was a Ph.D. student at UNLV working on trajectory prediction as part of this project, stayed in Las Vegas to take over the technical lead for the demonstration as a Postdoctoral Scholar. He was hired from Dec. 2021 through Dec. 2022. He will focus on development of the infrastructure sensing network – camera-based object detection and tracking, pedestrian trajectory prediction, and V2X communication – to provide early warning of dangerous situations.

Major Accomplishment: Hire of Graduate Assistant
Zillur Rahman was brought into the program as a MS student in Electrical and Computer Engineering. His background in robotics makes him a great candidate to lead development of in-vehicle environmental sensing (pedestrian and vehicles) and to develop the CAV control.

Major Accomplishment: Infrastructure Sensing
Object detection (YOLOv5) and tracking (DeepSort) are implemented on the TrafiRadar system to detect and track pedestrians and vehicles. This can effectively track a large number of pedestrians concurrently in real-time. Video is streamed to a server that processes each frame and will generate the J2735E messages.

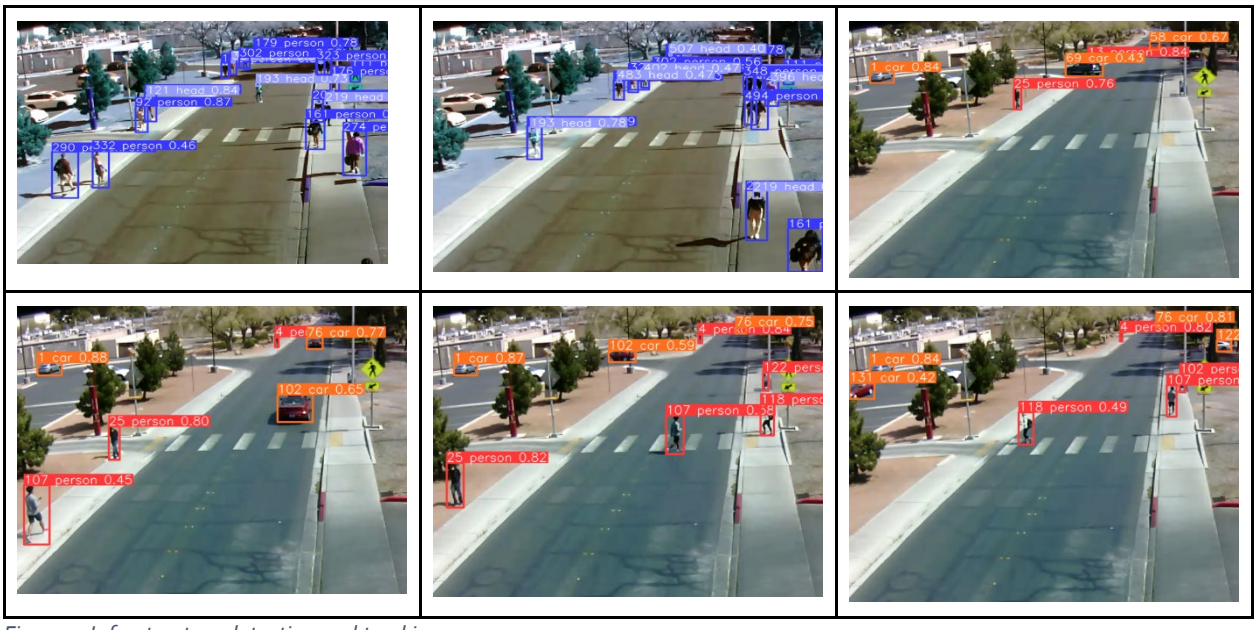

Figure 1: Infrastructure detection and tracking.

Major Accomplishment: Vehicle Sensing
YOLOv5 was previously used to detect pedestrians and vehicles in real-time from an on-board computer. The 2D image detection has been extended to produce 3D bounding boxes. With a calibrated camera, the 3D coordinates from all eight corners of a vehicle box can be estimated and provide a surround map using a bird's eye view.

Figure 2: Monocular 3D detection. Left: dash cam image. Right: top-down bird's eye view of the scene.

Major Accomplishment 3: Environmental Sensing

Additional Accomplishments

Proposals

The UNLV team has been actively seeking ways to leverage the KF to secure additional funding through various mechanisms and submitted two in the last six months (11 total):

- Nov. 2018 Nevada NSF EPSCoR RII Track-1 Program Pre-Proposal on "Infrastructure Improvement for Research and Education in Self-Driving Automobiles" with faculty in Electrical and Computer Engineering.
- Mar. 2019 USDOT Automated Driving System Demonstration Grants" on "NAVIGaTE Program" with Regional Transportation Commission of Southern Nevada, Aptiv, Atkins, Pillar, Switch, and UNLV.
- Aug. 2019 NSF Research Experiences for Undergraduates on "REU SITE: Smart Cities – Intelligent, Safe, and Secure Mobility" with faculty in Electrical and Computer Engineering.
- March 2020 NSF REU Site: Smart Cities – Intelligent, Safe, and Secure Mobility award, 6/1/20 – 5/31/ 23, $405k
- Aug. 2020 City of Las Vegas "City Of Las Vegas Connected Intersections and Connected / Automated Vehicles", $47.7k
- Aug 2020 US DOT ATCMTD "Integrated Safety Technology Corridor" with RTC, NDOT, Nevada Highway Patrol, Waycare), $15M total
- Dec 2020 NSF AI Institute "Artificial Intelligence in Transportation-Autonomous Infrastructure Networks" with Missouri S&T, University of Nevada, Reno, Georgia Tech. $1M (UNLV share)
- Jan 2021 NSF Major Research Instrumentation "MRI: Acquisition of a GPU Cluster for Multi-Disciplinary Research and Education at UNLV", $432k
- Mar 2021 NSF REU Site Supplement, $118k
- Jan. 2022 NSF "MRI: Acquisition of Connected Autonomous Vehicles (CAV) Infrastructures to Support Cooperative Human-Robot Driving and Pedestrian Safety", $539k
- Feb. 2022 FACE Foundation Thomas Jefferson Fund "IoT and Edge Vision for Connected Autonomous Vehicle (CAV) Environment Perception", $10k, collaboration with EFREI Paris

The 2022 NSF MRI was specifically to augment the current CAV platform from this project – in looked to obtain more vehicle sensors including lidar and roadside equipment for more intersections around campus.

Commercialization/Partnering
Developed a collaboration proposal with university in France, EFREI Paris, regarding infrastructure sensing and CAVs. The proposal provides funds to have visits at the partner institutions to develop a project. EFREI will look to send a graduate student to UNLV as part of the MS International Internship requirement.

Intellectual Property

As of March 1, 2022, no considerable intellectual property was created.

Programmatic & Project Changes

The emphasis of the project is still on infrastructure support for CAV operation but we no longer are including a researcher exchange as part of the outcomes since Covid-19 made this international coordination too difficult. A demonstration for pedestrian safety – infrastructure notification of a crossing pedestrian even when occluded from vehicle view – is planned at UNLV in the final quarter of the project. The work will be performed with a postdoc and graduate students rather than an international researcher.

Timeline
Our demo is planned for the last quarter of 2022 to be consistent with the end date of December. With remaining funds due to the conversion from researcher to postdoc position, we plan to seek a no-cost extension into 2023. This extension will allow for the hire of a new postdoc to further progress the CAV work and generate more collaboration opportunities.

Research Exchange Program (REP)
The REP is no longer a goal of the project due to difficulties with collaboration/travel/relocation due to Covid. Dr. Arsal Syed has taken on the role of computer vision researcher as a postdoc to lead the project demonstration.

Autonomous Platform
A FLIR ADK sensor was purchased for pedestrian detection. We are awaiting delivery to integrate into the vehicle. Additional V2X equipment and sensors are under consideration and mounting solutions are being explored to finalize platform setup.

Prior Period Assessment
A summary of goals in the previous period and status are provided below:

- Hire for Dr. Arsal Syed as postdoc for late October start – completed with a December 2021 start due to administrative and human resources delays.
- Complete all additional sensor purchases (FLIR IR camera and CV2X communication) and integrate into MKZ – partially complete. The FLIR ADK was purchased but we are still awaiting delivery. We have been in contact with vendors for quotes for the V2X equipment while also seeking equipment donation from Commsignia (RSU were used in the City of Las Vegas for project Blackjack).
- Recruit new graduate students for Spring 2022 – completed, Zillur Rahman (MS) was hired for Spring. We plan to hire a Ph.D. student in the Fall.
- Have an emergency pedestrian breaking demo ready for February 2022 – delayed. The full demo is expected in Q4 of 2022 with controls ready in the summer.
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- Finalize and receive the MKZ platform - completed
- Finalize hire for Dr. Al Mansur for July 1, 2021 start – cancelled and changed to postdoc position
- Complete all additional sensor purchases (FLIR IR camera and V2X communication) and integrate into MKZ – delayed until next period to consult with postdoc hire
- Recruit a new PhD student for Fall 2021 – No student was identified due to challenges with Covid Visa processes. We are looking to recruit for Spring 2022.

- Run at least two summer undergraduate research internships with the MKZ (through NSF REU award) – completed. Dinh Hoang (University of Central Arkansas) worked on computer vision for on-road environmental perception and Erin Searcy (Fort Valley State University) worked on highway traffic prediction. We will recruit Mr. Hoang as a graduate student for the Fall 2022 term.
- Have an emergency pedestrian breaking demo ready for early September – delayed until early 2022.

Looking Forward

The six month (March 2022 – August 2022) goals are to:

- Complete all additional sensor purchases (V2X communication) and integrate into MKZ using fixed mounting solutions that are environmentally protected.
- Recruit Ph.D. student for Fall 2022
- Host one student as part of the NSF REU program to work on the MKZ control.
- Develop vehicle control through on-board computer.
- Use V2X equipment to transmit infrastructure messages to vehicle.
- Request a no-cost extension to the project and recruit another Postdoc position.

Section 2: Performance

GOED Metrics

GOED Metrics	8/19/2019 8/31/2019	9/1/2019 2/28/2019	3/1/2019 8/31/2019	9/1/2019 2/28/2020	3/1/2020 8/31/2020	9/1/2020 2/28/2021	3/1/2021 8/31/2021	9/1/2021 2/28/2022
number of **Companies Moved to NV** as a result of REP	0	0	0	0	0	0	0	0
number of **Start-Ups Created** as a result of REP	0	0	0	0	0	0	0	0
number of **Jobs Created** as a result of REP	0	0	0	0	0	0	0	0
intellectual property - **IP Licenses**	0	0	0	0	0	0	0	0
intellectual property - **IP Revenue**	0	0	0	0	0	0	0	0
number of **Research Grants Awarded** to REP team	0	0	0	0	1	2	2	3
amount of **Research Funding Received** by REP team	0	0	0	0	$405k	$1.36M	$1.79M	$1.79M
number of **Sponsored Research Contracts** executed	0	0	0	0	1	1	1	2
number of **Patent Applications** filed	0	0	0	0	0	0	0	0
number of **Issued Patents**	0	0	0	0	0	0	0	0
number of **Student Internships**	0	0	3	0	7	9	12	13
number of **Students Placed** with companies	0	0	0	0	0	0	0	0
number of **Faculty/Staffs Hired**	1	1	2	2	3	3	3	4
amount/value of **Gifts/Donations Received**	0	0	0	0	0	0	0	0

Detailed Performance Information

Number of Companies Moved to NV as a result of REP
As of February 28, 2022, none.

Number of Start-Ups Created as a result of REP
As of February 28, 2022, none.

Number of Jobs Created as a result of REP
As of February 28, 2022, none.

Intellectual property - IP Licenses
As of February 28, 2022, none.

Intellectual property - IP Revenue
As of February 28, 2022, none.

Number of Research Grants Awarded to REP team
As of February 28, 2022, two.

11 proposals submitted:

- Nov 2018 Nevada NSF EPSCoR RII Track-1 Program Pre-Proposal on "Infrastructure Improvement for Research and Education in Self-Driving Automobiles"
- Mar. 2019 Thomas Jefferson Fund on "IoT and Edge Vision for Connected Autonomous Vehicle (CAV) Environment Perception"
- Mar. 2019 USDOT Automated Driving System Demonstration Grants on "NAVIGaTE Program"
- Aug. 2019 NSF Research Experiences for Undergraduates on "REU SITE: Smart Cities – Intelligent, Safe, and Secure Mobility"
- Aug. 2020 City of Las Vegas "City Of Las Vegas Connected Intersections and Connected / Automated Vehicles"
- Aug. 2020 US DOT ATCMTD "Integrated Safety Technology Corridor"
- Dec. 2020 NSF AI Institute "Artificial Intelligence in Transportation-Autonomous Infrastructure Networks" with Missouri S&T, University of Nevada, Reno, Georgia Tech.
- Jan. 2021 NSF Major Research Instrumentation "MRI: Acquisition of a GPU Cluster for Multi-Disciplinary Research and Education at UNLV"
- Mar. 2021 NSF REU Site Supplement, $118k
- Jan. 2022 NSF "MRI: Acquisition of Connected Autonomous Vehicles (CAV) Infrastructures to Support Cooperative Human-Robot Driving and Pedestrian Safety", $539k
- Feb. 2022 FACE Foundation Thomas Jefferson Fund "IoT and Edge Vision for Connected Autonomous Vehicle (CAV) Environment Perception", $10k, collaboration with EFREI Paris

Amount of Research Funding Received by REP team
As of February 28, 2022, $1.79M.

- $405k; Mar. 5, 2020; NSF Research Experiences for Undergraduates on "REU SITE: Smart Cities – Intelligent, Safe, and Secure Mobility".
- $955k; Dec. 2020 US DOT ATCMTD "Integrated Safety Technology Corridor" (UNLV share of full $15M to RTC-SN), awaiting contracting
- $432k; Aug. 2021 NSF MRI: Acquisition of a GPU Cluster for Multi-Disciplinary Research and Education at University of Nevada, Las Vegas (high performance computing for deep learning)

Number of Sponsored Research Contracts executed by REP team
As of February 28, 2022, two.

- Mar 30, 2020; NSF Research Experiences for Undergraduates on "REU SITE: Smart Cities – Intelligent, Safe, and Secure Mobility".
- Feb 24, 2022; NSF MRI: Acquisition of a GPU Cluster for Multi-Disciplinary Research and Education at University of Nevada, Las Vegas (high performance computing for deep learning)

Number of Patent Applications filed
As of February 28, 2022, none.

Number of Issued Patents
As of February 28, 2022, none.

Number of Student Internships
13 total

- Mr. Arsal Syed, PhD candidate starting Spring 2021 semester for deep-learning based pedestrian trajectory prediction.
- Ms. Yuria Mann, January - May 2021 to develop deep-learning based environment perception.
- Mr. Zillur Rahman, MS student starting Spring 2022 semester for vehicle sensing and control.

10 summer interns

- Mr. Gauthier Contat, Mr. Pierre Gumila, and Mr. Sebastian Michel brought in Summer 2019 to support deep learning-based pedestrian detection, motion-based object detection, and ROS DriveKit control respectively.
- (Summer 2020) Mr. Navaneeth Suresh, Mr. Arindam Biswas, Mr. Taapas Argawal, and Mr. Biswajit Ghosh – joint BS-MS students from India that worked a remote summer internship to work on the trajectory prediction problem
- Mr. Colin Saumure and Jaden Hardy for Summer 2021 as part of Faith Lutheran High School STEM Internship to work on trajectory prediction and V2X communication. Dinh Hoang came to UNLV through the NSF Research Experience for Undergraduates (REU): Smart Cities program to work on computer vision for environmental perception.

Number of Students Placed with companies
As of February 28, 2022, none.

Number of Faculty/Staffs Hired
4 total

- Hiring of Mr. Christopher Kappes in June 2018 at Fraunhofer IVI and in August 2018 at UNLV.
- Hiring of Mr. Marc Dinh for lightweight deep learning in June 2019.
- Hiring of Dr. Paritosh Parmar for autonomous vehicle simulation and algorithm development in Autoware
- Hiring of Dr. Arsal Syed in Dec. 2021 as postdoc to act as technical lead for demonstration.

Amount/value of Gifts/Donations Received by REP team
As of February 28, 2022, none.

Section 3: Budget

Company: University of Nevada, Las Vegas
Period: FY 2022 - 08 February
Worktags: Grant: GR07095 UNLV-Fraunhofer IVI Collaboration

Ledger Account Summary	Original Budget	Budget Amendments	Current Budget	Current Period Actuals	LTD Actuals	Obligations	Commitments	Actuals + Obligations + Commitments	Remaining Budget	Percent Remaining
Direct Expenses										
Personnel Expenses	$24,938.00	$298,334.41	$323,272.41	$7,255.64	$132,015.24	$27,697.76	0.00	$159,713.00	$163,559.41	50.59%
Professional Salary	$18,750.00	$187,113.30	$205,863.30	$4,583.34	$92,262.10	$18,333.36	0.00	$110,595.46	$95,267.84	46.28%
Graduate Salary	0.00	$53,962.00	$53,962.00	$1,200.00	$16,358.34	$3,600.00	0.00	$19,958.34	$34,003.66	63.01%
Hourly Wage	0.00	$6,275.00	$6,275.00	0.00	$5,455.00	$0.00	0.00	$5,455.00	$820.00	13.07%
Fringe Benefit Expense	$6,188.00	$50,984.11	$57,172.11	$1,472.30	$17,939.80	$5,764.40	0.00	$23,704.20	$33,467.91	58.54%
Other Direct Expenses	0.00	$176,727.59	$176,727.59	0.00	$144,279.12	$0.00	$0.00	$144,279.12	$32,448.47	18.36%
Travel Expenses	0.00	$4,887.80	$4,887.80	0.00	$2,887.80	0.00	$0.00	$2,887.80	$2,000.00	40.92%
Materials and Supplies	0.00	$13,487.89	$13,487.89	0.00	$1,237.57	$0.00	$0.00	$1,237.57	$12,250.32	90.82%
Services	0.00	$7,007.00	$7,007.00	0.00	$2,964.00	$0.00	0.00	$2,964.00	$4,043.00	57.70%
Tuition and Fees Expense	0.00	$12,238.00	$12,238.00	0.00	$2,560.50	0.00	0.00	$2,560.50	$9,677.50	79.08%
Capital Equipment	0.00	$139,106.90	$139,106.90	0.00	$134,629.25	$0.00	$0.00	$134,629.25	$4,477.65	3.22%
Total Direct Expenses	$24,938.00	$475,062.00	$500,000.00	$7,255.64	$276,294.36	$27,697.76	$0.00	$303,992.12	$196,007.88	39.20%
Facilities and Administration Expense	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%
Total Direct & Indirect	**$24,938.00**	**$475,062.00**	**$500,000.00**	**$7,255.64**	**$276,294.36**	**$27,697.76**	**$0.00**	**$303,992.12**	**$196,007.88**	**39.20%**

Budget Expended to Date

$ 303,992, 61.8% for period ending February 28, 2022

Section 4: Monthly Logs

2022 – February

- Zillur completed YOLOv5 based 2D object detection.
- Installed front and rear dashcam in MKZ
- Started exploration into monocular 3D object detection.
- Purchased FLIR ADK
- FY contract extended until Dec 2022 for Arsal Syed.
- Explored Autoware.Auto stack for AV platform.
- Submit collaboration proposal with EFREI Paris to develop edge computing sensors for CAVs.

2022 – January

- Returned back to campus to restart in-person operations.
- Repaired vehicles (MKZ and Pacifica). The Pacifica was broken into and needed to have its window fixed and batter replaced. The MKZ had to be manually opened and batteries recharged.
- Zillur began YOLOv5 implementation for project onboarding
- Researched FLIR ADK thermal cameras – determined appropriate field of view and connection type (USB vs. GSML)
- Submit NSF MRI to augment the MKZ platform with more sensors and add more intersections to the connected infrastructure.

2021 – December

- Official start for Arsal Syed as Postdoc.
- Submission of trajectory prediction paper to Machine Vision and Applications Journal
- Opened application portal for Summer NSF REU program

2021 – November

- Finalized paper work for postdoc position and hire.
- Completed experiments for journal paper on trajectory prediction using semantic segmentation.
- Offer GA position to Zillur Rahman
- Began planning for summer NSF REU program

2021 – October

- Postdoc paperwork regarding budget, search waiver, position listing.
- Video conference with Zillur Rahman, Amir Sharifi potential graduate students
- Mentor three teams for Bosch Future Mobility Challenge 2022

2021 – September

- Began process to hire Dr. Arsal Syed as postdoc.
- Recruitment of students.
- Served as (remote) judge for Bosch Future Mobility Challenge – 1/10 scale AV competition hosted by Bosch Engineering Center Cluj, Romani

2021 – August

- Corrected title transfer papers with Hexagon/AutonomouStuff
- NSF REU Poster Session in collaboration with UNLV Office of Undergraduate Research. Dinh Hoang presented on real-time object detection for color and IR cameras and panoptic segmentation for MKZ.
- Award: MRI: Acquisition of a GPU Cluster for Multi-Disciplinary Research and Education at University of Nevada, Las Vegas
- Implemented Real-Time Panoptic Segmentation (Toyota) and YOLO detection on MKZ.
- YOLOR implementation for detection - 25 fps

2021 – July

- Al Mansur was not able to take the UNLV position due to immigration issues. Terminated within UNLV Workday system.
- Trained YOLOv5 for object detection with thermal IR roadway dataset – runs at 25-50 fps.
- Trained models for panoptic segmentation (Panoptic DeepLab – 1 fps, EfficientPS- 0.6 fps)

2021 – June

- MKZ licensed in Nevada, issue with title paperwork needed to be corrected
- Dinh Hoang brought to UNLV as part of the NSF REU: Smart Cities program to work on real-time environmental perception in the MKZ during Summer 2021.
- Trained YOLOv5 object detection for roadway objects on NuImages dataset – runs at 24-54 fps.
- Two high school student interns came to the lab for Summer 2021 as part of Faith Lutheran STEM Internship. They worked on augmenting scene information for trajectory prediction and V2X-MQTT communication for arterials.

2021 – May

- Arsal Syed hired as Ph.D. research assistant for Summer 2021 working on pedestrian trajectory prediction.
- Started long-term pedestrian prediction with inverse reinforcement learning

2021 – April

- AutonomouStuff MKZ Platform training completed remotely.
- Autoware: compiled ROS publisher node with OpenCV
- Completed contract update for Paritosh Parmar
- Finished IV2021
- Re-confirmed Al Mansur's interest in position and timeline for arrival

2021 – March

- Hexagon Purchase Order finalized with 20% prepayment and addition to UNLV vendor list
- Received MKZ autonomous vehicle platform
- Submit NSF REU supplement to add NSF S-STEM scholars to summer program
- Offer to Al Mansur re-initialized in WorkDay

2021 – February

- Web conference with Hexagon (AutonomouStuff) for legal discussion on platform agreement
- Hexagon MKZ Platform agreement signed
- Finalized documentation (platform agreement, insurance, approvals) for MKZ
- Restarted hire and offer letter for Al Mansur

2021 – January

- Submit proposal with AV as project within NSF MRI (PI Mingon Kim, CS)
- Application period and recruitment for NSF REU: Smart Cities project
- Begin work with undergraduate researcher Yuria Mann – training on deep learning for environment perception through semantic segmentation

2020 – December

- AutoWare: Implementation of lane detection pipeline in ROS publisher-subscriber nodes
- Contract of Paritosh Parmar expired – updated time-in/time-out record keeping
- Submit proposal for NSF AI Institutes as a subawardee to Missouri S&T

2020 – November

- Autoware: compiled ROS publisher node with OpenCV
- Completed contract update for Paritosh Parmar
- Finished IV2021
- Re-confirmed Al Mansur's interest in position and timeline for arrival

2020 – October

- Dr. Morris served as General Chair for the IEEE Intelligent Vehicles Symposium (IV2021) (scheduled for Las Vegas but moved to virtual).
- Initiated AutonomouStuff Lincoln MKZ purchase – competitive exception review
- Updated temporary employee contract to meet mandatory minimum rate (Paritosh Parmar)
- Morris and Parmar attended the AutoWare Tutorial at IV2021

2020 – September

- Received quote for DSRC and C-V2X OBU from Codha

- Errors in Autoware installation resolved with assistance from developer
- Real-time scene was successfully simulated in Autoware Auto
- Perception module in the processing pipeline was able to receive raw data for further processing
- Scene object detection successful

2020 – August

- Contributed to US DOT ATCMTD grant (Integrated Safety Technology Corridor) led by RTC with collaborators (Nevada DOT, Nevada Highway Patrol, Waycare) $15M total
- Submit project proposal (City of Las Vegas Connected Intersections and Connected / Automated Vehicles) to City of Las Vegas
- Final quote for MKZ platform + sensor
- Filed UNLV Competitive Exception for MKZ Purchase
- Worked on Budget Adjustment with GOED – adjustments for limited time for Research Engineer and switch to PhD student
- Basic Autoware project for loading and displaying recorded Lidar data was started
- A number of errors were corrected – remote display and Autoware Conda environment variables

2020 – July

- Paritosh Parmar onboarded to project
- Received quote for dual-mode DSRC/C-V2X onboard unit
- Exploration of Autoware platform for automated vehicle platform (real and simulation)
- Autoware Auto platform was selected over Autoware AI
- Autoware computer with Ubuntu 18.04 was setup for remote access
- Autoware Auto and dependencies installed, though they contained errors

2020 – June

- Received quotes for full Lincoln MKZ platform from Hexagon/AutonomouSuff
- Received quote for MKZ sensor package (IMU, Radar, Lidar)
- Identified Paritosh Parmar for contingency support for AV platform development

2020 – May

- Hiring freeze lifted – offer letter to Al Mansur
- Personnel planning – replacement for Marc Dinh and inability to hire Al Mansur due to Covid-19
- Develop plan for restarting research on campus

2020 – April

- UNLV hiring freeze – submitted exception for Al Mansur
- Received hardware quotes from Hexagon/AutonomouStuff for Pacifica drive-by-wire solution and FLIR thermal camera

2020 – March

- Research Engineer position created in UNLV Workday
- Notification of NSF REU Sites award
- On-campus research stopped due to Covid-19
- Exploration of Kia models for completion of Polysync contract – none available

2020 – February

- Al Mansur not eligible for Postdoc, position changed to Research Engineer and process restarted
- Search NV State contracted auto dealers for sourcing of DriveKit compatible vehicle
- Interview summer internship candidates

2020 – January

- Vision-based lane keeping control algorithm development based on LaneNet
- Postdoc salary exemption and approval
- Meeting with New Eagle and AutonomousStuff at CES to discuss options for Pacifica Platform

2019 – December

- Contract extension for Marc Dinh.

- Begin contracting for Postdoctoral Scholar position for Al Mansur, prepare documentation and Search Waiver
- Contact New Eagle for Pacifica Drive by Wire (DBW) Kit

2019 – November

- TensorFlow Lite algorithm development for AV environmental perception (lane segmentation and object recognition)
- Work with Hertz to locate Kia Soul (could not guarantee correct model)

2019 – October

- UNLV Risk Management recommends purchase of Kia vehicle or rental
- Search for Kia Niro and Soul EV rental availability in Las Vegas.
- Complete NV State fuel program

2019 – September

- Identify alternate Kia Soul sourcing since PolySync no longer had access to Niro due to delay with UNLV legal.
- Follow-up with postdoc candidates as replacement for Mr. Kappes at UNLV.
- Lidar sensor quotes from Ouster

2019 – August

- Setup UNLV fuel account for Pacifica.
- Purchase Nvidia Jetson devices for low-cost low-power sensor processing.
- Brendan Morris visit to Fraunhofer IVI for collaboration meeting – identify final candidate for postdoc position.

2019 – July

- Develop highway lane detection/segmentation neural network.
- Present UNLV Legal and Risk Management PolySync DriveKit sourcing issue.
- Update IP address and IT troubleshooting for FLIR systems to improve network performance.
- Skype interviews with four computer vision Postdoc candidates – Fraunhofer to UNLV.

2019 – June

- Complete Pacifica documentation for title and registration.
- Develop motion-based object (pedestrian/vehicle) detection algorithm.
- Develop deep learning-based object detection algorithm.
- Evaluate and comparison of detection algorithms.
- Begin DriveKit ROS simulation.

2019 – May

- Develop remote video data collection application for FLIR TrafiSense and TrafiRadar systems.
- Purchase Chrysler Pacifica.
- Purchase PolySync DriveKit drive-by-wire platform.

2019 – April

- Campus site and demonstration planning.
- Completion of AV sensor evaluation.

2019 – March

- TrafiRadar height adjusted for improved vehicle tracking and speed logging.
- Completed Arduino event wireless communication enclosures and mounting. TODO: finalize testing of TI-xStream communication via Arduino devices.
- Rumble Strip operational testing
- Develop first draft of Rumble Strip paper for Advances in Mechanical Engineering: Special Collection: Vulnerable Road User Safety and Intelligent Transportation Systems (Deadline May 31, 2019).
- Begin quote process for autonomous test platform including vehicle control and sensing capabilities.
- US DOT Automated Driving System Demonstration Grants proposal titled "NAVIGaTE Program" in collaboration with RTC, Aptiv, and others.

2019 – February

- Switch from REP Engineer position to Postdoctoral Scholar
- Initial debugging of TrafiRadar system in collaboration with David Cole from Sierra Transportation Technology and FLIR. Recommendation made to lower TrafiRadar height for better calibration.
- Thomas Jefferson Fund proposal titled "IoT and Edge Vision for Connected Autonomous Vehicle (CAV) Environment Perception" in collaboration with EFREI Paris.

2019 – January

- Autonomous Vehicle Project Space and testing discussions with UNLV facilities
- Offer letters for Dr. Nathanael Lemessa Baisa from Fraunhofer IVI and UNLV
- Installation of FLIR TrafiSense and TrafiRadar camera hardware into Harmon St. site as part of the Rumble Strip project.

2019 – December

- Finalize preliminary testing of TrafiSense and TrafiRadar systems at temporary location to have full familiarity with system capabilities and calibration and settings for pedestrian detection in thermal IR camera.

2019 – November

- Initial interview with REP candidate Dr. Nathanael Lemessa Baisa
- Discussions with Tesla to take part in project and request for test vehicle.

2018 – October

- Christopher Kappes gives AutoTruck overview presentation in RTIS Lab meeting (10/5/2018).
- Mr. Kappes begins testing and familiarization with FLIR TrafiSense for pedestrian detection.
- Identified FLIR TrafiRadar as a combo camera/radar sensor for vehicle detection and speed measurement.