Implementation of an Ideal Automotive Engineer Workstation

Introduction:

Automotive engineers have strived over the years to enable autonomous vehicles (AVs) to perform in any given environment. AV engineers develop simulations for these vehicles and test them within walking distance thanks to the strides taken to bring convenience to automotive engineering. They can do this because major car companies have made investments in motion platforms to physically test their simulations. The access to such a device allows the person designing the code to physically test the software that could potentially oversee numerous lives. The ability to physically test a model before true implementation allows for vital insight to be gained about the driving experience of an AV. This technology could have prevented numerous injuries to consumers if it were utilized in the early development of AVs. Several consumers have experienced whiplash due to emergency braking functions deaccelerating too quicky. (NIH.gov) Using the programming and computing program named MATLAB, AV engineers can develop code that can run on an AV, test that code using simulations, change weather aspects of the simulations, and plot data from the results from a simulation. By implementing the tools provided in MATLAB, AV engineers can transfer the data used in the driving simulations to a motion platform to experience driving functions they develop. Along with connecting a motion platform via MATLAB, electronic steering wheels and pedals can be connected and used as inputs. The implementation of motion simulators with MATLAB driving simulations enables a variety of automotive engineering research topics to be conducted. This can not only improve the necessary elements in the AV systems but can also enable easier, safer testing. This research will be used to provide resources to both Jonathan Duke's and Oluwatimilehin Ojo's current research under Dr. Vargas at MTSU.

Objective:

The objective of this research is to provide insight into the creation and application of a 3 or 6 axis driving/flight simulator and the ergonomics of an automotive engineer's work environment. An economic analysis will also provide insight and guidance to the implementation of this workstation. An OSHA ergonomic assessment report will be done to truly investigate the positive and negative design flaws of the proposed workstation. This research will hopefully be implemented alongside current and future automotive engineering research at MTSU.

Methodology:

The economic analysis of the motion platform will consist of 3 different components. 3 different purchasing options will be analyzed to estimate the cost of manufacturing. Each design will be physically analyzed, and a list of hardware provided with pricing per part. Software is only available for purchase through one selected company currently, so in terms of economic analysis, software is quite tedious to price. Since this is a key pricing feature, I will be looking into implementing MATLAB DOF functions to interface electric motors controls to the Unreal game engine used for simulations. Motion platforms for AVs tend to have 3 to 6 Degrees of Freedom. DOF is a robotics term used to describe how an object can move. With 3 DOF an object has the rotational movements pitch, yaw, and roll. However, having 6 DOF allows the object to have rotational movements pitch, yaw, and roll but also have translational movements known as surge, heave, and sway. Other topics such as Forward, Reverse, and Jacobian kinematics will be researched to implement both rotational and translational movements related to motion platforms of both 3 and 6 DOF. In terms of ergonomics, an OSHA ergonomic assessment checklist will be provided in relation to the workstation. This report will provide key insight into the ergonomics of the workstation to help better the work environment for automotive engineers. Another report will be composed to show the viability of creating software via MATLAB from scratch in comparison to the software package currently marketed by *Motion Systems*.

Description of Duties:

I will provide economic and ergonomic insight into the implementation of an automotive workstation. I will also provide an OSHA ergonomic assessment pertaining to the workstation as well as individual and a combined economic report with hardware prices. A comparison between software will be mentioned, but it should not bear a significant role in the economic report. A written report will be developed as well to compare the kinematics of each researched motion simulator. This is my first URECA submission.

Role of Mentor:

Dr. Jorge Vargas will supervise, analyze funding methods, and provide insight for implementing future research opportunities. Dr. Vargas will also help enhance my understanding of rotational and translational movements.

Significance of Project:

This research will allow me to advance my knowledge on the topics of AV systems. The research will also heighten my sense of understanding about my career and enable the implementation of a safer AV work environment. Standardization has yet to come for many of the items being researched in this field. By conducting this research, I hope to provide a foundation for future standardization of an automotive workstation.

Timeline

Febuary:

- Develop economic report containing 3 and 6 DOF motion simulators for the company *Motion Systems*
- Research into this companies' software to see the capabilities it provides to its consumers
- Develop estimated hardware list with pricing per part
- Work with Dr. Vargas to gain insight into forward kinematics

March:

- Develop economic report containing 3 and 6 DOF motion simulators for the company *UpShift*
- Develop estimated hardware list with pricing per part
- Work with Dr. Vargas to gain insight into inverse kinematics

April:

- Develop economic report containing 3 and 6 DOF motion simulators for the company *DOFReality*
- Develop estimated hardware list with pricing per part
- Develop theoretical OHSA ergonomic assessment report for an automotive engineering workstation
- Work with Dr. Vargas to gain insight into jacobian kinematics

May:

- Combine and finalize economic reports
- Develop theoretical OHSA ergonomic assessment report for an automotive engineering workstation
- Develop a written report containing an analysis of both a 3 and a 6 DOF motion simulators
- Develop a written report containing software comparison options for MATLAB

References:

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