

Robotic Fueling System

Michael Andrews, Craig Thompson, Eric Warner, Matt Hebert, William Crowley - Students, and
Musa Jouaneh- Professor

Department of Mechanical Engineering
University of Rhode Island
Kingston RI 02881
Tel: 401:874-2349, Fax: 401-874-2355, jouaneh@egr.uri.edu

Abstract

This paper addresses the design of two subsystems of a concept robotic fueling system that performs automatic refueling of passenger and light truck vehicles for commercial use. A robotic fueling system has the advantage of preventing human contact with potentially dangerous fumes, avoiding driver's exposure to extreme hot or cold temperatures during fueling, and reducing the labor costs associated with full service fueling stations. The robotic fueling system consists of five main subsystems. These consist of the control system; the user interface and the various sensors used for vehicle positioning and identification; the robotic arm; the fuel dispensing nozzle; and the fuel port interface. This paper focuses on the user interface and sensor system, and the fuel dispensing nozzle. A recently developed and market tested robotic fueling system – the Shell's SmartPump[®] - was removed from market testing due to reliability and cost issues. The main focus in this project is an improvement over existing systems mainly by cost reduction through design simplification. Design simplification will be achieved by mainly reducing the number of autonomous tasks that must be performed by the robotic arm. These simplifications can be achieved by an intelligent vehicle positioning and identification system, and through less complicated mating process of the fuel nozzle and the fuel port.

The vehicle positioning and identification system is based on the use of several types of sensors that detect vehicle presence, position and orientation and the type of vehicle. Vehicle presence is determined by an optical sensor array, which upon detection sends a signal to activate a passive radio frequency tag in the area. If information exchange is successful, a magnetometer sensor ensures vehicle proximity in the particular fueling lane. The optical sensors also act to guide the driver for optimal positioning of the vehicle by measuring multiple distance points and vehicle skew from the fueling base. The information is relayed graphically through the user interface to assist the driver. Once the vehicle is positioned and ready for fueling, the fuel port is located by information on the vehicle's dimensions obtained from the vehicle database for the specific vehicle that was identified from the data sent by the transmitter. A simulation of the operation of this sensor arrangement with typical vehicles is currently under development. In addition, various fuel nozzle and fuel port designs are being considered and analyzed as well as possible points of fuel access for both vehicles of use today and future ones. A prototype for an improved fuel nozzle is currently under development. The experimental prototype utilizes an existing fuel nozzle handle with a retro-fitted actuator which allows the fueling process to be automatically controlled. The angled portion of the fuel nozzle is removed and replaced with a nozzle that interfaces with a new fuel port design. Simulation of the operation of the sensor system and results from fuel nozzle prototype testing will be presented.

Presenter Biography:

Michael Andrews is a senior student in the department of mechanical engineering at the University of Rhode Island. His interests include robotics, automation, and control systems. He has worked as an intern for Amgen, one of the world's largest biotech companies, developing utility analysis software for their West Greenwich, RI facility. Michael has also consulted on automation projects to various companies like C&M Wire and Cable, Sanitary Materials Testing Institute (SMTI) and Graham Packaging. His future plans are to pursue an advanced mechanical engineering degree and to work towards a P.E. license.