**Objective:**
Our objective is to provide a useful working real world application model of a Garage Parking Assistant that would be useful for a typical one car residential garage. Moreover, to reduce potential accident and injury’s that may result from poor driver judgment or error.

**Theory of Operations:**
Main components: LCD, Keypad, Servo Motor, Proximity Sensor, IR Switch Sensor, User prompted for password via LCD, user enters password in keypad. The servo motor uses three pins to function: VCC, GND and CONTROL LINE. We have modified our Servo Motor for continuous operation. Servos position is controlled by PWM (Pulse Width Modulation). Pulses must repeat every so many msec. The IR Distance Sensor takes a continuous distance reading and returns a corresponding analog voltage with a range of 10cm (4”) to 80cm (30”). Use of IC to read results from IR sensor switch, indicating either 2.4V or 0V.

**Design Alternatives:**
Prior to designing our Garage parking assistant, there were several considerations we determined such as board functionality, cost of parts, time, and construction and so on. Our original plans called for a two car garage parking assistant that consisted of several sensors to assist with parking. For example, we considered two proximity sensors (Sharp GP2D15) to interact simultaneously by displaying the output of two sets of LED indicators. One sensor would be placed along the back wall and another along the right side wall. As the driver pulled into the garage, these two sensors would allow the driver to park in the correct parking spot even if he/she had entered in the wrong lane, thus not to intrude on other objects that may be placed in the garage such as tools, mower, bikes, outdoor equipment, etc. Although this seemed feasible, this design presented challenges in simultaneously running two subroutines at the same time. Also, other alternatives included the use of a voice box placed within the garage to audibly warn the driver his distance to final parking position.

**Key Points for Selecting Your Design:**
The main reason we had selected this product as opposed to other design alternatives was mainly due to time constraint, money, and operability. Our design feature needed to meet class requirements, fulfill all objectives, provide a real life application prototype, and draw interest from observer.

**Constraints from Regulating Bodies on the Project:**
Some constraints we encountered relating to our project were the sensors that we had on hand. Basically, the GP2D15 sensor calculates the distance of an object and relays it using a A/D conversion. Since our prototype garage was relatively small, we needed to strategically place our sensor in position where it could output the values needed to trigger the correct LED. This was challenging since the range started at just over 11mm. In addition, a normal garage door, tracks and wheels are needed to elevate and lower the garage as with motor. In our prototype we were limited to using a simple vertical motion garage.

**Discussions of the Experimental Results:**
Discussion: Our prototype of the Garage Parking Assistant met all of the expectations we had originally designed it for. For example, we discovered that PA3 pin is set to output only and was always getting 5V. Software could not resolved this situation, so we needed to work around it. Also, many of the ports were unavailable like Port C or Port B, therefore we had to resort to use only Port A, D, and E, which in our case was just enough. Although, we would have liked to include more functionality such as voice box and additional sensors, time constraints and budget.

**Conclusions:**
Overall, we are satisfied with the outcome of our Garage Parking Assistant based on time allotted and budget at hand. Design, construction, coding, and implementation using the HC11 microcontroller was a great experience from which we all learned. In addition, acquiring these skills, we believe is essential for future use in industry.

**Related Patents:**
1. Patent# US5127357
2. Patent# US5177479