ELECTRIC VEHICLE CHARGER CONTROL SYSTEM

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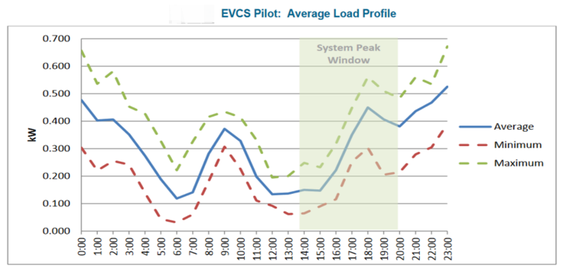
I. Motivation

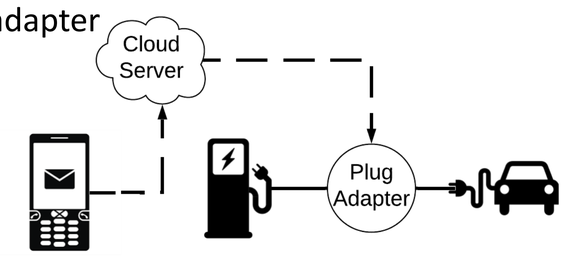
- The electric grid is unable to handle a significant increase in electric vehicle usage.
- Research was conducted on the potential strain placed on our control servers by projected electric vehicle usage and developed a scalability plan (Section VIII) to deal with the load.
- Because electric vehicles are becoming more common, a solution is imperative.



[2] Electric Vehicle Charging Station: Pilot Evaluation Report. May 2015. Xcel Energy. https://www.xcelenergy.com/staticfiles/xe-responsive/Admin/Managed%20Documents%20&%20PDFs/CO-DSM-2014-EV-Pilot-Evaluation.pdf

II. Methods

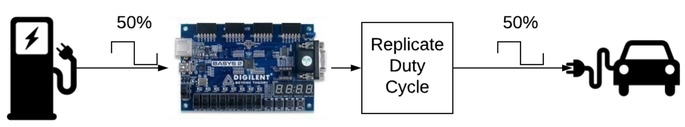
- A plug adapter was created to control the charge rate of an electric vehicle.
- The adapter is controlled by a cellular application.
- A server-client system incorporates a scheduling algorithm to control the smart plug adapter



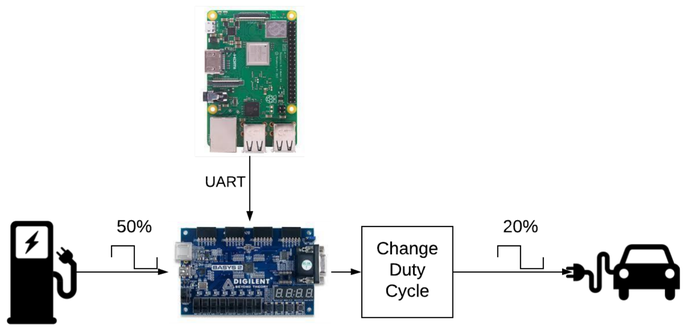
III. Altering Charge Rate

- The FPGA changes the charge rate via the duty cycle.

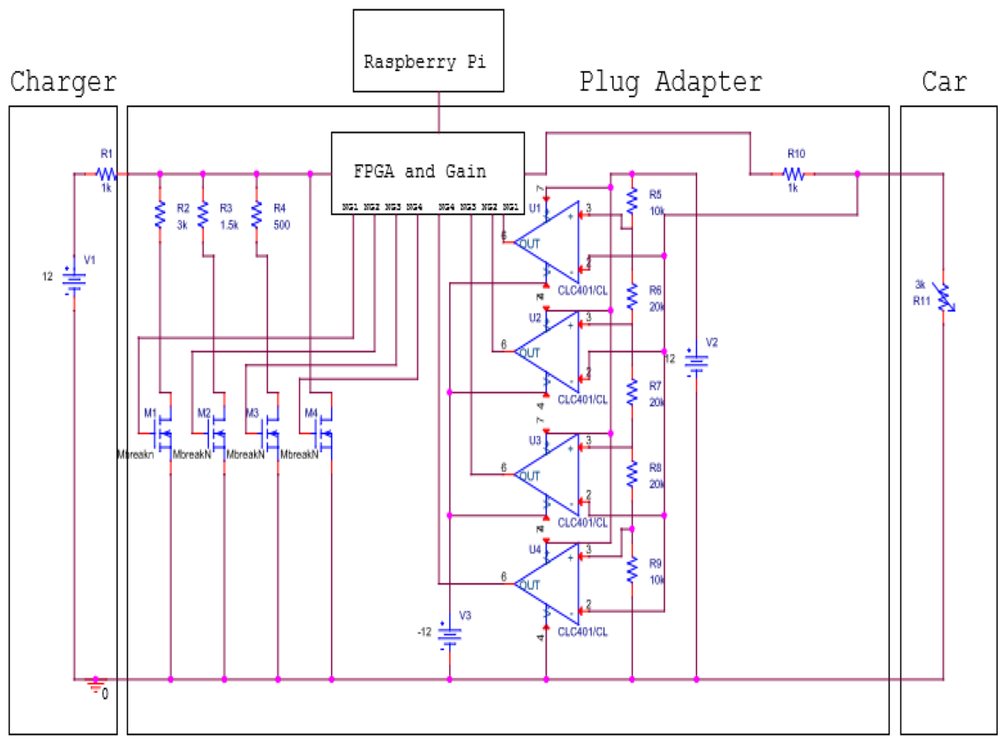
Normal Operation



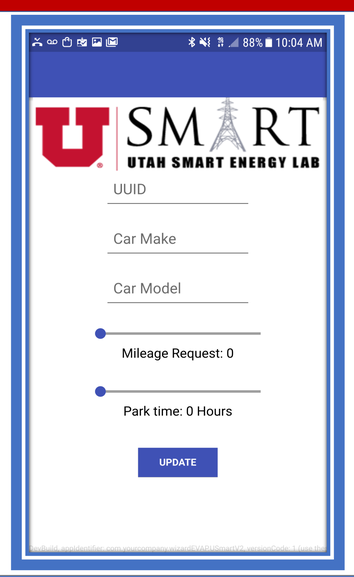
Modified Charge Rate

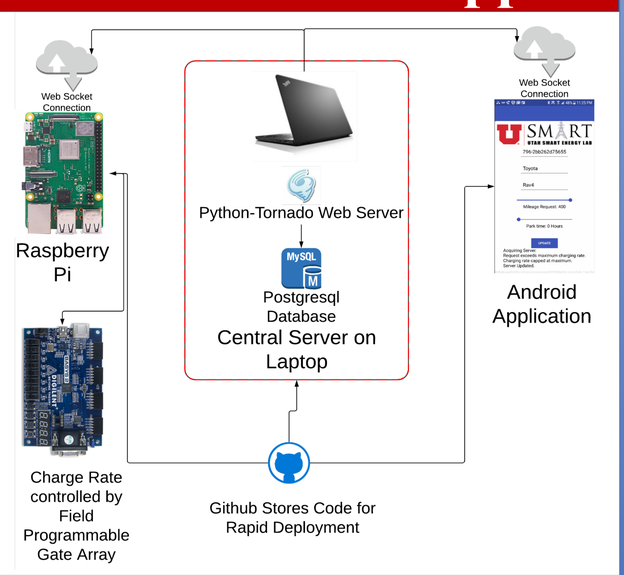


IV. Car State Switching Circuit



V. Software Architecture and App





VI. JSON and Database

```
{"charger_id": "2883551e-587f-4e86-b6c9-8a168fa7e3b7",
"park_time": 85, "car_model": "Rav4", "cost_preference": -42,
"request_type": "update_status", "car_make": "Toyota", "kwh": 4}
```

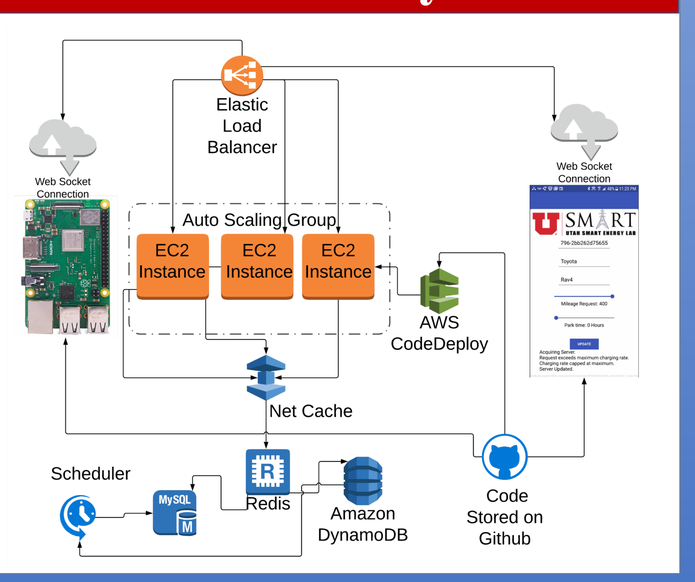
Car_make (Primary Key)	Car_model (Primary Key)	Kwh_per_mile
VARCHAR	VARCHAR	INT
Tesla	Model3	.00000000001

Charger_id (Primary Key)	kwh	Car_make (Foreign Key)	Car_model (Foreign Key)	Park_time	Cost_preference
UUUID	INT	VARCHAR	VARCHAR	INT(Minutes)	INT
D9844901-51da-45b6-8004-471ddbaf8800	4	Tesla	Model3	154	-42

VII. Results

- The duty-cycle of the control pilot can successfully be altered, thus changing the charge-rate.
- The server-client system allows a scheduling algorithm to control a smart plug-adapter.
- The Raspberry Pi and the FPGA can successfully communicate.
- The plug adapter can facilitate communication between the charger and car via voltage states.
- Mobile application developed to communicate user preferences to an EV Charge Preference database.

VIII. Scalability Plan



IX. Conclusion

- The Android Application is able to alter the charge-rate of the electric vehicle.
- A plug-adapter was created that can replicate and match charging states.
- The plug-adapter can change the duty-cycle.
- The server-client system is able to be utilized by a scheduling algorithm.

X. Future Work

- Create a scheduling algorithm to control which vehicles charge and when.
- Package the plug-adapter into a smaller, more reliable package.
- Alter the communication protocol to include more information.