

*EVS30 Symposium
Stuttgart, Germany, October 9 - 11, 2017*

Automatic Energy Supply Docking System for Electric Scooter

Yu-hung Lin(林昱宏)¹, Shioh-Huey Suen(孫秀慧)², Chein-Chung Sun(孫建中)³, Chun-Hung Chou(周俊宏)⁴, Bing-Ming Lin(林炳明)⁵

¹ *Material and Chemical Research Laboratories, Industrial Technology Research Institute
Hsinchu, Taiwan, ROC. E-mail: poundlin@itri.org.tw*

Summary

We would like to delivery an innovation energy supply solution for e-scooter beyond charging and swapping (battery exchange) concept. That is automatic energy supply docking system (AESDS). Riders just need to push e-scooter into the docking station naturally and easily, the e-scooter will be locked and charged automatically. Let electric scooter be charged without rider's consciousness, get rid of IC engine vehicle fueling thinking, and let battery operator take over this job. The only thing riders have to do is just to ride and enjoy this clean and quiet e-scooter.

Keywords: Unattended, auto-charging, automatic energy supply docking system, AESDS, e-scooter, scooter sharing

1 Introduction

At present the e-scooter energy supply mode inherited the IC engine scooter gasoline station concept, mainly has the charging station and swapping system two forms, all needs to execute through the human to have the consciousness. Resulting in the use of e-scooter is inconvenient impression.

E-scooter can develop its unique charging mode with widespread power grid infrastructure in the city, and more and more technology will be applied. [1]

This automatic energy supply docking system (AESDS) is designed for electric scooter. Riders just push e-scooter into the docking station naturally and easily, the e-scooter is locked and charged automatically. It prevents from riders forgetting charging battery cause "range anxiety", increases the reliability of charging, and reduces the probability of lithium battery over-discharge.



Figure1: Automatic Energy Supply Docking System for E-Scooter

2 Structure

2.1 Wheel axis kit

AESDS has to bear the impact of e-scooter forward inertial force, and needs to have a very good weather proof , anti-fouling, charging reliability, as well. The designed wheel axis kits provide multi-function, they can be clamped and fixed well by AESDS, and can play a connector role being charged and communicated .

Cylindrical wheel axis kits which installed on both side of e-scooter front wheel are made of copper alloy to meet high conductivity, impact resistance, wear resistance, stain resistance characteristics requirement, manufacturing processing benefits, and low maintenance cost requirement.

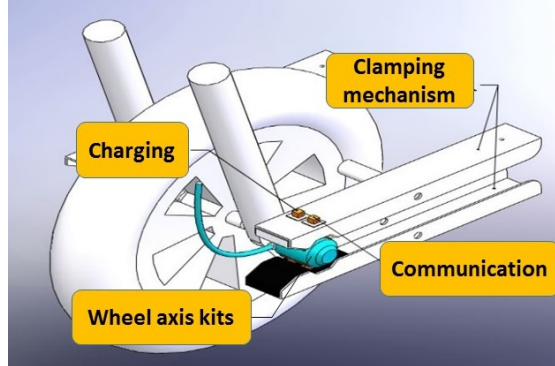


Figure2: Wheel Axis Kits

2.2 Clamp and lock mechanism

Automatically clamping and locking mechanism in AESDS consists of upper and lower arm with the dc motor driving cam rotation to achieve rapid response.

When docking, the public as long as naturally pushes e-scooter into the docking station, so that the wheel axis kits of e-scooter smoothly slide into the recess of upper and lower arm. When the sensor detects the wheel front end arrives, the dc motor drives cam and starts to clamp wheel axis kits immediately.

When getting riding, the AESDS receives the release command form e-scooter , the dc motor reverse the cam and quickly unlock, but still maintain a certain grip strength by spring, so that people have enough

time to open the trunk to wear helmet and prepare for riding. Then the public gently pull back electric scooter and ride.

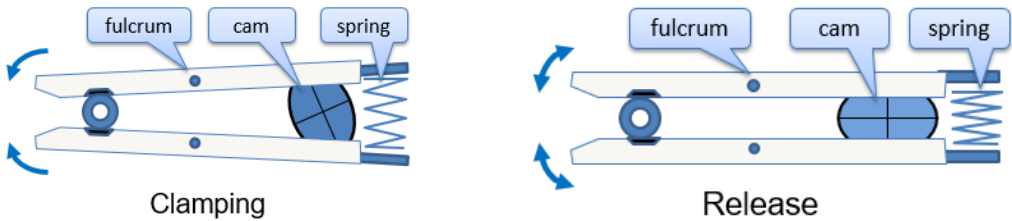


Figure3: Clamp and lock mechanism

2.3 Charging System

In order to ensure that the conductive between docking station and electric scooter, the power line carrier communication method (CAN over power line) is applied to confirm the charging power circuit be connected well. The advantage is that the communication and power circuit in the same physical line, carrier communication conduction on behalf of the charging loop conduction, this approach is also superior to wired or wireless communications.

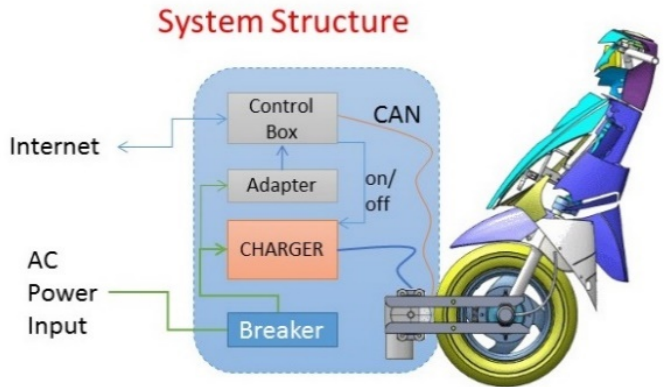


Figure4: Charging System Structure

3 Application scenarios

3.1 Public scooter

In Taiwan there are 13.68 million registered motorcycles, and cause several issue. E-scooter sharing system can reduce the amount of private scooters, improve the urban appearance, reduce traffic congestion, carbon emissions, PM 2.5 and other air pollution. [2]

This AESDS is very suitable for unattended e-scooter sharing system. Consumers do not need to pay attention to charge e-scooter.



Figure4: E-Scooter Sharing System (simulation)

3.2 Commercial use of electric scooters

E-scooter in Taiwan due to the cost of charging fee only 10 to 15% of IC engine scooter fuel cost, the enterprise willing to adopt. However, the use of electric scooters increases staff additional workload to charge or exchange the battery, resulting in the exclusion of employees. The use of this docking station can solve this problem.



Figure5: Docking Application in House

4 Conclusions

Automatic energy supply docking system (AESDS) has two major benefits. One is to charge the scooter without customer's consciousness into an innovation way, and secondly is to do a better battery inspection and management.

AESDS is currently used to drive clamping motion by dc motor, cost is still high. The future and then should simplify the mechanism to reduce cost.

If AESDS can further develop discharge function to supply load, then it could co-work with smart grid in the future.

Acknowledgments

The authors acknowledge the support funded by Industrial Technology Research Institute, Kwang Yang Motor Co., LTD., and Rotasun Mechanism Co..

References

- [1] Tesla, Mental Snake Charger, <https://twitter.com/TeslaMotors/status/629305813912326146>, accessed on 2015-8-6
- [2] MOTC ROC, <http://stat.motc.gov.tw>, accessed on 2016-12.

Authors



Yu-hung Lin is the leader of automatic energy supply docking system project in MCL, ITRI, Taiwan. His current research interests include auto-charger, battery cloud, risk based assessment in battery.



Shiow-Huey Suen:

Administrator, Material and Chemical Research laboratories, Industrial Technology Research Institute, Chutung, Hsinchu, Taiwan, ROC.

Major work: Power lithium-ion battery and light electric vehicle promotion



Chein-Chung Sun obtained the degree of Ph.D. in EE from National Central University in 2006. He is the leader of BMS team at MCL, ITRI, Taiwan. His current research focuses on battery information estimation algorithm, control strategy, battery testing, data mining, energy service for battery management system.



Chun Hung Chou received the degree of Ph.D. from National Taiwan University in 2008. With the strong ability of fuel cell dual power module, remote failure diagnoses in BMS team of MCL, ITRI, Taiwan. His current research interests in distributed computation, multi-measurements signal, advanced protection for battery management system



Bing-Ming Lin:

Deputy Director, Material and Chemical Research laboratories, Industrial Technology Research Institute, Chutung, Hsinchu, Taiwan, ROC.

Major work: Power lithium-ion battery development and application.

