DEFENDING UNETHICAL-UNPLUGGING OF EV-CHARGING CABLE (DUEC)

DR. RAZIQ YAQUB AND MPHANDE PHIRI
### DEPARTMENT OF ELECTRICAL ENGINEERING, ALABAMA A&M UNIVERSITY
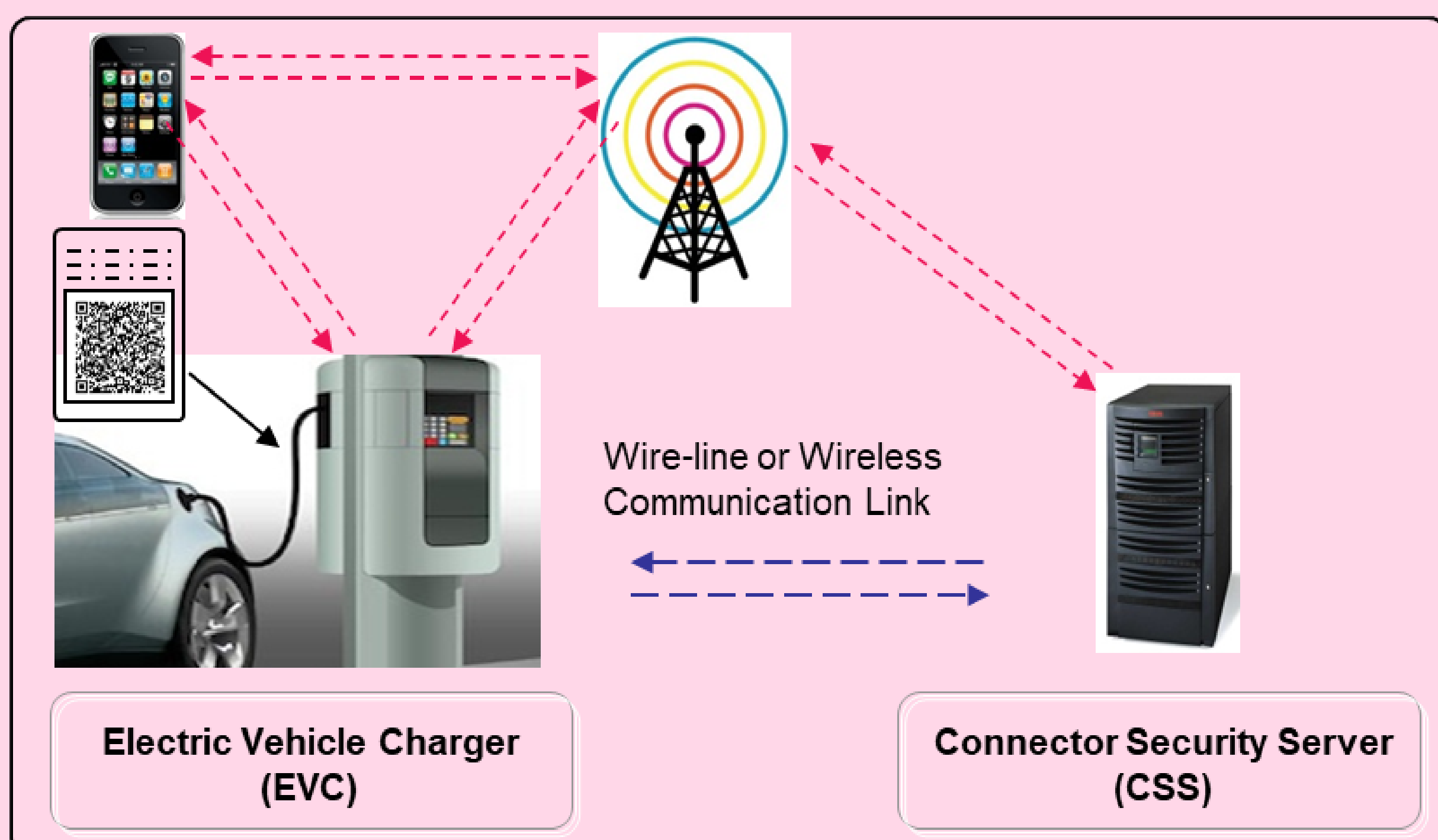
INTRODUCTION

- This research project addresses the problem of unethical unplugging of the EV-charging cables.
- It gives a possible solution to defend EV users by introducing simple electronic-based charger locks.
- The user-friendly lock/unlock mechanism will be derived using a machine like the "Automated Parking Pay Stations."
- The EV-charging cable should include an in-built lock/unlock mechanism that, through QR code, will enable a specific user to lock/unlock the charging cable from the car.
- The machine will be programmed with all the features to prevent unethical unplugging of the cables.

DISCUSSION AND DESCRIPTION OF PROPOSED SOLUTION

- Statistics show just how the number of EV's in circulation has evolved over the past years

GLOBAL
MONTHLY PLUG-IN VEHICLE SALES & Y-O-Y GROWTH
Light Vehicles
EV VOLUMES
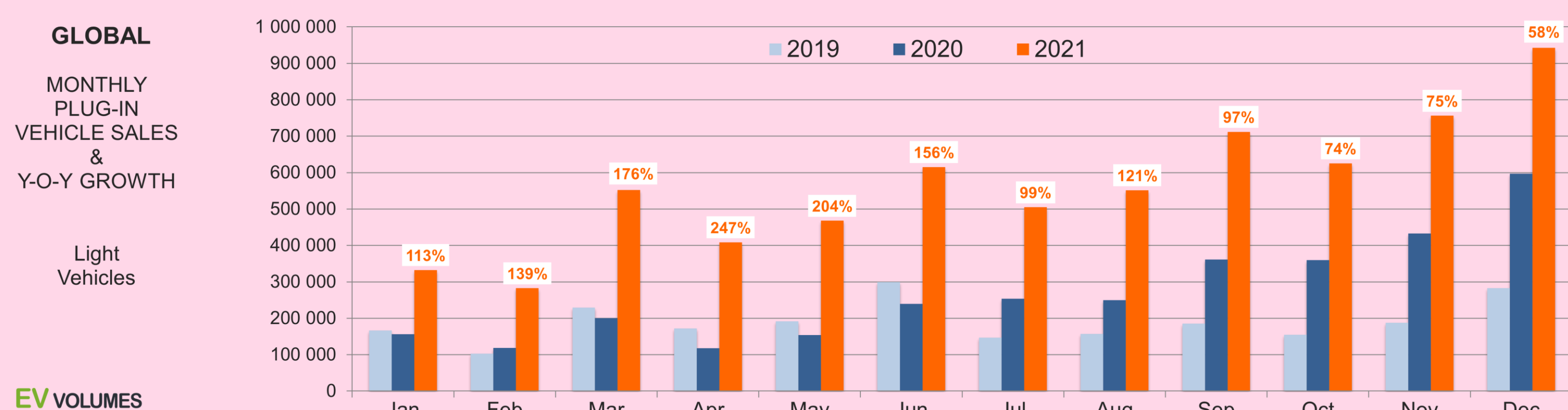
- We are going to use a concept like the "Automated Parking Pay Stations." The EV-charging cable should include an in-built electronic lock and unlock mechanism.
- The connector is unlocked only by the person who holds the secure electronic key called the DUEC-KEY which is generated by the proposed DUEC mechanism in the form of encrypted QR Code.

Electric Vehicle Charger (EVC)

Wire-line or Wireless Communication Link

Connector Security Server (CSS)

CSS is located in the service provider's network and provides several attractive features like:
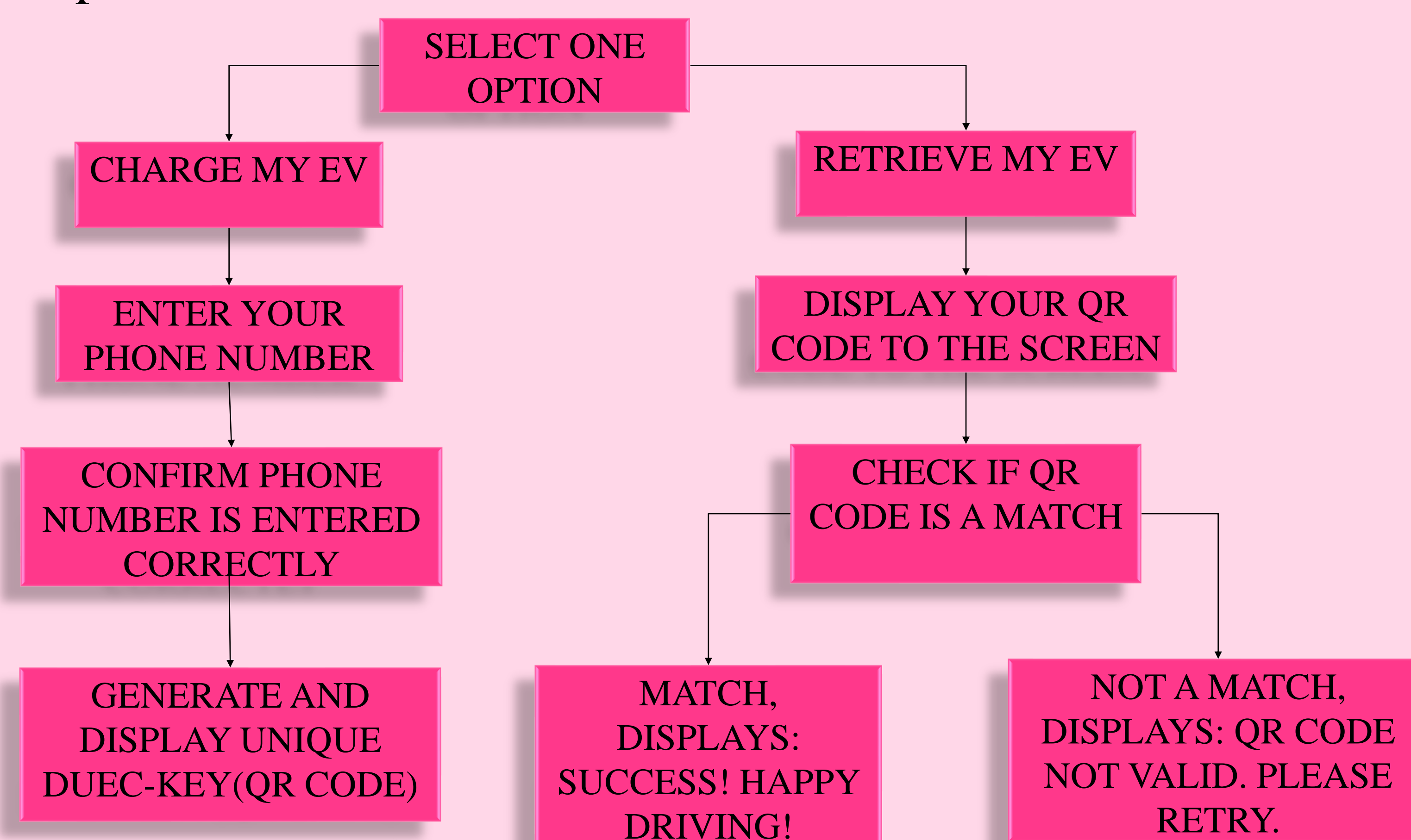1. *Remote charging status query*
2. *Remote EV claim*
3. *Transmission of DUEC-KEY over the air to unlock the connector*

Sample DUEC-KEYS and messages the machine will display to the user if the QR Code is valid or not.
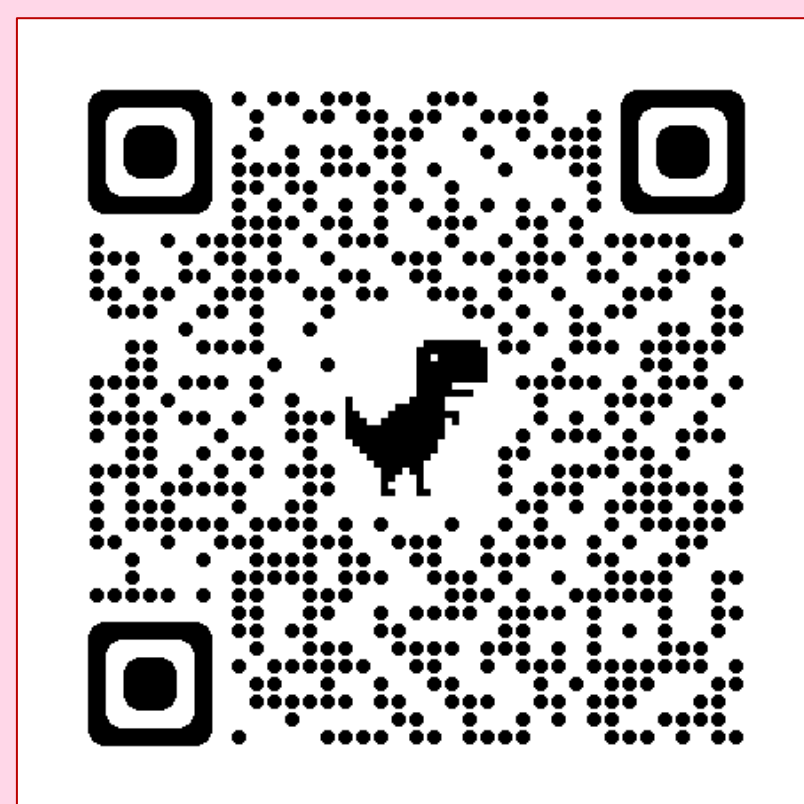
RESULTS

- Using Python, code was written to execute the steps outlined, simplified as:

SELECT ONE OPTION

CHARGE MY EV → ENTER YOUR PHONE NUMBER → CONFIRM PHONE NUMBER IS ENTERED CORRECTLY → GENERATE AND DISPLAY UNIQUE DUEC-KEY(QR CODE)

RETRIEVE MY EV → DISPLAY YOUR QR CODE TO THE SCREEN → CHECK IF QR CODE IS A MATCH → MATCH, DISPLAYS: SUCCESS! HAPPY DRIVING! / NOT A MATCH, DISPLAYS: QR CODE NOT VALID. PLEASE RETRY.

```
"""def generate_qr_code(client_number):
    code = str(datetime.datetime.now()) + " " + client_number
    img = qrcode.make(code)"""


#generate_qr_code(s)
```

A snippet of the Python code that executes the proposed solution

```
What is your name?                              Q  ×
Mphande
Hi, Mphande!
Enter your phone number.(e.g 4047562345)
1234567890
Number 1234567890 is valid.
Is 1234567890 your phone number? Enter Y for Yes or N for No.
Y
Thank you! Standby whilst your QR code is being generated.
>
```

Snippet of well executed result

CONCLUSION AND FUTURE DIRECTIONS

- The solution is to be implemented on an Arduino and tested on a prototype for efficiency.
- Continued monitoring of EV's at charging stations is advised.

REFERENCES AND ACKNOWLEDGEMENTS

1. Yaqub, Raziq. Defending Unethical-unplugging of EV-charging Cable (DUEC). *IEEE,* 2018.