UNLV
Electrical and Computer Engineering

KED
Keyless Entry Door

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Abstract

Keyless Entry Door (KED) is developed to provide convenience and security to the front door. The device is inspired by the future of smart homes. KED offers convenience by unlocking the door using FaceNet, a convolutional neural network (CNN) for facial recognition. FaceNet analyzes the person's facial structure and verifies their identity. If the person's identity is valid, the motor will unlock the door, otherwise the door remains locked. Thus, giving a seamless entry without the need of a key. Security is also improved by implementing a force detecting sensor onto the device. If an unusual amount of force is applied to the door, KED will alert the owner of a possible breakin or dispatch authorities if necessary. Further functions of KED include the ability for couriers to safely drop off packages, generate digital keys for friends or family, and access the camera at the front door.

FaceNet

FaceNet is one of several available CNN for facial recognition. Developed by Google researchers in computer vision, FaceNet was selected for KED because it accomplishes both accuracy and efficiency. Other models such as OpenFace achieved quick results but poor accuracy whereas VGG had better accuracy but too slow for real-time facial verification.

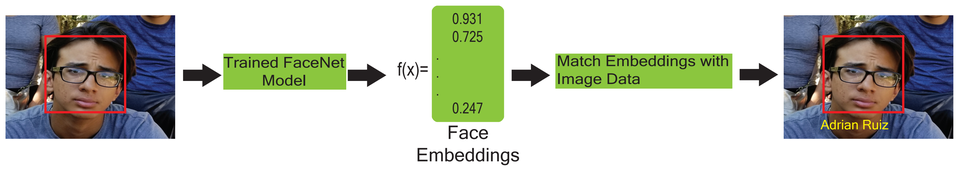

Figure 1: Illustration of FaceNet's process.

According to the FaceNet research paper (Schroff et al., 2015), FaceNet maps the face into a 3D Euclidean space. Once mapped, the facial structure is compared to the expected face. This comparison is done by computing the distance between the two Euclidean spaces. If the two faces are identical, then the distance is short, else the two faces are unrelated. Although facial recognition is the primary function of FaceNet, there are some characteristics of FaceNet that excels above other CNNs. For example, a low image quality of the face has little impact on the result. FaceNet is also insensitive to "occlusion, lighting, pose, and even age" (Schroff et al., 2015). These additional features help KED reduce the possibility of false positive results.

Future Implementations

The smart home market is projected to grow two billion dollars by 2022 (Yang et al., 2018). The idea of a smart home is to interconnect different devices or appliances inside a house's network. KED can also interact with other smart home devices. For example, a smart smoke detector can communicate with KED by automatically unlocking the door for first responders during a fire outbreak. These are one of the many possible ways that KED can be used in a smart home system.

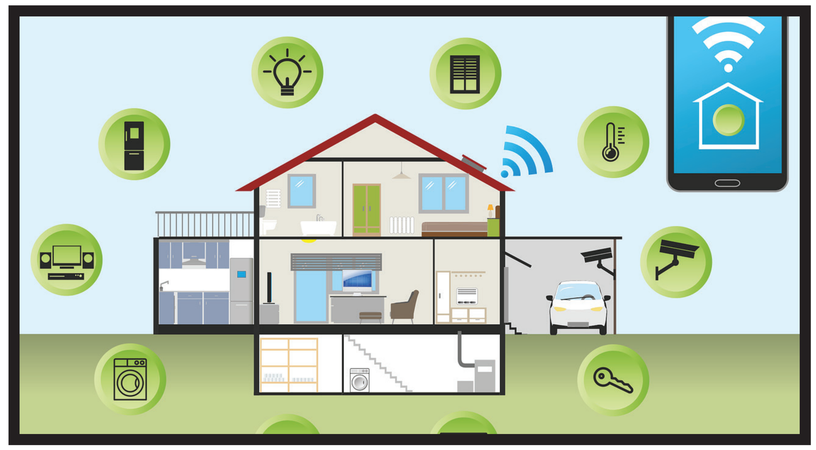

Figure 2: Smart home concept (iotevolutionworld.com).

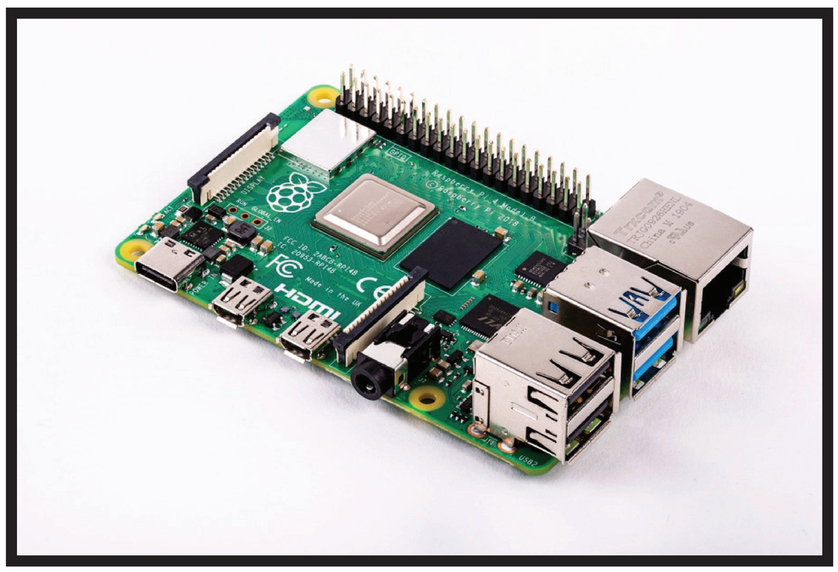

Figure 3: Image of Raspberry 4 (raspberrypi.org).

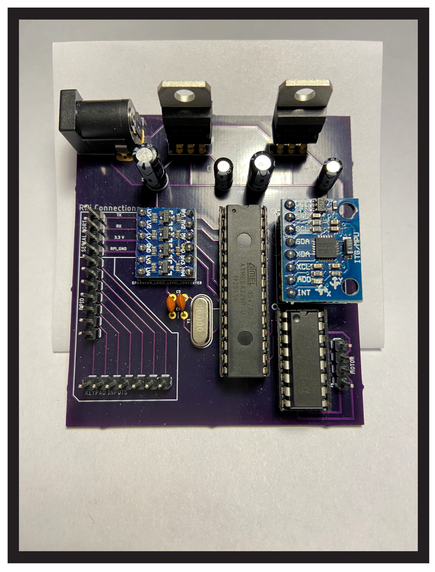

Figure 4: Image of KED's PCB.

References

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[4] Schroff, Florian, Dmitry Kalenichenko, and James Philbin. "FaceNet: A Unified Embedding for Face Recognition and Clustering." 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR) (2015): n. pag. Crossref. Web.