Initial Project Proposal

Year: 2019 Semester: Fall Project Name: IntelliFace (Intelligent Interface)

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1.0 Description of Project:

The intended design of the project incorporates a smart computer interface that provides cosmetic accessories to the user in the form of a digitally enhanced mirror. The design can be fit onto any flat surface or hung from a wall, and in addition to simply serving as a mirror, will present a set of users the option to view metrics important to their daily needs like indoor temperature, weather, a news feed, and an user interface that will allow users to try out accessories like hats, mustaches, and popular image filters, all controllable through the usage of an infrared gesture system.

2.0 Proposed Solution:

The smart mirror interface features an LED monitor that when illuminated, displays the smart features of the mirror. The mirror functionality is planned to be a camera display projecting a video stream onto the user interface on the monitor. A series of gestures are to be written into the mirror interface, read from the infrared sensor values. When the interface is not in the mirror mode, it can display regular information that the user will need to start their day. The mirror will authenticate the user using simple facial feature detection, and if authenticated, allows the user to harness all the features of the mirror. An ambient light sensor on the mirror surface also adjusts the mirror interface brightness automatically.

3.0 ECE 477 Course Requirements Satisfaction

3.1 Expected Microcontroller Responsibilities

The primary requirement of the course is satisfied through the usage of an ARM STM32F051R8T6 Microcontroller, responsible for handling the sensors onboard the mirror, namely a series of ultrasonic sensors for gesture reading, temperature sensors, and ambient light sensors. To handle the image processing requirements of the project, we plan to use an Nvidia Jetson TX2 board. We selected this board due to its computational prowess needed for handling imaging libraries like OpenCV, possible User Interfaces and dashboards using Python, Grafana and other tools. Also being considered for this role is the significantly cheaper Raspberry-Pi. Peripherals needed include USART to communicate between the STM32 and the TX2, ADC/PWM/SPI to interface the sensors.

3.2 Expected Printed Circuit Responsibilities

We plan to create a PCB for the STM32, integrating all sensors which will offer portability and neat packaging to this section of the project. The PCB is planned to support extended cabling to the ultrasonic sensors, and LEDs for embellishment, controlled by ADC and PWM.

4.0 Market Analysis:

With the growth in smart home devices like the Google Home and Amazon Alexa, smart mirror technology is being looked into heavily by smaller companies as potential for growth, and the market is currently at an estimated $400 million valuation. Inroads into the usage of smart mirrors in the cosmetic departments is also a growing market, several products being displayed in CES and Expo halls across South-East Asia.

5.0 Competitive Analysis:

5.1 Preliminary Patent Analysis:

5.1.1 CN103479140A:

**Patent Title:** Intelligent Mirror

**Inventor:** [陈显龙](https://patents.google.com/?inventor=%E9%99%88%E6%98%BE%E9%BE%99), [陈晓龙](https://patents.google.com/?inventor=%E9%99%88%E6%99%93%E9%BE%99), [杨志鹏](https://patents.google.com/?inventor=%E6%9D%A8%E5%BF%97%E9%B9%8F)

Filing Date: 2013-09-10

The invention relates to an intelligent mirror which comprises a common mirror face, a display mirror face and a control system. A display device is arranged on the back side of the display mirror face, the control system is mounted on the back side of the common mirror face and comprises a power source module, an infrared sensing module, a communication module and a controller, the controller is connected with a display device, the power source module, the infrared sensing module and the communication module respectively, and a wireless network connecting device is arranged on the communication module. Starting and stopping of the display module on the intelligent mirrorare automatically controlled, so that intelligentization, convenience and friendliness of housing and accommodation are improved, and power source consumption is greatly saved. During working, the intelligent mirror receives related information pushed by a cloud service system through wifi and displays the related information. The intelligent mirror adopts non contact-type touch screen gesture recognition technology to switch collection cities and can display time, weather information and related wearing guides to enable users to timely add clothes and carry umbrellas, so that intelligence, interactivity and practicability of the mirror are improved.

5.1.2 CN104223858A:

**Patent Title:** Self-Recognition Intelligent Mirror

**Inventor**: 蔡文生张达李纯冬黄海林

Filing Date: 2014-09-28

The embodiment of the invention discloses a self-recognition intelligent mirror, which is used for automatically recognizing and updating the personalized information display of a user so that the convenience and the use experience can be improved. The self-recognition intelligent mirror according to the embodiment of the invention comprises a display mirror surface, wherein the back side of the display mirror surface is provided with a display device, the self-recognition intelligent mirror also comprises a control system, the control system concretely comprises a power supply module, a communication module and a controller, the controller is respectively connected with the display device, the power supply module and the communication module, the self-recognition intelligent mirror also comprises a camera, a human face recognition module and a setting information obtaining module, the human face recognition module is used for analyzing a user image shot by the camera and recognizing the user identity of the user, the setting information obtaining module is used for being connected with a remote end platform through the communication module and obtaining setting information corresponding to the user identity from the remote end platform, and the display device is used for updating display contents according to the setting information.

5.1.3 US20020080494A1:

**Patent Title:** Mirror Information Panel

Inventor: [Robert Meine](https://patents.google.com/?inventor=Robert+Meine)

Current Assignee: Hewlett Packard Development Co LP

Filing Date: 2000-12-21

The inventive mirror provides both an image and information to a user. The inventive mirror allows a user to review electronic information, while performing personal hygiene procedures. For example, the user could look at the inventive mirror and review news headlines and/or stories, read and respond to e-mails, and/or review and edit their schedule of appointments, while grooming. The smart mirror has two modes. In a power off mode, the smart mirror acts as a standard reflective mirror. In a power on mode, then the smart mirror becomes a display device. The display device may comprise a touch screen, which would allow direct user interaction.

5.2 Commercial Product Analysis:

5.2.1 Etsy Smart Mirror:

Price: US $280

Smart Mirror interface with TV channels, voice recognition, weather, news, traffic information, and speakers. Added features include Alexa and Smart Home integration.

5.2.2 QAIO Single Sink Mirror:

Price: US $1299

Smart Vanity mirror with basic functionality including TV tuning, Alexa integration, weather and traffic information, news, controllable through a touch display.

5.2.3 Google Assistant Mirror:

Price: US $975

Motion activation and gesture sensing through a camera, with standard weather and news updates, features continuous video analysis of user and gestures.

5.3 Open Source Project Analysis:

5.3.1 Smart-Mirror by Evan Cohen:

An extensive smart mirror interface intended for the Raspberry Pi, complete with IoT integration for other tools including remotely controllable LEDs for mood-lighting, iRobot integration for smart-vacuuming, and Spotify Integration with speakers connected over bluetooth. Emotion detection is a notable feature in this project, however this is achieved through API calls to paid microservices on AWS Rekognition. Work is primarily done in JavaScript, and is not robust enough for easy expansion, and has voice control that slows down the mirror interface. It also utilizes API calls to Amazon Alexa to achieve these ends, and simplifies the smart mirror interface.

5.3.2 MagicMirror2:

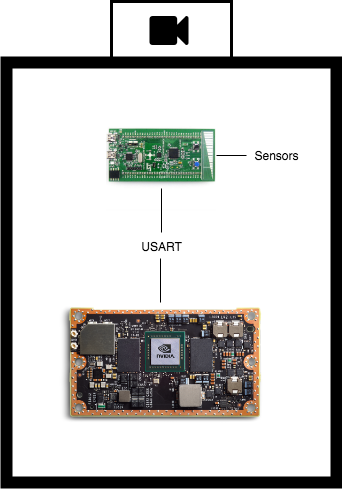
An open-source smart mirror project on GitHub, the dashboard done through PyQt libraries was entirely community driven, with over 180 contributors to the project. This is done entirely on a Raspberry Pi, and has limited features due to its lack of computing power needed for more advanced tasks. It’s facial recognition feature is built through the usage of a pretrained neural network which will not work for multiple users, and is not adaptive to changes in facial features of a user.

6.0 Sources Cited:

1. Assessing Cardiovascular Function using an Optical Sensor. (2018). United States Patent and Trademark Office
2. Blended Reality Systems and Methods. (2018). United States Patent and Trademark Office, retrieved from <https://patents.google.com/patent/US20160292917A1/en>
3. Global Market Study on Smart Mirror: Driven by High Market Potential in Automotive and Retail Industry with North America to Witness Highest Adoption By 2022 (2016). Persistent Market Research Inc.
4. The open-source smart mirror platform. (2018). MagicMirror2, retrieved from <https://github.com/MichMich/MagicMirror>
5. Jetson TX2 Module. (2019). NVIDIA Developers, retrieved from <https://developer.nvidia.com/embedded/buy/jetson-tx2>

Appendix 1: Concept Sketch

*Concept Full-view of the mirror:*



*Concept Frontal-view of the mirror:*

