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Magic Mirror with User Profiles and Alexa

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Abstract

This paper intends to research and understand the existing work in the field of Smart Mirror development and its contributing classes. This paper abstracts a wide variety of topics from the beginnings of the smart mirror to the developments that have branched out to diverse fields, each customised to the needs of those fields respectively along with a brief look at Facial Recognition using machine learning.

Keywords: Alexa, Body Sensors, Smart Mirror, User Identification.

1. Introduction

The Internet of Things has revolutionised the way we go about our day to day life. The ability to have devices that communicate with each other has led to an ecosystem of connected devices, or "Smart Devices" as they're monikored, which make life very convenient. Every device that currently exists can be connected in some for or the other to make it more functional. An object that had largely gone unnoticed during the first wave of Internet-Connectedness was the humble mirror. While the mirror is the first thing that most of us look at first thing in the morning, the functionality it offers is very largely basic. For an object with so much screen real estate and ability to showcase information, it was never really considered to be a secondary display. Mirrors have been used to showcase some amount of information from the early days, either by way of stickers or LEDs placed within them in places such as departmental stores, cinemas, salons, etc.It wasn't until 2014 when Michael Teeuw[1]got inspired by such a mirror in a departmental store that a "Smart Mirror" was born. The idea for such a device first came to him while walking through a departmental store, where he saw a mirror with an illuminated sign in it. With his skills in basic woodworking skills and knowledge of computers, he realised that he can make better use of this idea by attaching a screen to a 2-way mirror connected to a Raspberry Pi which can then be used to provide the user with valuable data such as his events for the day, the weather, etc. In the short time succeding that, development of the smart mirror has spread far and wide, ranging from topics about home automation to monitoring the health of people.

2. Related Work

Before undertaking such a project, there are a few vital questions that need answering. The first question that arises is- is there a target audience? Do end users actually need this? Oh, Moonseok[2] undertook a survey to answer these questions. His

reasearch showed that users of different age groups and demographics were looking to get different information out of such a device, but a vast majority of them agreed that this would improve their Quality-of-Life. Other such studies have also concluded on similar lines, that such an addition, while not necessary, would improve the user's life.

The second question that arises is that of implementation. While there exists a plethora of ways to implement it, including custom controllers or basic displays with local readings, the most effective and functional method seems to be to use a Raspberri Pi. As showcased by Sun yong, Geng Liqing, Dan Ke[3], a Raspberry Pi with required extra components can increase the functionality of a smart mirror substantially. Here, the authors have used extra modules such as a Text-To-Speech to convert output from the mirror to voice-speech, a clock module to keep track of the time and a wireless and Bluetooth module to communicate with other devices.

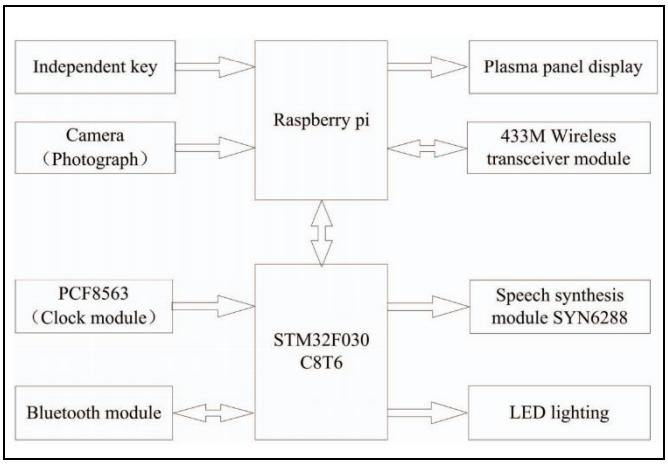

Fig 2.1:Block Diagram of System used in [3]

Project [15] follows on this by using more sensors and also adding more connected features.Another example for implementation using a Raspberri Pi comes from Prof. PYKumbhar, AllauddinMulla, Prasad Kanagi and Ritesh Shah[4] where the authors have used a Raspberri Pi to display details such as the current weather, upcoming calendar events and news updates. The recurring theme amongst a majority of these devices seems to be provide the user with a basic overview of their day, which also seems to be the ideal use case scenario as the time spent looking at a mirror is usually at the beginning of the day and for a few moments, allowing the user to glance over their upcoming day.

Due to the availability and omnipresence of a mirror, one of the earliest implementations of it was to use it to monitor for signs of a disease of in a user. Colantonio, S., Coppini, G., Germanese, D., Giorgi, D., Magrini, M., Marraccini, P., … Salvetti, O[5] in their 2015 article had proposed the Wize mirror which they wanted to use to detects and monitors over time semeiotic face signs related to cardio-metabolic risk, and encourages users to reduce their risk by improving their lifestyle. Various developments in this regard have taken place, from being used to remind people of their drug schedule. The Memory Mirror[19] performs the function assistant to the elderly by graphically showing the status of drug usage over a period of 24 hours. It keeps track of all the drugs removed from the medicine cabinet and records it in a history log in order to display the details of previous usage and to warn about possible lost or misplaced items. To do so, it uses RFID technology to keep a track of what's been removed and how much of it is left.

A major issue faced by early smart mirrors was that of interaction. While it was more than adept at displaying a set data, it provided no way for a user to control it without getting into the root of the software. One of the earliest attempts at solving this was by way of voice control. Muhammad Mu'izzudeen Yusri, Shahreen Kasim, Rohayanti Hassan, Zubaile Abdullah Husni Ruslai, Kamaruzzaman Jahidin, Mohammad Syafwan Arshad[6]made a smart mirror where the user couldask the mirror a set of pre-defined commands and be shown the relevant data.

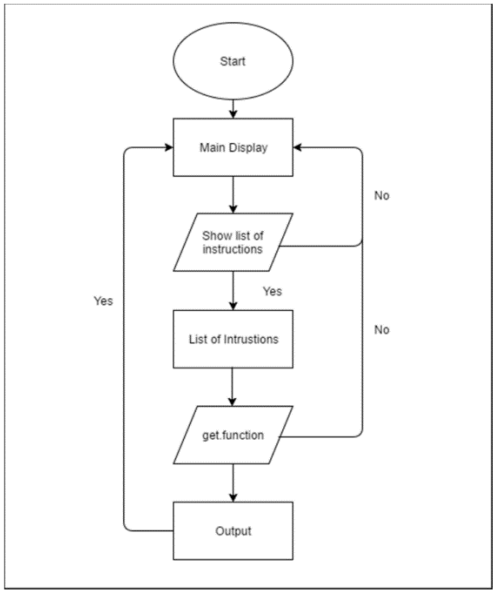

Fig 2.2:Flow chart for voice command implementationin [6]

This advancement brought about a whole new facet to the smart mirror where one could interact with the mirror. Project [14] takes over the same, wherein they've used voice commands to control elements of the smart mirror.Athira S, Frangly Francis, Radwin Raphel, Sachin N S, Snophy Porinchu, Ms.Seenia Francis[7] furthered on the novel idea of using voice recognition by using Google API's to convert speech to text and using Jasper to set commands that help control the devices around a users home.

With advancements in AI and continued interest by Tech Giants such as Amazon and google, virtual assistants started arriving on the scene, smarter than ever and with more functionality than ever. This led to a trend where the APIs of both Amazon and Google's offerings, Alexa and Google Assistant respectively, were being added to smart mirrors. The projects [8] and [9] showcase as to how Alexa, a much more powerful created by Amazon can be used instead of ones own custom voice assistant to further increase functionality, given the immense power and links that Alexa possesses. Alexa is a "Digital Assistant" with the ability to conduct a wide variety of functionalities, using what are known as "Skills" which are the commands.

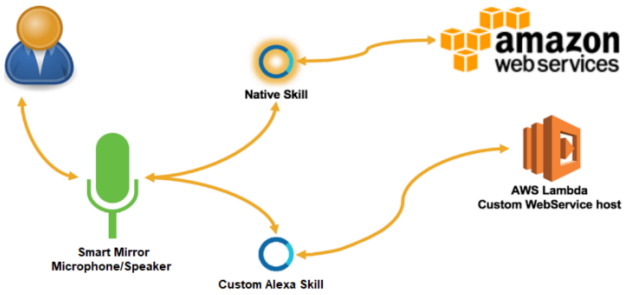

Fig 2.3:An Overview of using Alexa Skills in [10]

A lot of companies have already created custom skills for their products, which help in a diverse field from home automation to ordering groceries. Several APIs can be used to connect to the various products, for instance Wipro offer smart lights with a specific skill to control them. The blogs [10] and [11] show how to implement Alexa and what exactly it does while also detailing the methodology behing creating custom skills that can be used in conjunction to controlling the smart mirror.

Another method of controlling a smart mirror is by way of touch. The device made by K. Jin, X. Deng, Z. Huang and S. Chen[20] is one such example where the entire surface of the mirror was converted into a touch surface. While this increases the functionality of the device multi-fold, the expense related to creating such a device is prohibitive. Until the pricing for touch-sensitive, large displays reduces, such a product would be economically prohibitive for mass market production.

With the increase in interaction came about the increase in modularity. By making it easier to pick and choose what the user would like displayed, now a lot of different things could be shown at the right time and got rid of when not required. Article [15] talks about the modularity of the information being displayed. Modularity is an important aspect of customisation as it lets the user pick and choose the information that the user would want to receive, while allowing the content publishers to create custom modules for their services and providing them with the flexibility to do it in the way they'd want. The concept of Modularity in the smart mirror world has been perfected by the community Magic Mirror[2][16]. Magic Mirror is an open source, community driven effort where a plethora of modules are already available and people with their own ideas for modules have the ability to use them as starting blocks and customise and individualise them, or downright create new ones and grow the community further.

One unique idea we intend on intemplating is to first recognise the user and display the content that is unique to him. To do this, we had to understand Facial Recognition with OpenCV. To do so, we reference [12],[16],[17] and [18]. OpenCV is a library of programming functions mainly aimed at real-time computer vision. This can be achieved by the set of algorithms that detect unique points on each persons face and compare it to the pre-existing data to check for matches. The dimensionality of face image is reduced by the Histogram of Oriented Gradients (HOG) and this algorithm is developed to detect frontal views of faces. After detecting the face part of image, extract the 128 face features for the given image by using a Deep Neural Network algorithm and the recognition is done by the Support Vector machine (SVM) classifier. By differentiating between multiple users, guaranteeing security of the data as in no unauthorised access and also provide the data one wants instead of a one-size fits all method.

3.Proposed Work

With the ensuing pandemic, we decided to ask ourselves as to how we can contribute to the efforts. Hence, we propose the following work-

- Create a smart mirror using a Raspberri Pi and it's associated components, while using advancements in the field of medical sensors to implement an infrared sensor to take a reading of the body temperture of the user.
- Creating different user profiles and logging them in to the right one by implementing a form of basic facial recognition implemented with the use of machine learning concepts to deliver personalised data to each user.
- Do all this while still coming in a price bracket where it's more affordable and easy to install for the average user.

4. Conclusion

The most common and functional way of implementing a smart mirror is with a connected Raspberri Pi. Within a short span of time, large diversification in functionality has taken place, with it being applied in various sectors, from stores to help people virtually try on clothes to the health sector. Various methods of interaction are currently possible, with voice controlled methods being the most popular and economically feasible option. The rapid development in Virtual Assistants and the added functionality it offers converts the mirror into a hub to control the connected devices around the house.

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