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Smart Mirror using IoT and Raspberry Pi

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Abstract: ***Smart mirrors as a concept are growing rapidly. These mirrors directly affect the day to day lives of the people as it provides customization and a luxurious lifestyle. With the help of devices like smart mirrors people are getting exposed to technology and are in turn contributing to a tech supported lifestyle. The smart mirror is one such device where a normal mirror acts as a smart device which consists of a user interface with which the user can interact. This paper proposes a model which is robust and can be utilized by individuals in their day to day lives. The proposed model in this paper is in the form of a mirror developed with a combination of hardware and software. The mirror incorporates Oracle VM Virtual Box which supports the Raspbian OS. The model uses the Magic Mirror Module on the software part to implement different features like Calendar, Music App, Weather Forecast, News etc. These features are implemented using their respective API's. The proposed model can be scaled to add more and more features thus making it more robust, also the model is very cost effective. With the help of this people would be able to ease their lifestyle a bit and automate things as much as possible.***
Keywords: Raspberry Pi, Raspbian OS, Magic Mirror module, Smart Mirrors, Internet of things (IoT), Smart Homes

I. INTRODUCTION

Internet of Things (IoT) is a technology which has been directly affecting how we live our daily lives. Concepts like Smart Homes and Smart mirrors have been possible with the help of IoT. The concept of smart mirror is basically a two/one way mirror with an in-built display which is used to show different features like weather, calendar, list of tasks, music etc. The term smart mirror has been in talks for quite some time now but very few initiatives have been taken in building a smart mirror industry and product range in general. The one's in the market right now are very expensive and are not cost effective. Automation is something which is of paramount importance going into the next decade as it will reduce the burden on the people's lives and will thus enhance productivity. This is also the reason why smart mirrors as devices should be implemented on a global scale in a cost-effective way. The domain of this project can be termed as Smart Homes which is mainly dominated by the technology called Internet of Things. The main objective of this project is to provide a futuristic and cost-effective smart mirror. The current mirrors in the market are very expensive due to very low production scales. With the help of this project, we want to demonstrate that smart mirrors can be implemented at a small-scale DIY level. The main feature of our smart mirror is that it requires very low maintenance cost. All the components used in the project are very generic and are not reliant on any other components. Another great advantage of our project is that it is fully scalable. We can add as many features as we want as it is open source and can be modified as per needs as well.

II. RELATED WORK

P. Mathivanan et.al [1] recently reported how smart mirrors can help in atomizing our homes. This paper provided a detailed overview on how to design such a system. From this paper we decided what system architecture should look like. Uddin, K.M.M et.al [2] very recently reported about Smart mirrors using facial recognition. The project in this paper was very vast and very detailed. The paper illustrated the importance of the features integrated in the mirror and how it affected the personalization of the user. From this paper we concluded on which all different features we would try to add in our mirror. Y. Sun et.al [3] recently reported how with the help of voice recognition we can create an entire ecosystem of integrated features which will give the user all the things he/she needs in just one command. D. A. Alboaneen et.al [4] recently reported a detailed literature review on different advancements that had been done in the smart mirror space. They had done a thorough survey of what all different features have been implemented so far. This paper helped us in gaining more insights about how and why smart mirrors are built. M. M. Yusri et.al [5] recently reported how we can use the Raspbian OS on a virtual machine to re produce the same mirror experience as working on a real raspberry pi. It was from this paper we got the cue of the raspberry OS and we started exploring how we can implement our project using the same. R. Nadaf et.al [6] recently reported on how we can use smart mirrors as a security and authentication system as well.

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III. METHODOLOGY

The proposed model can be further classified into two categories: hardware and software. The description of each component of both categories has been illustrated in the next section.

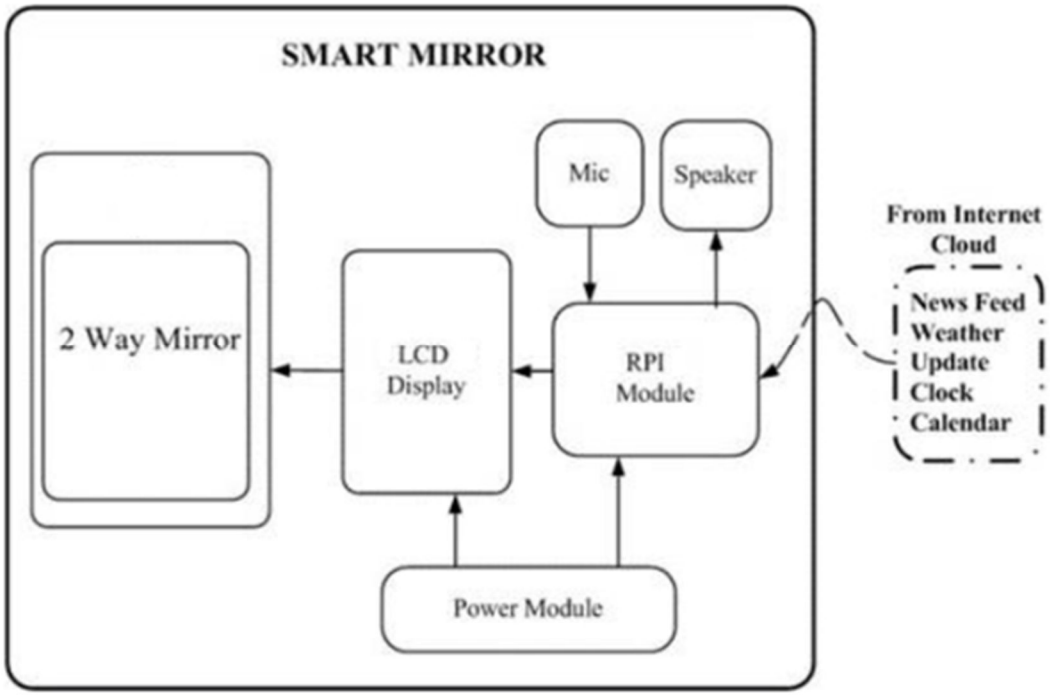


Fig.1 Block Diagram of the Proposed System

Fig. 1 illustrates the block diagram of the proposed model. A two-way mirror with a LCD display at its back makes the core structure of the model. The power module enables the display on the mirror where information is displayed with the help of raspberry pi. The raspberry pi interacts with the APIs to tailor the information that is to be displayed on the screen. The config.js file is responsible for making the calls and fetch information from the source. The events of these API calls are both users driven and natural depending upon the use case.

A. Hardware System

The hardware system includes a two-way mirror, LCD display, a power module, a Raspberry Pi along with a mic and speaker.

1) *Two-Way Mirror:* The proposed model uses a two-way mirror at its core. These kinds of mirrors are more reflective as compared to one-way mirrors. As the mirror has a display behind it the more reflective nature of it comes in handy as it is adaptable to both dark and light environments.
2) *LCD Display:* The model has a 15.6-inch LCD display placed behind the mirror. This particular display acts as the primary display source. The LCD display is responsible for displaying the assembling various features mentioned in the form of a user interface.

B. Software Description

For the software part of this proposed model, the Magic mirror module has been explicitly developed for smart mirrors. The magic mirror module is an open-source library which has a collection of different installable modules also known as features. The magic mirror module is mostly based on JavaScript and has a config file which is the brain of the mirror. The config.js file contains the layout of the user interface and with the help of that file we can specify which module will occupy which space on the mirror and all the other factors. The config file comes with built-in features like calendar, weather, compliments etc. The file also has custom 3rd party modules in that file viz. Trello and Spotify. The diagram given below illustrates the basic outline of the config file.

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Table 1 – Outline of the contents of the config.js file

Option	Description
Module	The name of the module. This can also contain the subfolder. Valid examples include clock, default/calendar and custom modules/my module
Position	The location of the module in which the module will be loaded. Possible values are top_bar, top_left, top_center, top_right, upper_third middle_center, lower_third , bottom_left, bottom_center, bottom_right, bottom_bar, , fullscreen_above , and fullscreen_below This field is optional but most modules require this field to set. Check the documentation of the module for more information. Multiple modules with the same position will be ordered based on the order in the configuration file.
Classes	A list of additional CSS classes which will be set on the module. This field is optional.
Header	To display a header text above the module, add the header property. This field is optional.
Hinddenon Startup	Set module as being hidden on start-up. This field is optional.
disabled	Set disabled to true to skip creating the module. This field is optional.
config	An object with the module configuration properties. Check the documentation of the module for more information. This field is optional, unless the module requires extra configuration.

IV. RESULTS

The result of this project is a fully functioning Smart Mirror which has features which are needed in our day-to-day life. The output is first seen on the laptop screen after we boot up the OS in Virtual Box. The output which is seen on the laptop screen is then given to the monitor which is there behind the mirror with a HDMI cable. The pictures attached below show the mirror in action.



Fig 2 – Mirror (1)



Fig 3 – Mirror (2)

SR No.	Existing System	Proposed System
1	Supports limited modifications	Full customisation and modifications can be implemented
2	The program and operating system are heavy and unnecessary	While using a simple OS which is light weight and without restricting any features
3	Displays cannot be interchanged if once damaged causing heavy maintenance costs	Multi resolution support enables to work with variety of display's
4	Live module addition isn't supported	Modules can be hot swapped into the system no restart is required
5	Most commonly used materials are aluminium, SS or GI.	Wooden materials are used to provide a protection from steamy areas such as bathrooms to absorb the steam and eradicate the water dripping issues
6	There is a compulsion of hardware that raspberry pi should be used.	The proposed system can use any old laptop with a p4 or above processors and at least 1 GB of ram
7	Direct Lan connection cannot be established	Lan connections can be made to increase the redundancy
8	Usually costs around 25-30 thousand rupees	The proposed system is feature rich as well as cost effective at price of 8 to 10 thousand.

Fig 4 – Comparative Analysis of existing and proposed system

In the picture above there's a comparative analysis between our proposed system and the existing system.

V. FUTURE SCOPE

The future scope of this project is immense. Smart mirrors are extremely scalable products. One can add as many features as wanted in order to reach the end goal of customer personalization and satisfaction. In the future, technologies like Face Recognition would be a thing we would like to integrate. With the help of face recognition, a whole new level of personalization can be unlocked. Along with these things like Video Playback (YouTube, Movies) and Smart Sensors for Home Automation can also be integrated in order to create a full-fledged end to end product.

VI. CONCLUSION

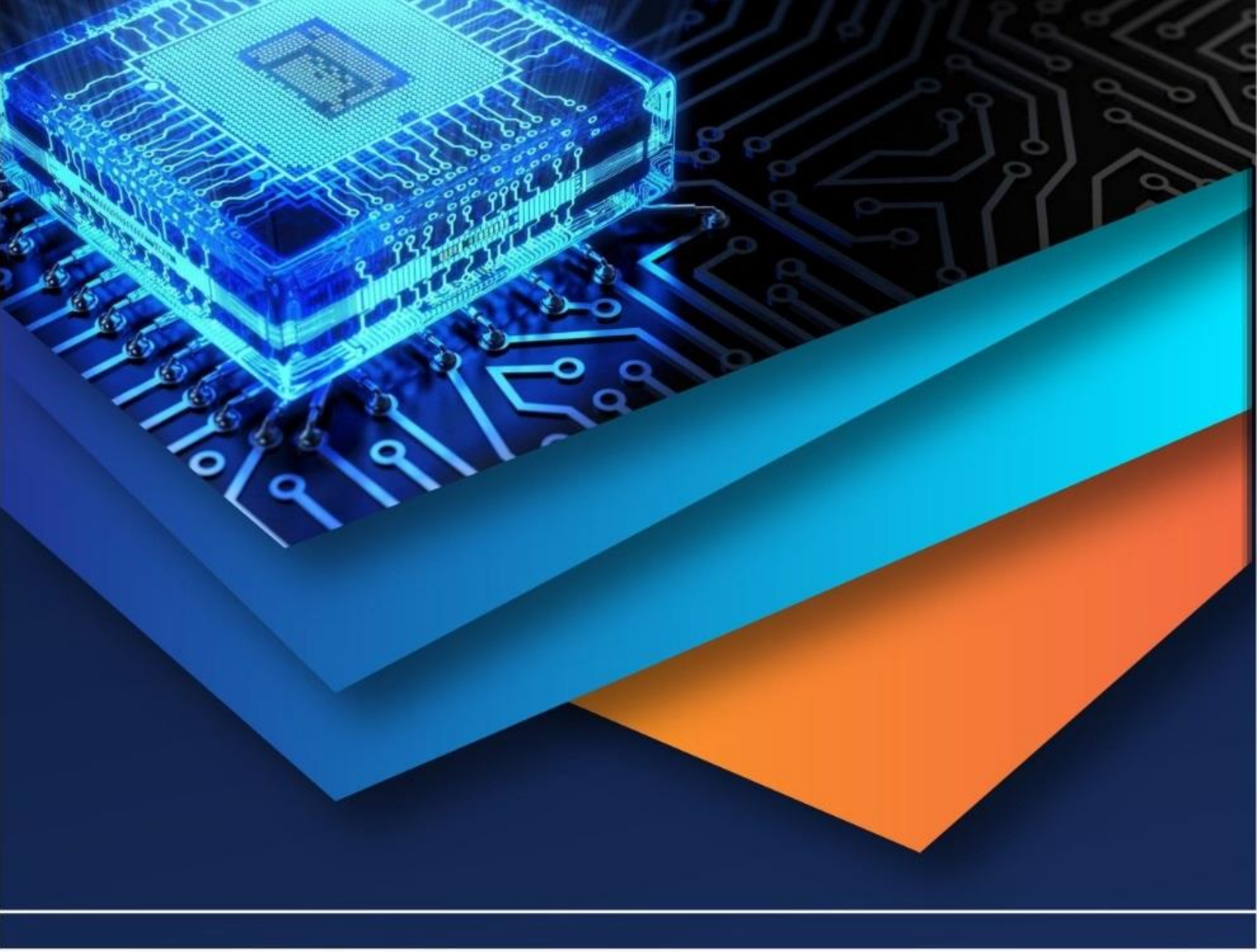
In conclusion to this proposed model, one can firmly say that this is a sample prototype to a Smart mirror which has all the necessary features like Calendar, Weather, Tasks, Music etc. Along with these features the model is robust and scalable as it is done on virtual machines and requires very low maintenance cost hence it is very cost effective in contrast to what smart mirrors actually cost in today's market.

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