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Ambient Reflector– An IoT based Smart Notice Board System

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Abstract - *Internet of Things is one the trending technologies of our time. It is used to connect various devices in a network that is made available anywhere within the range of the network. It allows a person to access his resources on the go. In this paper we propose an Ambient Reflector for a Smart notice board system using the concept of Internet of Things. The system uses Raspberry pi- Single Board Computer (SBC), acting as the processor with Wi-Fi network connectivity. It comprises of wireless sensor nodes, camera modules and a display unit forming the additional requirements of the system. The proposed system uses Evolutionary Prototyping methodology. The prime feature of the system is to display updates seamlessly to the users. The system's root user updates the notices that are to be displayed on the designed interface. The system enables the users to use voice recognition tool to interact with the notice board. It has the ability to monitor the surrounding, by availing the camera module embedded to the framework. It also has an additional ability to automate the locality with ministration of sensors. The system is coded using Python for Rpi environment. The key motive of this IoT based Ambient Reflector, is to unveil the notices promptly. The proposed system replaces printed notices which saves time, shrinks man power and assists in achieving a greener environment.*

Key Words: Reflector, Raspberry Pi, IOT, Smart Notice Board.

1. INTRODUCTION

The Internet is a global network of interconnected devices that uses standardized communication protocols. It is a living entity, always changing and evolving. In addition to evolving, technology is also changing the landscape. Connection via broadband is becoming cheaper day by day and is pervasive. Devices are becoming more powerful and smaller in size with a variety of on-board sensors. IoT uses this Internet technology that connects various "things" that communicate with each other to ease the work and to automate the surroundings. The name "IoT" was coined by Kevin Ashton in 1999. IoT is an upcoming domain which has its applications in various fields including medicine, engineering, agriculture, industry, research, etc.

By connecting various devices in the form of a network, we can exchange data easily in real time and access it remotely. This creates a smarter environment saving tons of time and energy and also producing accurate results, thus increasing efficiency. The cost of implementation is negligible compared to the complexity of the problem. It highly reduces human intervention by automating the system. Reluctantly there are challenges associated with the Internet of Things, most explicitly in areas of trust and security, standardization and in terms of governance that is required to ensure a fair and trustworthy open Internet of Things, which provides value to all of the society. IoT is an interconnection of Wireless Sensor Network (WSN) devices which includes embedded devices with wireless sensors. Scrolling display board is a common sight today. Advertisement is going digital. The use of LED scrolling display board at big shops, shopping centers, railway station, bus stands and educational institutes is becoming an effective mode of communication in providing information to the people. But these off-the-shelf units are somewhat inflexible as the message keeps scrolling. The proposed Ambient Reflector is an IOT enabled Smart Notice Board that displays the notices on the reflector, which is easy to update. Humans physiologically have the desire to see how they look. This reflector acts as a mirror and also a notice board thus serving the purpose of displaying notices while it reflects their appearance. The Ambient Reflector comprises of a 2 way reflective sheet mounted over a display screen connected to the credit card sized processor- Raspberry pi which is connected to sensors and camera modules to provide automation and seek the surveillance of the surroundings. The Ambient Reflector gets the inputs from all these sensors, processes it and provides output by displaying text and graphics on the reflector.

Our contributions are as follows: Conceptualization, design and development of Ambient Reflector that acts as a smart notice board to the user providing automation of surroundings and a connected camera module to seek the surveillance of the surroundings.

2. SURVEY OF EXISTING SYSTEMS

The existing systems that have been built in past by various researchers have successfully displayed notices but they have certain issues to be solved. Our proposed system solves some of the major issues such as updating notices anywhere within the network, increase in ease of readability and use of voice commands which is used for interaction.

A Digital Notice Board based on GSM [13] operated at the Universities, colleges, schools, hospitals, railway stations, gardens etc. for exhibiting day-to-day information continuously or at regular intervals without affecting the surrounding environment. It offers pliability to display flash

notices, information or announcements faster than the programmable system. A text notice will be typed in the GSM based mobile phone to LED moving display boards. The information provided keeps scrolling causing difficulty in reading. A digital notice board and a home automation system [8] using a GSM SIM900 module. The thought behind this project is to furnish important notices in an LCD. The notice can be passed through an android application designed in the developed project, to the GSM SIM900 module which consists of a SIM card inside it. The control system of the module is done using microcontroller, GSM technology for communication and sends SMS containing the message through the android application. There is no security of the application which is the major drawback to this system. The earlier designed LED based Scrolling Notice Board [2] made use of LED matrix-based display system. The intelligence and control were done using ATMEGA 16 microcontroller to display the message. The main issue faced here includes difficulty in reading the scrolling message. A notice system [12] was developed, which didn't demand reaching to the display or any pinning or sticking of papers anywhere. The system is built on single board known as Raspberry Pi which includes quad core processor ARM 8 from Broadcom which has a speaker, it is integrated with a voice alert notice which was to announce the notice but issue was that all should may attention at that particular time as it creates noise. The goal of Smart Mirror [3] is to positively affect the user's feelings by increasing his/her motivation, mood and feeling of fitness. Smart mirrors make use of two-way reflectors which acts as both a mirror and an interface to trace relevant information such as time and date, weather, warning, traffic, and location map. A multi-user smart mirror system [10] conceived to promote wellness and healthier lifestyles in the work environment through persuasive strategies. By means of a RFID reader, the interactive mirror recognizes different users through their personal corporate ID card, which allows them to have access to their personalized user-interface. Thus these ID cards acts as RFID tags whose signals are captured by the reader, which inturn is used to recognize the tag, thereby identifying the tag holder.

A home automation system [6] based on internet of things is developed that allows the user to automate all the devices and appliances of home and integrate them to provide seamless control over every aspect of their home. IoT based security surveillance system [16] were installed in buildings using Raspberry Pi connected with WiFi. On receiving the event notification, the controller enables the camera and alerts the user via email, phone call and SMS and places the live video of event on webpage. The biggest advantage of the system is that the user can seek surveillance from anywhere in the world and can respond according to the situations.

3. FUNCTIONAL ARCHITECTURE

The detailed architecture of IoT based Ambient Reflector, is divided into four parts:

- Wi-Fi enabled Reflector to display the notice
- Surveillance of the Neighborhood
- Automation of the surroundings
- Integrating the Voice Command Module

It is mandatory that the system and the connector sensor nodes and modules should be on same network. Acting as a reflector it can be used to show the reflection of the user himself. Being the wireless sensor node, it can be easily installed anywhere inside home. System follows evolutionary prototyping and the Sensor nodes follows modular design so that any number of nodes can be added or removed.

The system (Fig.3.1) uses Raspberry Pi as the micro processor, which is a small single-board computer which performs various operations and also controls other devices connected to it. Ambient Reflector is a two-way reflector that displays the notices to be viewed by the users. Jasper is software that is installed within the Raspberry Pi that is used to enable Voice Recognition in the system. Camera Module is connected to the Raspberry Pi which captures real-time data that is used for surveillance of the ambience. Motion Server is the software used to install the camera module to the Raspberry Pi. Sensors such as temperature sensors and Ldr sensors are also integrated in the system to sense heat and light respectively, which are used to automate the surroundings. The entire system is connected to the Internet and hence updating notices can be done anywhere within the network.This system makes use of the following components:

1. **Ambient Reflector:** It is a two-way reflecting surface that is made smart with the help of IoT Technology. A two way mirror is chosen because it acts as a normal mirror until unless light is projected on it as shown in (Fig.3.2.1). Here, the LCD screen placed underneath the reflector acts as the source of light. Thus when the LCD is switched on, the mirror becomes smart.

2. **Raspberry Pi**: It is the processor used in this system. Raspberry Pi has a Quad Core 64bit CPU , 1GB RAM with Bluetooth Low Energy (BLE) on board as shown in (Fig.3.2.2).

3. **Microphone:** It is used to capture the command given by the user (Fig.3.2.3) that is to be interpreted by the processor.

4. **Sensors:**

   4.1.LDR Sensor: LDR (Fig.3.2.4) stands for Light Dependent Resistor. It has a variable resistance that changes with the light intensity that falls upon it. With the help of these sensors we can detect a gloomy day and turn on lights automatically as needed.

5. Temperature Sensor: Temperature sensors (Fig.3.2.5) can be used to detect the chillness in a room in order to automate fan or AC settings.

6. Webcam: It is used for real-time video for surveillance as shown in (Fig.3.2.6).

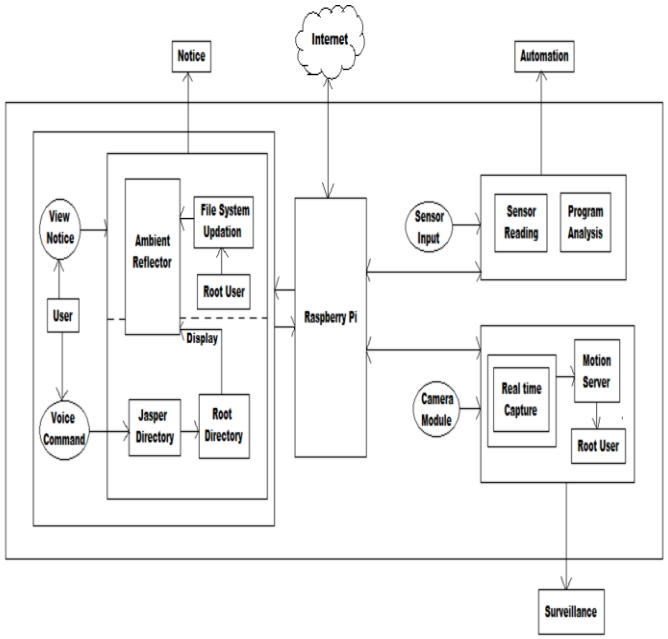


Fig. 3.1. Functional Architecture of Ambient Reflector

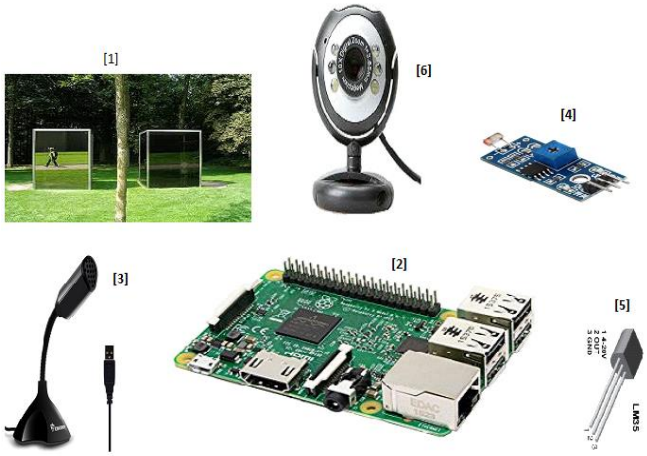


Fig. 3.2 Components of Ambient Reflector

Raspbian: Raspbian is a Debian-based computer operating system for Raspberry Pi.It is the primary operating system for the family of Raspberry Pi single-board computers.It is free and easy to use.

Python: Python is an interpreted high-level programming language. It has a lot of pre-built libraries. It is one of the easiest and highly efficient programming languages. Python Tkinter is used to provide the frame layout to the system.

4. SYSTEM DESIGN AND WORKING

This system uses IoT Technology to achieve an efficient, smart notice board system. IoT Technology is preferred here because it is the easiest and simplest way to establish communication between systems, with the help of Internet. Here, Ambient Reflector acts as an interface between the user and the system. This reflector is basically a two-way reflective surface which acts both as a mirror and as an interface to display the notices. Hence this mirror is referred to as Smart Mirror. An LCD screen is placed behind this smart mirror. When the LCD screen is switched off, the reflector acts like a normal mirror and when it is switched on, the mirror becomes smart (i.e.) it performs the function of both traditional mirror and as an output peripheral. Thus this system can replace all traditional mirrors by smart mirrors, which not only functions primarily as a mirror, but also as an interface to display valuable information.

The input to this smart mirror is given by voice command. This input is processed and required actions are performed. The processor used here is Raspberry Pi 3 Model B which is a credit-card sized computer. Apart from being a smart notice board it has some additional features such as a surveillance and automation of the surroundings. Webcams are used for surveillance and sensors are used to detect light and temperature which are used in automation.

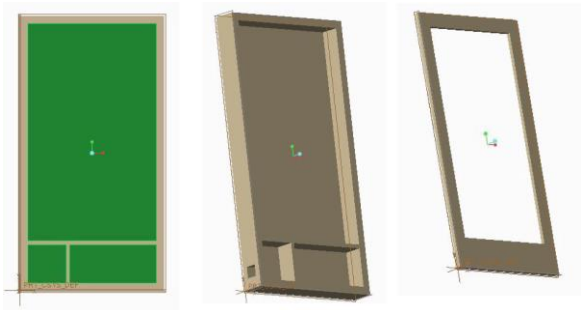
4.1 Hardware Design:

The system is designed as an embedded system which has four parts. The hardware designing is required in 2 main stages:

1. To prepare an framework for the Ambient Reflector
2. Integrating the Camera module with the Raspberry Pi
3. Connecting sensors involved in the system.

The hardware design of each part is as follows:

(Fig.4.1.1a) illustrates the front view of the box. There are three compartments: one for the monitor, one for the controller board, and one for fixing the power cables.



(a) Front view (b) 3D model (c) Front cover

Fig. 4.1.1 Ambient Reflector box model-Framework

A 3D model of the box is given in (Fig.4.1.1b). In addition to the three compartments, one can also see an opening on one side of the box. This opening will allow access to the controller boards USB ports. (Fig.4.1.1c) represents the front cover of the box. Once all components are placed inside, the box will be sealed with this cover and thus keeping everything inside of the box in one place.

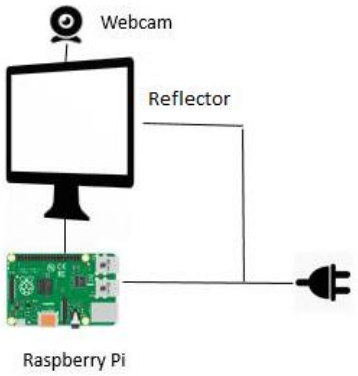


Fig. 4.1.2 Integration of Camera Module with Hardware

In the (Fig.4.1.2), the user needs to install the camera, the user requires a webcam that must be connected with the system through Wi-Fi. It is installed at one of the USB port openings of the Raspberry pi.

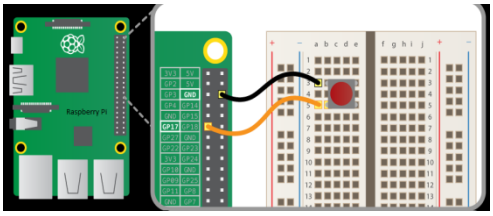


Fig.4.1.3. Connection of sensors and nodes with Hardware

GPIO stands for General Purpose Input Output. Raspberry pi has 40 pins, (Fig. 4.1.3), It's the procedure by which Pi can control and monitor the outside world by being connected to electronic circuits. The Pi is able to control LEDs, turning them on or off, or motors, or many other things. It is also able to detect whether a switch is pressed, or temperature, or light.

4.2. Software Design:

The user of this system (Fig.4.2.1) communicates with the Ambient Reflector through voice commands. If the command is recognized by the system, it performs the required action, else prompts the user for a valid command. These actions include displaying a particular notice, turning on and off the smart mirror, etc. Root User is the only user who has access to update or post new notices in the File System. All the notices in the File System will be displayed on the Ambient Reflector. Updating of these notices can be done anywhere within the network by the use of ip address.

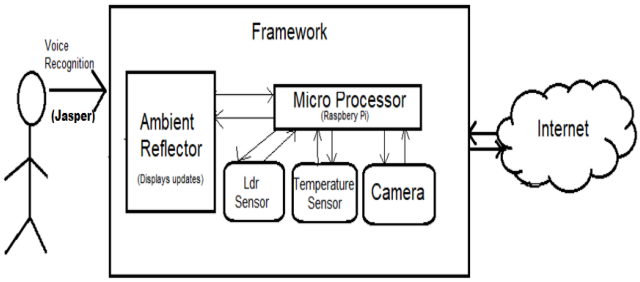


Fig. 4.2.1 Software Design of Ambient Reflector

The system is developed by Raspberry pi- single board connectivity with internet connectivity. It also comprises of sensor modules, camera modules for additional requirements of the system. The camera module have the ability to monitor the surroundings thereby seeking surveillance. Webcam and sensors are integrated with the system for surveillance and automation of the surroundings which act as additional features to the system. Motion Server software enables capturing of real-time data through the webcam. Similarly Jasper software enables Voice Recognition. The results of sensors are used in automation, to turn on and turn off lights and fans in the ambience.

5. RESULTS OF IMPLEMENTATION AND PERFORMANCE ANALYSIS

5.1 Module 1:

This module is specifically designed to allow the user to give voice command to get the information what they needed to view. The users can view the notice in the Ambient reflector. Here, the root user updates the relevant information to the file system. The file system receives the data from the root user and sent to the Ambient reflector which will be displayed as a notice to the users.

Table 5. 1.Performance Analysis of Module 1

TEST CASE	TEST INPUT	EXPECTED RESULT	ACTUAL RESULT
Root user to connect with the Raspberry Pi	The user is requested to login with the user id and the password.	WiFi gets enabled and the root user logs into the Raspian OS	User logs in first and then only gets connected with the WiFi.
Root User updates the notice in the configuration file of the Ambient Reflection.	The circular that needs to be displayed on to the notice board must be specified.	Displays the results immediately on the reflector.	The root user needs to save the configuration file and refresh the module once again.

5.2 Module 2:

This phase consists of camera module which seeks surveillance of the locality. This module is connected to the raspberry pi which acts as a interface between the root user and the camera module. Here, the Motion server is the software is used to access the camera module. Initially the root user should enter the ip address in the raspberry pi to view surveillance. The raspberry pi uses the Motion server software to seeking surveillance which requests for the relevant data from the camera module. Then the data obtained in the camera is transferred to the raspberry pi. Finally the data will be delivered to the root user which enables to view the live video of the surroundings. The main process of this module is to provide surveillance footage as and when the root user seeks.

Table 5.2.Performance Analysis of Module 2

TEST CASE	TEST INPUT	EXPECTED RESULT	ACTUAL RESULT
To download the motion software in the OS.	Commands required to start the motion streaming.	Should start the webcam.	Shows error message to configure the daemon and port number.
To view the live streaming.	To enter the IP Address and the port number of the pi.	Displays the live streaming of surroundings.	Doesn't display the streaming. Should be connected to the same network.

5.3 Module 3:

To automate the surroundings of our locality. This module consists of two types of sensors: LDR(Light dependent resistor sensor) sensor and Temperature sensor. LDR(Light dependent resistor sensor) is a component that has a (variable) resistance that changes with light intensity that falls upon it. This allows them to be used in light sensing circuits. Temperature sensor is a device which is designed specifically to measure the hotness or coldness of an object.

Table 5.3.Performance Analysis of Module 3

TEST CASE	TEST INPUT	EXPECTED RESULT	ACTUAL RESULT
To fetch input from Ldr sensor to detect the surrounding lighting condition.	Details from Ldr sensor.	Analyse the surrounding conditions and switch on/off the light correspondingly.	Light is switched on/ off.
To fetch input from the temperature sensor to know temperature of the ambience.	Details from temperature sensor.	Analyse the temperature to modulate the settings of fan, light, AC, etc.	Speed of fan, Ac, etc. are modulated and light is switched on/ off.

Fig. 7. Results of the modules involved in Ambient Reflector

5.4 Module 4:

The user should give the voice input to the system. Then the input is processed by using the jasper software. Finally, if the given command has matched then the desired content will be displayed on the ambient reflector as a notice.

Table 5.4.Performance Analysis of Module 4

TEST CASE	TEST INPUT	EXPECTED RESULT	ACTUAL RESULT
To fetch valid input from the user to perform useful actions.	Voice command from user.	Performs the required action.	May not recognize and interpret it wrongly.

6. CONCLUSION AND FUTURE WORK

This system aims to design a smart and efficient notice board system. It overcomes the issues of bulletin pin notice boards in terms of efficient space utilization, immediate updations,

eco-friendly design, less manpower and control over the display of notices thus avoiding misinformation from being displayed on the screen. It also overcomes the issues in scrolling text notice boards, where we need to wait for an information to scroll by, in order to read the desired content. It also has other additional features such as surveillance and automation of the surroundings which can be most appropriate in conference rooms, cabinets, etc. It can be enhanced by integrating it with RFID modules and a microcontroller to increase its functionality.

7. REFERENCES

[1] Belma Ramic-Brkic ,Sadeta Kulovic, (2018), "Diy Smart Mirror", Springer International Publishing ,2018.

[2] Adesh Kumar, Anita Gehlot, Mohit Suyal, Nikhil, Rajesh Singh, Vivek Kaundal, (2017), "Microcontroller And Fpga-Based Analysis Of 8 48 Led Matrix Display With Keyboard Interface",Springer Publication,2017.

[3] Alexander Nikic Frank Honold,Daniel Besserer, Felix Schüssel , Johannes Bäurle, Michaelweber (2016), "Fitmirror: A Smart Mirror For Positive Affect In Everyday User Morning Routines", Acm Publication , November 2016.

[4] Kamaruzzaman Jahidin , Muhammad Mu'izzudeen Yusri , Mohammad Syafwan Arshad, Rohayanti Hassan , Shahreen Kasim , Zubaile Abdullah Husni Ruslai (2017),"Smart Mirror For Smart Life", Ieee Publication,March 2017.

[5] Antonio Guerrieri, Andrea Vinci,Franco Cicirelli, Giancarlo Fortino , Giandomenico Spezzano,(2016),"Metamodeling Of Smart Environments: From Design To Implementation", Advanced Engineering Informatics , Elsevier Publication , 2016.

[6] C.Kormanyos,(2015)," Working With A Real-Time C++ Program On A Board",Springer Publication,2015.

[7] Aniket Pramanik, Biplav Choudhury, Rishikesh , Vikash Nagar, Satyam Dwivedi, (2016)," Gsm Based Smart Home And Digital Notice Board", International Conference On Computational Techniques In Information And Communication Technologies (Icctict) , 2016.

[8] Sruthy S, Sudhish N George,(2017)," Wifi Enabled Home Security Surveillance System Using Raspberry Pi And Iot Module", Ieee Spices 2017.

[9] Danila Germanese, Daniela Giorgi, Giuseppe Coppini, Giovanni Raccichini, Massimo Magrini,Massimo Martinelli, Maria Aurora Morales, Maria Antonietta Pascali, Marco Righi, Ovidio Salvetti, Paolo Marraccini, Sara Colantonio, (2015)," A Smart Mirror To Promote A Healthy Lifestyle", Published By Elsevier,2015.

[10] Diego Casado-Mansilla ,Oihane Gomez-Carmona (2016)," Smiwork: An Interactive Smart Mirror Platform For Workplace Health Promotion",Ieee Publication,2016.

[11] Maninder Jeet Kaur, Piyush Maheshwari, Sarthak Anand, (May 2017) "Smart Mirror:A Reflective Interface To Maximize Producticity", International Journal Of Computer Apllications,2017.

[12] Jagdish Pimple, Rahul Fating, Shubhangi Borkar,(February 2017)," An Implementation Of Smart Notice Announcement System On Linux Platform With Raspberry Pi: A Review" , International Journal On Recent And Innovation Trends In Computing And Communication, Volume: 5 Issue: 2,2017.

[13] M.Sathishkumar , M.Sasikumar, (Jan - Jun 2017)," Gsm Based Digital Notice Board Using Microcontroller", Nehru E- Journal, Vol 4 Issue 2,2017.

[14] Dhruv Nair, Preeti Pannu, Vaibhav Khanna, Yash Vardhan,(January,2017)," Design And Development Of A Smart Mirror Using Raspberry Pi", International Journal Of Electrical, Electronics And Data Communication, Volume-5, Issue-1,2017.

[15] Jane Jose, Jait Jacob , Mir Masood Ali, Raghav Chakravarthy, Sonia Maria D'souza,(February 2017)," Home Automated Smart Mirror As An Internet Of Things (Iot) Implementation - Survey Paper", International Journal Of Advanced Research In Computer And Communication Engineering, Vol. 6, Issue 2, 2017.

[16] Adesh Kumar, Anita Gehlot, Mohit Suyal, Nikhil, Rajesh Singh, Vivek Kaundal, (2017), "Microcontroller And Fpga-Based Analysis Of 8 48 Led Matrix Display With Keyboard Interface",Springer Publication,2017.

[17] Narasimha Rao Vajjhala, Salu George Thandekkattu,(May 2017)," Smart Mirror-Network Architecture Based On Iot And Cloud Computing Technology", International Conference 2017 Technology, Innovation And Industrial Management.

[18] Chidambaram Sethukkarasi, Raja Pitchiah, Vijayadharan Suseela Kumari Harikrishnan, (2012)," Design And Development Of Interactive Mirror For Aware Home", The First International Conference On Smart Systems, Devices And Technologies,2012.

[19] D.K. Mittal , R. Rastogi, V. Verma,(December 2017), "A Comparative Study And New Model For Smart Mirror", International Journal Of Scientific Research In Computer Science And Engineering Vol.5, Issue.6, Pp.58-61, 2017.