Smart Magical Mirror to Exhibit Programme for User through Image Processing

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Abstract

Smart mirror, which continues to grow vastly, plays an important role in the future technology, providing both the functionalities of a mirror and the smart features that come with it to the users. The impact of such emerging technology would completely change the lives of the people on a day-to-day basis. In recent years everything is turning smart, such as smart home and smart cities. The smart mirror is one such device where a normal mirror acts as a smart device. This mirror represents a very graceful interface for glancing the information and can also be used for intrusion detection in a homely environment. It has different modes namely the regular mode where the mirror will act as a normal mirror and the smart mode where the mirror accepts external commands and displays relevant results. We exploit a deep learning technique to develop most of the smart functionalities. The effectiveness of the device is demonstrated by the performances of the implemented functionalities, and the evaluation in terms of its usability with real users

Index Terms: Magical Mirror, Embedded system, MATLAB, Arduino, Image Processing.

1. Introduction

Smart mirrors are straight from science fiction. They are part of an optimistic vision of the future that imagines a world where screens and data are everywhere, ready to feed you whatever information you need at a moment's notice. Basically, the mirror is looks like normal mirror but when someone stands in front of it the scene changes. The mirror provides a functional, user friendly and interactive UI to its user for accessing their social sites, messengers, etc. It has widgets for displaying the current weather conditions, Time, Events, Latest news headlines. The Smart Mirror would help in developing smart houses with embedded artificial intelligence, as well as finding its applications in industries. Switching home appliances becomes easy with mirror. Virtual dressings, a smart way of having trials with your fashion sense make things quite easy in malls. Having such intellectual mirror will only surge the beauty of home. Day after day we are moving towards a more automated and interconnected world because of various wirelessly connected embedded devices. These are responsible for changing and improving the standards and quality of living. Many devices are being developed which use concepts of multimedia communication, artificial intelligence, internet of things (IoT) to revolutionizing the way we perform our various day to day tasks in our home, offices or even industries.

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Most of us use mirrors every day to look at ourselves; we psychologically interact with the mirror every day to check how we look and how our attire is while getting ready for our work or colleges. So, the idea of having an interactive mirror that can respond to your commands can excite anyone. Magic Mirror aims at augmenting the basic reflective mirror with embedded intelligence to combine daily routine tasks like reading newspaper, getting stock updates, weather updates etc. and providing all that data to the user while he/she gets ready. The Magic mirror will help in automating our work and development of smart houses. This paper provides a detailed idea of theory of design and practical implementation of Magic Mirror. With the advancement of technology, most of things which we are using in our day-to-day life are automated. Few examples are smart phone, cars, cities and homes. Home automation system is required to monitor the essential things that include temperature, power, closing and opening of doors/windows, turning on and off the light and fan and water tank. This can be done from anywhere at any time through mobile. With the help of Internet of Things (IoT), multimedia and artificial intelligence essential services may personalize to manage the activities in a comfortable manner. IoT is an integrated technology consisting of wireless sensors and Internet. Smart mirror offers weather, news update, local date and time. In future smart mirrors are enabled with security performs to manage the payment of electricity bills, phone bills, insurance policy details and daily appointments. Smart mirror may be implemented by using raspberry pi and data from the internet.

2. Methods

2.1 MATLAB

MATLAB (matrix laboratory) is a numerical computing environment and fourth-generation programming language. Developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, and Fortran. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MUPAD symbolic engine, allowing access to symbolic computing capabilities. An additional package, Simulink, adds graphical multi-domain simulation and Model-Based Design for dynamic and embedded systems. In 2004, MATLAB had around one million users across industry and academia [2] MATLAB users come from various backgrounds of engineering, science, and economics.

2.2 Graphics and Graphical user Interface Programming

MATLAB supports developing applications with graphical user interface features. MATLAB includes GUIDE (GUI development environment) for graphically designing GUIs.[10] It also has tightly integrated graph-plotting features. For Example the function plot

can be used to produce a graph from two vectors x and y. The code x=0: pi/100:2*pi; y = sin(x); plot(x, y) produces the following figure of the sine function:
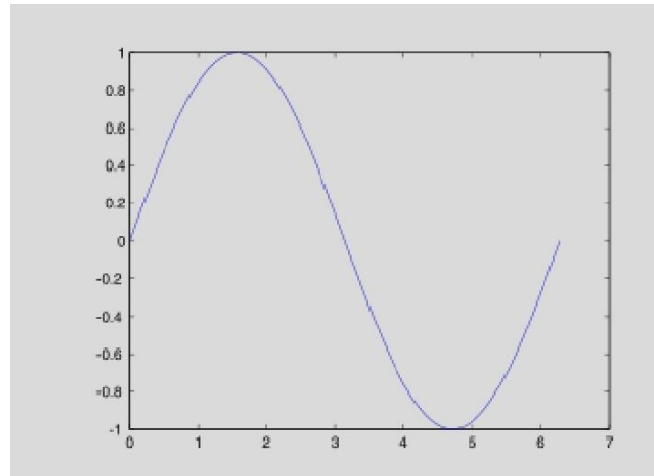
2.3 Embedded and Microcontroller

Embedded systems are controllers with on chip control. They consist of microcontrollers, input and output devices, memories etc., on chip and they can be used for a specific application. A small computer designed in a single chip is called a single chip microcomputer. A single chip microcomputer typically includes a microprocessor RAM, ROM, timer, interrupt and peripheral controller in a single chip. This single chip microcomputer is also called as microcontroller; These Microcontrollers are used for variety of applications where it replaces the computer. The usage of this microcomputer for a specific application, in which the microcontrollers a part of application, is called embedded systems. Embedded systems are used for real time applications with high reliability, accuracy and precision, Embedded systems are operated with Real Time Operating systems like WinCE, RT Linux, VxWorks, PSOS, etc..

2.4 Role of Embedded Systems

Embedded systems are compact, smart, efficient, and economical and user friendly, they are closed systems and respond to the real-world situation very fast, closed system means, everything required for a specific application is embedded on the chip and hence, they do not call for external requirement for their functioning. Segments of Embedded Systems.

2.4.1 Debugger

It is a software tool used to debug the programs. A debugger detects the non-workability of the program by detecting the errors online (i.e. while the program is running in the target it has the capability to detect proper functioning of the application program)

2.4.2 Cross-Compiler

Cross-compiler is a software program, which is used to convert high –level language program like C to machine language of a specific Microcontroller, using cross-compiler user can write programs in C language, which speeds up the development process.

2.4.3 Simulator

Simulator is software, which implements the features of a specific Microcontroller on PC. It helps in testing and debugging the programs and interfaces that are to be actually implemented on a Microcontroller at a later stage. Using simulator, the program can be executed and tested without using the evaluation kit, usually the program is simulated under pc environment.

2.4.4 Emulator

Emulator is an in-circuit Microcontroller emulation probe, which provides the user with substantial control over all of the Microcontroller functions and responsibilities. It provides hardware assistance for debugging the most difficult real time problems. Emulators offer visibility into system initialization, before software-based debuggers can function, Emulators can identify the code corrupting a data structure, it can also be used to determine how often a particular function is invoked,

2.5 Relays

Relays are electrically controlled switches. In the usual type, a coil pulls in an armature when sufficient coil current flows. Many varieties are available including "latching" and "stepping" relays; the later provided the cornerstone for telephone switching stations, and they're still popular in pinball machines. Relays are available for dc or ac excitation, and coil voltages from 5 volts up to 110 volts are common. "Mercury-wetted" are "reed" relays are intended for high-speed (~ 1ms) applications, and giant relays intended to switch thousands of amps are used by power companies. Many previous relay applications are now handled with Transistor or FET switches, and devices known, as solid-state relays are now available to handle ac switching applications. The primary uses of relays are in Remote switching and high-voltage (or high-current) switching. Because it is important to keep electronic circuits electrically isolated from the ac power line, relays are useful to switch ac power while keeping the control signals electrically isolated. The electrical relay offers a simple on / off switching action in response to a control signal. When a current flows through the coil of wire a magnetic field is produced. This pulls a movable arm, the armature, that forces the contacts to open are close; usually there are two sets of contacts with one being opened and the other closed by the action. This perhaps an electric heater in a temperature controls.

2.6 Standard Serial Interface

The serial port is full duplex, meaning it can transmit and receives simultaneously. It is also receive-buffered, meaning it can commence reception of a second byte before a

previously received byte has been read from the register. (However, if the first byte still hasn't been read by the time reception of the second byte is complete, one of the bytes will be lost.) The serial port Receive and transmit registers are both accessed at Special Function Register SBUF. Writing to SBUF loads the transmit register, and reading SBUF accesses a physically separate receive register.

2.7 RS-232C

RS-232 stands for Recommend Standard number 232 and C is the latest revision of the standard. The serial ports on most computers use a subset of the RS-232C standard. The full RS-232C standard specifies a 25-pin "D" connector of which 22 pins are used. Most of these pins are not needed for normal PC communications, and indeed, most new PCs are equipped with male D type connectors having only 9 pins

2.8 MAX-232 Serial Port Interface
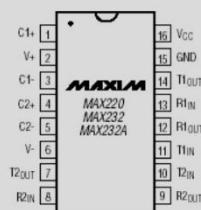

MAX 232- SERIAL PORT INTERFACE
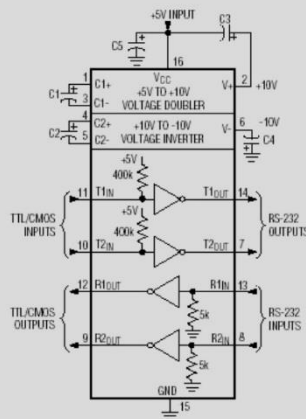
FIG.11 PINOUT DIAGRAM OF MAX232

FIG.12 FUNCTIONAL DIAGRAM OF MAX232

2.9 Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

2.10 Summary

- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage
- (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA
- Flash Memory 32 KB (ATmega328) of which 0.5 KB used by bootloader
- SRAM 2 KB (ATmega328)
- EEPROM 1 KB (ATmega328)
- Clock Speed 16 MHz

2.11 Power

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Ground and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

3. Results and Discussions

3.1 Opening MATLAB in the Microcomputer Lab

- Access the Start Menu, Proceed to Programs, Select MATLAB 6.5 from the MATLAB 6.5 folder --OR—
- Open through C:\MATLAB6p5\bin\win32\matlab.exe

3.2 MATLAB

- When MATLAB opens, the screen should look something like what is pictured.
- The Command Window is the window on the right -hand side of the screen.

- This window is used to both enter commands for MATLAB to execute, and to view the results of these commands.
- The Command History window, in the lower left side of the screen, displays the commands that have been recently entered into the Command Window.
- In the upper left -hand side of the screen there is a window that can contain three different windows with tabs to select between them. The first window is the Current Directory, which tells the user which M-files are currently in use. The second window is the Workspace window, which displays which variables are currently being used and how big they are. The third window is the Launch Pad window, which is especially important since it contains easy access to the available toolboxes, of which, Image Processing is one. If these three windows do not all appear as tabs below the window space, simply go to View and select the ones you want to appear.

- In order to gain some familiarity with the Command Window, try Example 2.1, below. You must type code after the >> prompt and press return to receive a new prompt. If you write code that you do not want to reappear in the MATLAB Command Window, you must place a semi colon after the line of code. If there is no semi colon, then the code will print in the command win

3.3 The M-file

- M-file – An M-file is a MATLAB document the user creates to store the code they write for their specific application. Creating an M-file is highly recommended, although not entirely necessary. An M-file is useful because it saves the code the user has written for their application.
- Create an M-file and saving the M-file, then open the saved M-file and start to write the code. After writing the code resaves it and run the code.

3.4 Images

The first step in MATLAB image processing is to understand that a digital image is composed of a two or three -dimensional matrix of pixels Individual pixels contain a number or numbers representing what grayscale or colour value is assigned to it. Then load an image and write the images.

3.5 Image Properties

- Histogram – A histogram is bar graph that shows a distribution of data. In image processing histograms are used to show how many of each pixel value are present in an image.
- Negative – The negative of an image means the output image is the reversal of the input image. In the case of an 8-bit image, the pixels with a value of 0 take on a new value of 255, while the pixels with a value of 255 take on a new value of 0.

3.6 Frequency Domain

- Fourier Transform – In order to understand how different image processing filters work, it is a good idea to begin by understanding what frequency has to do with images. An image is in essence a two -dimensional collection of discrete signals.

- Convolution – Convolution is a linear filtering method commonly used in image processing. Convolution is the algebraic process of multiplying two polynomials. An image is an array of polynomials whose pixel values represent the coefficients of the polynomials. Together to produce a new image through the process of multiplying two polynomials. An image is an array of polynomials whose pixel values represent the coefficients of the polynomials.
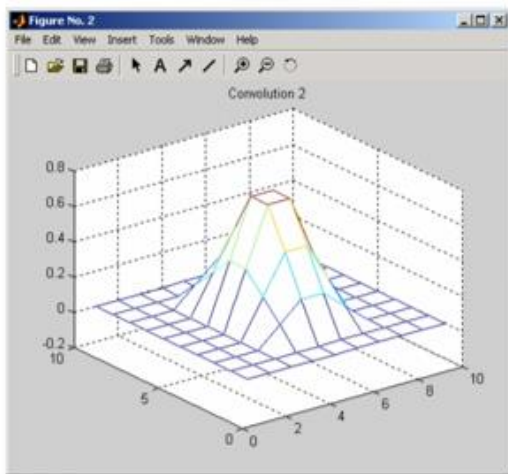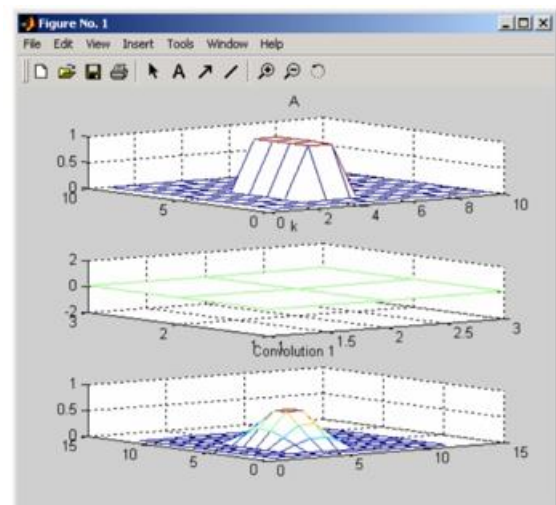

Figure 6.8: Convolution Using ifft2(fft2(A).*fft2(k))

Figure 6.7: Convolution using conv2(A,k)

3.7. Filters

- Filters – Image processing is based on filtering the content of images. Filtering is used to modify an image in some way. This could entail blurring, deblurring, locating certain features within an image, etc...

- Low Pass Filters – The first filters we will talk about are low pass filters. These filters blur high frequency areas of images. This can sometimes be useful when attempting to remove unwanted noise from an image.

- Median Filters – Median Filters can be very useful for removing noise from images. A median filter is like an averaging filter in some ways. The averaging filter examines the pixel in question and its neighbour's pixel values and returns the mean of these pixel values.

- Erosion and Dilation – Erosion and Dilation are similar operations to median filtering in that they both are neighbourhood operations. The erosion operation examines the value of a pixel and its neighbours and sets the output value equal to the minimum of the input pixel values. Dilation, on the other hand, examines the same pixels and outputs the maximum of these pixels.

- Edge Detectors – Edge detectors are very useful for locating objects within images. There are many different kinds of edge detectors, but we will concentrate on two: the Sobel edge detector and the Canny edge detector.
- Segmentation – Segmentation is the process of fractioning an image into its component objects. This can be accomplished in various ways in MATLAB. One way is to use a combination of morphological operations to segment touching objects within an image.

4. Conclusion

The smart mirror provides a great ambient environment between users and the internet. This will help the users in their daily life activities. The smart mirror can also be used is various industrial and home appliances. The facial recognition technology can be used in the smart mirror to act as an important means for security purpose. With this smart mirror, users can plan their activities more effectively. Applications of the smart mirror are limited to the presently available supporting technologies that can be integrated to support required functionality. With the future advancement in supporting technologies, sophisticated applications from smart mirror can be expected.

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