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Recall The Past: An Interactive Visual Story Telling Simulation Of Deterioration Of Semantic Memory In Alzheimer Disease
Paper, Artworks

Topic: Art

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Abstract:

This paper is about to make awareness to Alzheimer disease. In this study a hardware and software system was designed for interactivity with people. This system has an ultrasonic range finder for human detection, a web camera for image acquisition, main control board for communication between hardware and software, motor driven circuit, three servo motor for mini mechanical drawing arm, stylus touch screen pen and a cell phone. When system detects a person in front of kiosk by using ultrasonic range finder, it snapshot's a photo of cell phone screen with webcam. Images coming from the camera processed by Matlab in order to detect if they are colored or not. By serial communication, main control board (Arduino) was triggered according to image processing results and mechanical arm stars doodling on mobile phones screen via touch pen. This interactive cycle simulates the "recall the past" symptom of Alzheimer disease.

In the early stages of Alzheimer, most of the family member may not instantly aware the problem. In the early stages of this symptom, patients start to forget the recent events. They forget the names, dates, places and so on. In a conversation they remember the past as if they are living in that time because they concatenate the daily events, with childhood. At the end patients forget eating, drinking and breathing. Regression of their brain doesn't stops, until they are death…

Both of us lost our grandparents because of that disease. So we want to raise awareness for their memories in this study, for that reason a system was developed for a visual simulation of the deterioration of semantic memory in Alzheimer disease. One of the signs of this disease "recall the past" event wished to be demonstrated. Simple hardware setup, image processing and other programming languages are used for an interactive visual story telling system.

Keywords: Interactive Visual Story Telling, Color Detection, MATLAB, Arduino, Webcam, App Inventor, Alzheimer Simulation

Recall The Past: An Interactive Visual Story Telling Simulation Of Deterioration Of Semantic Memory In Alzheimer Disease

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This paper is about to make awareness to Alzheimer disease. In this study a hardware and software system was designed for interactivity with people. This system has an ultrasonic range finder for human detection, a web camera for image acquisition, main control board for communication between hardware and software, motor driven circuit, three servo motor for mini mechanical drawing arm, stylus touch screen pen and a cell phone. When system detects a person in front of kiosk by using ultrasonic range finder, it snapshot's a photo of cell phone screen with webcam. Images coming from the camera processed by Matlab in order to detect if they are colored or not. By serial communication, main control board (Arduino) was triggered according to image processing results and mechanical arm stars doodling on mobile phones screen via touch pen. This interactive cycle simulates the "recall the past" symptom of Alzheimer disease.

Keywords: Interactive Visual Story Telling · Color Detection · MATLAB · Arduino · Webcam · App Inventor · Alzheimer Simulation

1 Introduction

In the early stages of Alzheimer, most of the family member may not instantly aware the problem. In the early stages of this symptom, patients start to forget the recent events. They forget the names, dates, places and so on. In a conversation they remember the past as if they are living in that time because they concatenate the daily events, with childhood. At the end patients forget eating, drinking and breathing. Regression of their brain doesn't stops, until they are death…

Both my wife and me lost our grandparents because of that disease. So we want to raise awareness for their memories in this study, for that reason a system was developed for a visual simulation of the deterioration of semantic memory in Alzheimer disease. One of the signs of this disease "recall the past" event wished to be demonstrated. Simple hardware setup, image processing and other programming languages are used for an interactive visual story telling system.

2 Background

Our grandmothers died after living with Alzheimer for many years. One of them was born in 1927. She grew up as an intellectual woman. She has given education to many young girls and boys, including her three children, for being a tailor until she got ill. After eighty years of her life, she began to forget daily events, especially the new memories.

The other one was born in 1908 and migrated to another country with her family at her early ages. After graduating from most popular and successful schools, she decided to be a sculptor. A prosperous life with three children paused because of forgetting daily events, especially the relatively new things.

However both of them could tell their childhood memories perfectly, they started to ask the same questions again and again about any fresh experiences towards the end of their lives.

We try to tell this story by associating the past memories with black & white photographs and the daily ones with colored. This system is programmed to respond when a color photograph encountered which means "brain can't remember the event".

3 Hardware, Software and Mechanical Parts Of The System

Hardware and software components of the system are as follows.

3.1 Hardware

As shown on Fig.1, for image acquisition hardware Logitech model webcam is used to simulate patient's eye. Asus Zenfone6 (Fig. 2.) screen is used for visualizing the memories on patient's mind.

Fig. 6.

Logitech HD Webcam C310

Fig. 7.

Zenfone6

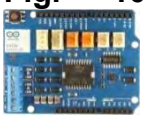
Fig. 8.

Arduino Uno

Fig. 9.

Micro Servo

Fig. 10.



Motor Shield

Fig. 6.

HC-SR04

3.2 Boards & Shields of the system

As shown on Fig.3-6 Arduino Uno R3, Motor Shield for Arduino Uno, HC-SR04 ultrasonic range finder, micro and normal servomotors are used for brain reactions and other communications between hardware and software. Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer (e.g. Flash, Processing, MaxMSP.)[1] The Arduino Uno R3 is a microcontroller board based on the ATmega328 . 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 an AC-to-DC adapter or battery to get started. [2] The Arduino Motor Shield is based on the L298, which is a dual full-bridge driver, designed to drive inductive loads such as relays, solenoids, DC and stepping motors. It lets you drive two DC motors with your Arduino board, controlling the speed and direction of each one independently. You can also measure the motor current absorption of each motor, among other features. [3] The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats or dolphins do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package, from 2cm to 400 cm or 1” to 13 feet. It operation is not affected by sunlight or black material like Sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect). It comes complete with ultrasonic transmitter and receiver module. Test dist. = (high level time×velocity of sound (340M/S) / 2. [4]

3.3 Mobile

To characterize brain activities, “Alzheimer” named application has been developed for android operating system. This app shows the images on the screen randomly. By touch pen, doodling can be done over loaded image by mechanical arm as in Fig 2-a,b,c. This application was developed with MIT App Inventor.

Fig. 7. App Inventor - Blocks Screen

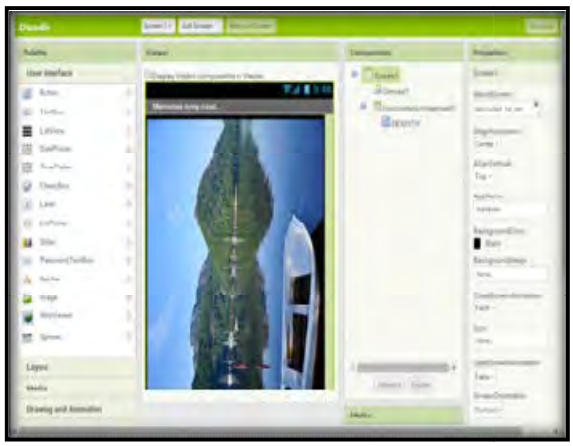


Fig. 8. App Inventor- Designer Screen

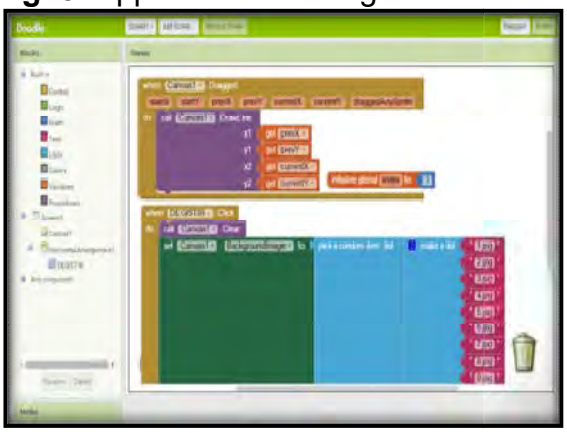


Fig.9. Alzheimer App - Doodling by mechanic arm

MIT App Inventor is a blocks-based programming tool that allows everyone, even novices, to start programming and build full functional apps for Android devices. Newcomers to App Inventor can have their first app up and running in an hour or less, and can program more complex apps in significantly less time than with more traditional, text-based languages. Google's Mark Friedman and MIT Professor Hal Abelson co-led the development of App Inventor while Hal was on sabbatical at Google. Other early Google engineer contributors were Sharon Perl, Liz Looney, and Ellen Spertus. App Inventor runs as a Web service administered by staff at MIT's Center for Mobile Learning - a collaboration of MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) and the MIT Media Lab. MIT App Inventor supports a worldwide community of nearly 3 million users representing 195 countries worldwide. The tool's more than 100 thousand active weekly users have built more

than 7 million android apps. An open-source tool that seeks to make both programming and app creation accessible to a wide range of audiences, MIT App Inventor has grabbed the attention of: Formal and informal educators, Government and civic employees, Researchers, Hobbyists & Entrepreneurs. [5]

3.4 Matlab

Matlab code has been written for real time computer vision to simulate the recalling event. Using the theory of image acquisition and fundamentals of digital image processing, images on phone screen has been detected and categorized in real time. Because of captured images from webcam are all in RGB space, we need to separate the gray ones from colored by image processing techniques. [6] For communication between image processing result and the rest of the hardware, serial programming has been developed with Matlab.

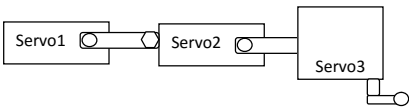
3.5 Arduino

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the processing multimedia programming environment. [7] To trigger the servomotors of the system for interaction, ultrasonic range finder is used and programmed in Arduino programming IDE. By the way, simulation of brain neurons and its reactions to “lost memories” may be showed.

3.6 Mechanical Design Of The Arm

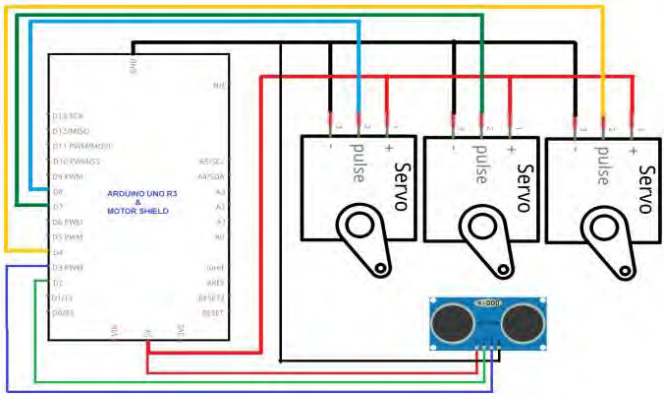
For drawing random doodles on phone screen normal and micro servos was connected to each other as figured in Fig.3 Their negative poles was grounded and +5V connected to positive poles.

Fig. 10. Mechanical diagram of arm



In this study images stands for “the memories remaining on patients mind”. Some images are gray colored, which means that this memory belongs to childhood. The colored images stand for the near past, like daily events. Over 100 images were photographed by Nikon D90 and resized to 380x275 pixels for best fit on phone’s screen. For memory efficiency all images copied to SD card of the phone.

Fig. 11. Circuit diagram of the system



4 How System Works

When system is turned on, Matlab starts listening the serial port of computer and also ultrasonic range finder, which is connected to Arduino, starts measuring the distance of the empty space in front of the kiosk. Normally this ultrasonic range finder can measure up to 4 meters away. When a person comes and stands maximum 50 cm away from the kiosk, a time counter starts incrementing in Arduino program. If more than 5 seconds with a distance shorter or equal to 50cm is calculated, system regards as “somebody is standing”. Then Arduino card sends “human detected” signal to Matlab via USB cable. When serial data is available, Matlab triggers the camera for snapshot that was focused to the screen of the phone before. As described above, phone screen is brain of the patient and the photos shown on the device is the recorded daily or childhood memories of him. The captured image processed by Matlab with image processing algorithms. The color detection algorithm [6] says that if all the RGB values of a pixel are same with each other, then this image is said to be in gray color mode. Because of the lightning and shading over phone screen we need to do some tricky steps over processing results.

```
1   vid = videoinput('winvideo', 1,'RGB24_640x480');
2   img = getsnapshot(vid);
3   [h,w,d] = size(img);
4   Sum = 0;
5   Arr = zeros(1,w*h);
6   for w=1:480
7     for h=1:640
8       if (abs(img(w,h,1)-img(w,h,2)>=35) ||
9   abs(img(w,h,1)-img(w,h,3)>=35) ||
10  abs(img(w,h,2)-img(w,h,3))>=35 )
11            Sum = Sum +1 ;
12      end
13    end
14  end
15   if (Sum < 5000 )
16      % do nothing wait for the next image…
17   else
18      % send start doodling signal to
        % mechanical arm which is connected to
        % arduino!
19  end
```

As seen on Matlab script, absolute value of difference of RGB values is checked over the whole image that if they are greater than or equal to threshold value on lines 8,9 and 10. Decision for color or gray is also done to a threshold value as seen on line 15. If its colored image Sum will be more than 10000 according to chosen size of snapshot data as seen on line 1. Doodling is done with stylus pen over phone screen, which is connected to servo3. Mechanical arm’s servo angles are randomly selected within the range of the 6-inch screen size of the phone. Servo3 makes up and down movements like hand when doodling. When brain remembers the image (is gray) it does not doodle over it. This means this image belongs to childhood. If the image can’t be remembered (is colored), because of the deterioration of the semantic memory, it starts doodling over it.

5 Conclusion

Both hardware and software parts are included in this project. Communications between different platforms are the hardest part of this project especially in data transfer. Also in this project, as in the most of others, the detection and classification of local structures (i.e. edges, corners and T-junctions) in color images is important for many applications, such as image segmentation, image matching, object recognition and visual tracking in the fields of image processing and computer vision [8]. This project is still working by the authors. In the newest version of the hardware, human like entertainment robot is planning to be done for showing rather than telling. Showing rather than telling means to make the documentary primarily visual. You can establish location, relationships,

story transitions, and other elements visually, and reduce explanatory text or narration [9]. Short video of the system can be watched on authors' YouTube channel.

6 References

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