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IoT and ML Based Smart TV for Child Eyes Safety

Prof. Shubhangi R. Khade[1], Sushil Jagtap[2], Nitin Hirve[3], Tushar Pandhare[4], Bhavesh Patil[5]

[1]*Assistant Professor, Department of Computer Engineering, M. E. S College of Engineering Pune, India*
[2,3,4,5]*Student, Department of Computer Engineering, M. E. S College of Engineering Pune, India*

Abstract - *The most neglected issue that is of the child eyes safety while watching the television from a closer distance eventually causing degradation of the retina. Due to which most of the children get opted to spects in small age. So, our system which is a model based on the concepts of Internet of Things and Sensors can reduce the rate of retina degradation at some extent. If some critical distance is maintained from the television screen then it will reduce the rate of strain on eyes while watching television. The system is totally controlled by the Raspberry Pi 3 Model B/B+. The Sensors like proximity sensor, raspberry pi camera module with computer vision library are used for distance measuring and child detection respectively. This system if developed further can also be used for the child tracking using the camera and sensors.*

***Key Words*: Internet of Things, Raspberry Pi 3 Model B, Proximity Sensor, Proximity Sensor, Computer Vision, Camera Module**

1. INTRODUCTION

With the ever-increasing advancement in technology, it has brought the advantages to the user of the technology. But, with this, it has also brought many disadvantages causing harmful effects on the user of the technology.

The system proposed in this paper focuses on one similar harmful effects caused due to the radiations emitted from the TV screen. The backbone of the system is the Internet of Things. Due to advancement in the Internet of Things, it has become really easy to control the devices from remote location and automate the systems. Our systems target audience is the small children, as they watch the television from a quite closer distance, which eventually causes slow degradation of the seeing ability of the children.

The system is totally controlled by the Mini Computer i.e., Raspberry Pi 3 Model B/B+. The system consist of 3 modules: 1) Raspberry Pi 3 Model B/B+ interfaced with Ultrasonic sensor for measuring distance. 2) Camera Module of Raspberry Pi for Eyes and Face detection using the Haarcascade classifier. 3) Sending SMS to the mobile of parents using the GSM Module or bulk SMS's.

The safe distance for watching the television is around 2 to 3 meters from the television screen, so we are going to detect the distance using the ultrasonic sensor and also the camera is used for detecting the object i.e., children whether it is looking towards the television or any other area. If the system founds the critical distance crossed it will wait timer of 15 seconds to finish and then the Raspberry Pi will trigger the GSM Module or the Bulk SMS can be sent from the Raspberry Pi to the –parents of the children so they can decide whether to leave a message for their children or not. They will send the key to the GSM module which in turn will be checked by the Raspberry Pi and then the action will be taken depending on the response from the parents.

2. MOTIVATION

This paper gives an overview of a new system based on the Internet of Things. The small children getting specs in small age, though it is not a serious problem it should be acknowledged so that this rate can be reduced. This can also cause a problem like a retina degradation, strain in eyes, watery eyes. This problem, if not looked upon, can also cause serious problems. As such systems are not available in the market, it will be a helpful system for parents for looking on to their children when they are not home.

3. SYSTEM ARCHITECTURE

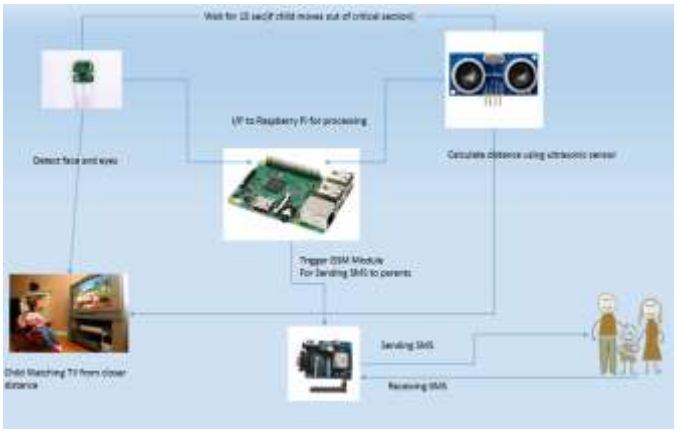

Fig -1: System Architecture

The Above System Architecture gives a rough idea of the system and the components comprising of the system. The main Components present in the system are:

1) Raspberry Pi 3 Model B/B+
2) Ultrasonic Sensor
3) Camera Module of Raspberry Pi
4) GSM Module/Bulk SMS's

4. COMPONENTS OF SYSTEM

1.1 Raspberry Pi 3 Model B/B+

Fig -2: Raspberry Pi 3 Model B

Following are the features of the Raspberry Pi 3 Model B:

- Quad Core 64 bit Processor with 1.2 GHz Processing Power
- 1 GB RAM
- Wireless LAN and Bluetooth Low Energy(BLE) on board
- 100 Base Ethernet
- 40-pin Extended GPIO
- 4 USB 2 Ports
- 4 Pole Stereo O/P and Composite Video Port
- Full Size HDMI
- CSI Camera Port for Connecting a Raspberry Pi Camera Module
- DSI Display Port for Connecting a Raspberry Pi Touchscreen Display
- Micro SD card for Loading Operating System and Storing Data
- Upgraded Switched Micro USB Power Source upto 2.5 A

2.2 Ultrasonic Sensor

Fig -3: Ultrasonic Sensor

Ultrasonic Sensor HC-SR04 is a simple sensor which emits Ultrasonic Radiations from its transmitter and is used for measuring the distance between sensor itself and any obstacle in front of it. The sensor has a transmitter and a receiver on it.

This sensor consists of four pins, which are:

- **Vcc (+5V)**: You need to provide +5V at this Ultrasonic Sensor HC-SR04 Pin.
- **Trig (Trigger)**: Its a trigger Pin where we need to provide a trigger after which this sensor emits ultrasonic waves.
- **Echo**: When Ultrasonic waves emitted y the transmitter, hit some object then they are bounced back and are received by the receiver and at that moment this echo Pin goes HIGH
- **GND**: We need to provide ground to this PIN of HC-SR04 Ultrasonic Sensor.

Trigger pin is an output pin while the Echo pin is an input pin. Moreover, it requires +5V to start operating. It is normally used to detect objects in front of it or to measure the distance between different objects.

2.3 Camera Module

Fig -3: Raspberry Pi Camera Module

Below given table gives the features of the Camera Module. The Camera module used in our setup is 5 MP camera, but it can be replaced with high quality camera for more accurate face and eye detection.

Resolution	**5 MP**
Lens Focus	**Fixed Focus**
Image Size	**2592×1944**
Interface Type	**CSI(Camera Serial Interface)**
Sensors	**Omni vision 5647 fixed-focus**

Table -1: Camera Features

5. INTERFACING COMPONENTS WITH RASPBERRY PI 3 MODEL B

1.1 Interfacing Ultrasonic Sensor with Raspberry Pi

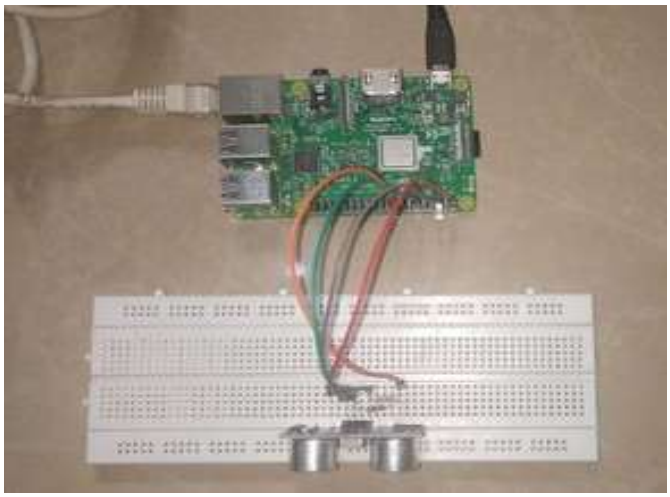

Fig -4: Interfacing Ultrasonic Sensor with Raspberry Pi

Ultrasonic Sensor is used for calculating distance from the children or object. The first module used in our system is interfacing Raspberry Pi with ultrasonic sensor. The Ultrasonic sensor gives accurate reading of distance up to 4 meters. The child when watching television screen from closer distance, the ultrasonic sensor send the reading to the Raspberry Pi. But the distance is not the only criteria for taking further action. The Camera module is also used in coordination with ultrasonic sensor inducing more accuracy to the system.

1.2 Interfacing Camera Module with Raspberry Pi

Fig -5: Interfacing Camera Module with Raspberry Pi

The camera module is used for face and eyes detection of the children watching television. The Haarcascade classifier is used for detecting eyes and face of the child watching television. The camera, using the Haarcascade classifier will draw the contour around the eyes and face which will be drawn only when the child is looking towards the screen.

6. ROLE OF COMPUTER VISION (OPENCV)

1.1 Face and Eyes Detection using Haarcascade Classifier

Haar feature-based cascade classifier: This is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. This is the used to detect objects in other images. Each feature is a single value obtained by subtracting sum of pixels under the white rectangle from sum of pixels under black rectangle.[11] There are lot of features possible to be extracted from the image. So it becomes difficult and reduces performance of the algorithm.[8]

1.2 Why is it called Cascade of Classifier?

Instead of applying all 6000 features on a window, the features are grouped into different stages of classifiers and applied one by one. Normally the first few stages will contain very few classifiers. If the window fails the first stage, discard it. If passes then advances to the next features and then to next stage. The window which passes all steps is a face region.[8]

Adaboost: Algorithm used for increasing performance. This algorithm can be used in conjunction with many other type of learning algorithm to improve performance. OpenCV comes with a trainer as well as detector. Opencv already contains many pre-trained classifiers for face, eyes, smiles etc. Those XML files are stored in the "opencv/data/haarcascades"[8]

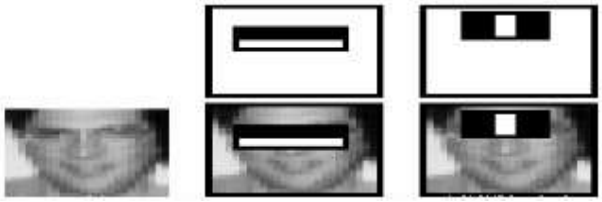

Fig -6: Features Mapping

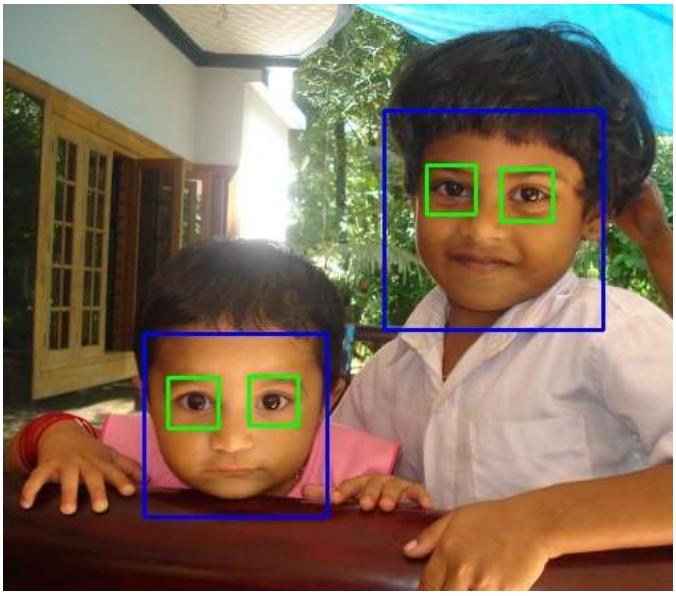

Fig -7: Face and Eyes Detection

7. OVERALL WORKING OF THE SYSTEM AFTER MODULES INTEGRATION

The small children watching television from closer distance is continuously monitored by the camera module interfaced with the Raspberry Pi. The face and eyes will be detected by the camera continuously and also distance will be verified from the Ultrasonic sensor which is calculating the distance of the children from the television. The safe distance to watch television is 4 meters but in our system the distance to limited to 2 meters. If the distance is less then 2 meters the SMS will be sent to the parents letting them know that their child is watching television from closer distance. The SMS will be sent to parents from using the online Bulk SMS's facility. Then the system will wait for 15 secs and the screen will be turned off.

8. CONCLUSION

Hence, the different IoT devices, applications and sensors are studied and model of the system in built. Hence, the system if deployed in live environment can be used for reducing long exposure of child eyes with TV.

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