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A Smart Blind Interaction System Using Deep Learning

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Abstract: IoT attempts to help people Internet-connected devices, applications, and services anytime and anywhere. However, how providing an efficient method of interaction between people and IoT devices is still an open challenge. The proposed interaction system called IoT Interaction, where users can control an IoT device by gazing at it and doing simple gestures. The system mainly consists of four categories such as object detection module , gaze estimation , hand gestures , IOT controller module . A selected device is identified by various deep learning-based gaze estimation and object detection techniques. Finally, hand gesture recognition is applied to generate an IoT device control command which is transmitted to the IoT platform. The method is used for Visually Challenged Peoples.

Keywords: Deep Learning, Gaze Estimation, IoT, Object Detection, Smart Interaction.

I. INTRODUCTION

The recent developments in network infrastructure and smart devices have resulted in the rapid spread of the Internet of Things (IoT) applications and services. A IoT attempts to help people access internet-connected devices, applications, and services anytime and anywhere. However, how providing an efficient method of interaction between people and IoT devices is still an open challenge. In this work, we propose a novel interaction system called IoT Interaction, where users can control an IoT device by gazing at it and doing simple gestures. The proposed system mainly consists of four categories: 1) object detection module, 2) gaze estimation module, 3) hand gesture recognition module and IoT controller module. A selected device is identified by various deep learning-based gaze estimation and object detection techniques. Finally hand gesture recognition is applied to generate an IoT device control command which is transmitted to the IoT platform. The final results and case studies demonstrate the feasibility of the proposed system and imply the future research directions.

II. IOT and DEEP LEARNING

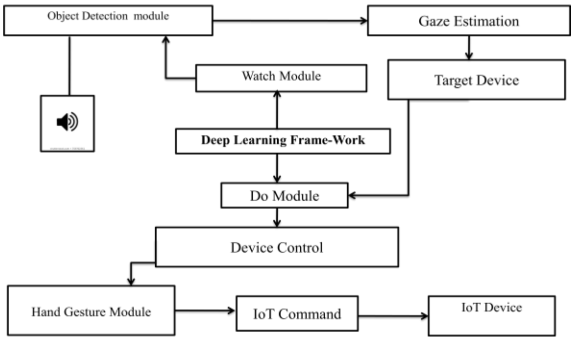
The Internet of things is a interaction between user and internet connected device anywhere and anytime. Each IoT devices allows the user to interact or access the IoT devices over a internet. It also allows the user to access IoT devices anywhere and anytime. Deep learning is a child or a part of machine learning in artificial intelligence. In deep learning, a convolutional neural network allows analyzing visual imagery. CNN is part or set of deep neural network. Adding deep neuralnetworks to IoT devices to support a new realm of interactions between humans and their physical surroundings.

III. THE EXISTING SYSTEM

The target device is identified by various Algorithms are used for gaze estimation and object detection techniques. Afterwards, hand gesture recognition is applied to generate an IoT device control command which is transmitted to the IoT platform. These algorithms results are not accuracy. The experimental results and case studies demonstrate the feasibility of the proposed system and imply the future research directions.

IV. THE PROPOSED SYSTEM

Proposed system works as follows. First, the Watch module records the opposite side of the user to detect and recognize the types of IoT devices installed in the room. Second, the Watch module detects the user's head region and then computes a fine- grained head pose information (i.e., pitch, yaw, and roll) to estimate the user's gaze position. With this information, the proposed system can identify the target device. Then, the Do module captures the user's hand gestures. A combination of hand gesture information and the type of selected IoT device is then translated into an IoT command and transmitted to IoT platforms. The target device is identified by deep learning Algorithms are used for gaze estimation and object detection techniques.



V. MODULES DESCRIPTION

A. Gaze Estimation

We use the orientation of the face (i.e., pitch, yaw, and roll) and the distance between the Watch module and the user as head pose information for training a gaze estimator. A deep learning-based approach called Deep Gaze was employed to compute the value of face orientation. The DeepGaze uses a convolutional neural network (CNN) to output the values of face orientation from the given face image. As also described the user's head orientation for each grid can vary with the distance between the Watch module and the user. Therefore, we consider this distance to training the gaze estimator. This distance can be calculated from the area of the detected face region. The method of face detection is presented. The final feature vector for gaze estimation thus includes information on the face orientation and distance of the user. A set of feature vectors are then used as input to train the models of final gaze estimators such as deci- sion trees, random forest, support vector machines (SVMs), and k-nearest neighbors (k-NN) algorithms.

B. Object Detection

The Watch module also records the opposite side of the user to detect the IoT devices installed in the room and recognizes their types. For object detection and recognition, recent deep learning approaches have shown excellent performance in terms of accuracy. The Deep Learning framework divides each input image into S x S grids and each grid predicts N bounding boxes and their confidence scores which indicate whether the bounding box contains an object or not. On the other hand, the regression-based object detector, called TENSERFLOW demonstrates a comparable accuracy with improved speed (about 30 60 fps). Further, each grid is assigned a detected label with a class score. The information from the bounding box and class probabilities are then utilized in the final object detection and classification output. In this work, we use the following labels for IoT device categories: a fan, lamp and Tv. We use the convolutional weights pre-trained on ImageNet and train our own network using the images regard- ing the IoT device labels. The result of IoT device detection and classification using the TENSERFLOW framework. Gesture Recogonition Gesture recognition is performed by a commercial ges- ture sensor module. This sensor supports the following nine hand gestures: "Up", "Down", "Left", "Right", "Forward", "Backward", "Clockwise", "Counter clockwise", and "Wave". User's hand gestures are associated to different actions accord- ing to the type of the selected IoT device. For simplicity, we assigned maximum four gestures (i.e., forward, backward, right, and left).

VI. HARDWARE REQUIREMENTS

In IoT interaction system uses a different types of hardware devices like Arduino UNO, Gesture Sensors, Relay circuit board.

i. Arduino UNO

The Arduino UNO is a open source microcontroller board. It has 20 digital input and output pins, a 16 MHz resonator, USB connection, power jack, in circuit system programming and a Reset button.

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ii. Gesture Sensors

Gesture Recognition is a alternative user interface for providing real time data to a computer. Gesture recognition using a camera to read the movement of the human body and communicates data to computer that uses the gestures as input.

iii. Relay circuit board

Relay circuit board also known as relay switch circuit. It uses electromagnet to operate a pair of movable contacts from open position to closed position.

VII. EXPERIMENTS

To evaluate the performance and feasibility of the proposed system, we conducted quantitative experiments with a proto- type. The prototypes of the Watch module and Do module were configured using commercial webcams and small single-board computers. The deep learning models used for gaze estimation and object detection were trained using a desktop PC with commercial graphic cards supporting parallel computations. The IoT platform used in our experiment is a prototype implementation from the authors' previous work.

VIII.CONCLUSION

In this work, we proposed a novel smart IoT interaction. The proposed method helps Visually challenged peoples easily control the IoT devices. The hardware module called "Watch" is located at the center of a room (e.g., a living room or a patient's room). This module estimates user's Head position and detects the IoT devices. Using Tensorflow and Google API indicates voice label to the user opposite side of the IoT installed device. Another module called "Do" is installed around the user (e.g., near the arms) to detect hand gestures. The proposed system works as follows. First, the Watch module records the opposite side of the user to detect and recognize the types of IoT devices installed in the room. Second, the Watch module detects the user's head region and then computes a fine- grained head pose information (i.e., pitch, yaw, and roll) to estimate the user's gaze position. With this information, the proposed system can identify the target device. Then, the Do module captures the user's hand gestures. A combination of hand ges- ture information and the type of selected IoT device is then translated into an IoT command and transmitted to IoT plat- forms. Finally, the device is manipulated according to the command. Using Tensorflow and Google API indicates voice label to the blind peoples easily selects the target device.

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