Using Voice and Gesture to Control Living Space for the Elderly People

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***Abstract*— To elevate the imperativeness and reinforce the fitness of elders, assisting a home care system can be an admittance that provides comprehensive nursing and monitoring them in the regular interim. In order to provide an interactive service management platform to the elders a smart environment of numerous sensors are clubbed together to establish an intuitive platform that can control the home appliances and gadgets within the living space of elders. The proposed system used voice and gesture to control the home appliances like turning on/off the light, closing/opening of curtains, TV, and fan or AC within the living spaces. The system also supports the real-time activity and monitor the healthcare system for the elderly citizens like heart rate and body temperature. In the case of emergency, for instance, anomalous behaviors like heart stroke occur, the proposed system set-up triggers an alarm and the emergency bulb will be on to alert to their kin. This smart environment can set the temperature and help control the living parameters of light based on the users' comfort and their health conditions. The whole design is to provide modest support systems for the elder to live healthily and safety in the independent living of elders.**

Keywords—voice, gesture, home appliances, health conditions.

I. INTRODUCTION

The existing population of the elderly is ostensibly neglected by the younger generations due to their individual circumstances and a major percentage of elderly populace undergo higher probability of age-related conditions such as diabetes, cardiovascular disease, Alzheimer's disease, or Parkinson's disease, a different chronic disease that hinders their livelihoods. Basic activities could be difficult for independent living off this rapidly aging population. However today, innumerable technologies of wearable devices, biosensors, and wireless sensor networks have been dramatically varying the landscape of people's daily life. Analyzing the specific requirements and various range of difficulties, thereby providing an alternative to rescue the elderly population from various unpredictable health risks and physical disabilities this paper addresses the interactive platform of the environmental control system to assist the elders and optimize the quality of living without losing safety and wellbeing of daily life. This core objective of this archetype is to enhance the elder's liability and to extend their healthy living experience. The technical set-up that is introduced in this paper is therefore to execute a performative strategy of elders using various sensors and actuators, which are encrypted and connected to different home appliances.

The concept of the technical set-up in this paper is organized as follows. Section II describes the architecture of smart environment on how the devices are connected and controlled by the varied sensors. Section III states the user interface platform of the home management system with voice and gesture control for the well-being of elders. Conclusions and future work are outlined in the final section IV.

II. BACKBONE CONNECTION OF SMART ENVIRONMENT

Progressively escalation of information and communication technologies (ICT) system generate better living experience by designing smart living environment to provide interactive and inconspicuous support systems for the people. To facilitate such advanced level of eccentricity, home utility gadgets, such as *light, fan, TV, AC, or curtain*, of the smart environment are connected with various sensors and actuators to assist the elders remotely. Fig. 1 shows how the sensors and home appliances connected to the microcontroller to control specific functionality within the living environment.

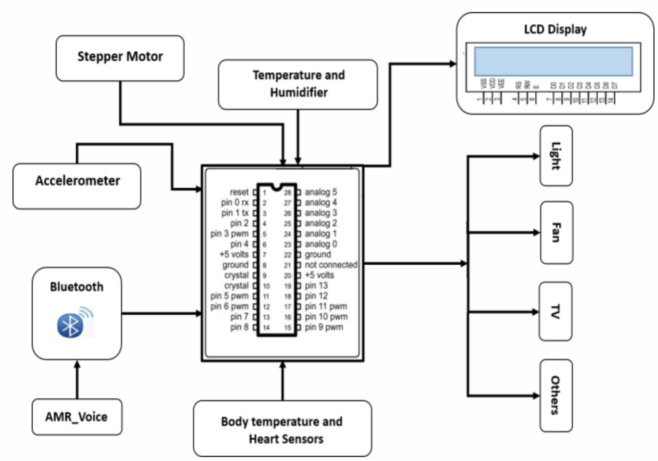

Figure 1. The architecture of sensors and home appliances for the assisting living space.

III. CONTROL SYSTEM OF LIVING SPACE

The smart environment for ambient assisting the elder living space is clustered into three main sections, (i) voice control system, (ii) gesture control system and (iii) personal monitoring system.

Table I shows the hardware's specification of microcontroller, various sensors, and actuators to assemble the prototype of voice and gesture support system of the living environment.

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TABLE I. HARDWARE'S SPECIFICATION USED TO CONTROL VARIOUS HOME APPLIANCES

Hardware's	Model	Functions
MCU	ATMEGA328P	Micro controller
IMU	GY-521(MPU6 050)	Gesture detection
Bluetooth	Arduino HC06	Connection between the microcontroller and gadgets
Stepper motor	28BYJ-48 ULN2003	Control curtain on and off
Passive infrared sensor	HC-SR501	Motion detection for the intruder
Temperature and humidity sensor	DHT11	To control temperature and humidity in the living space
Fan	80mm, 3000RPM	Control the room temperature
Display	LCD 1602	To display characters of execution
LED Lights	E15 3mm	To show working model of hardware connection
Buzzer	85dB 23 x 12mm	Alarm in any emergency
Power supply	Lithium battery 5V	Power supply in the microcontroller
Android phone	Android 4.0 or above	Navigate the smart interface, Add or Remove devices

A. *Voice*

The projected system is amended to a user's voice [1,2] to control switching on/off of various household appliances such as *fan, lights, TV, AC, curtains* or other electrical utilities. The purpose designed is to improve easy accessibilities and realm of communication within the living experience of the elders who live independently [3] and for those who have difficulties to any physical movement.

The voice command recognition [4,5] is accomplished using dedicated hardware components Bluetooth, Arduino micro-controller board, smartphone, and AMR (adaptive multi-rate) audio codec for voice command [6,7] processing and control. All the basic home appliances are connected to the microcontroller along with Bluetooth devices then Audio codec is connected with a mobile phone. Fig. 2 shows the prototype to connect the electronics appliances controlled by the user's voice.

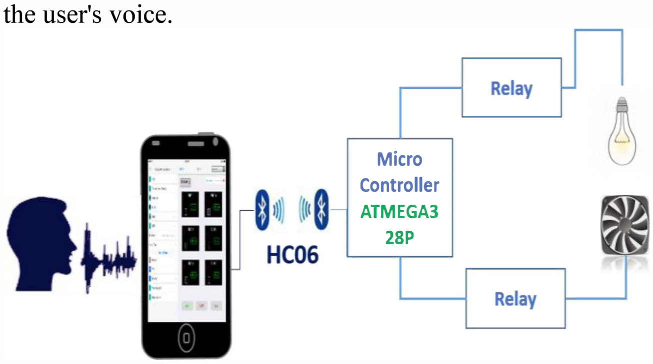

Figure 2. Voice control architecture to control the home appliances.

This prototype will provide a feasible solution for the user to integrate the system of various sensors devices and home appliances within the living space and communicate securely through this mobile *APP*. This *APP* can provide a cognitive interface system where the user can store, retrieve and set the data from the gesture [8,9] and voice recognition system [10,11] then process them for a qualitative information.

Fig. 2 shows the prototype to connect the electronics appliances controlled by the user's voice. In the physical scenario, the *relay* is used to mechanically switch electric appliances by a relatively small electric current that can turn on or off a much larger electric current. It is safer as there is no any physical contact between Arduino and AC.

Once the setup is done, the user can use the voice commands for switching on/off the electrical appliances connected to the microcontroller. Performance evaluation of the user's voice command is carried out by voice training for some few minutes, eventually, the user can adapt easily to the interface system. Fig 3. Shows the flowchart of voice to control a single device. More devices can be added based on the subject preference of needs.

Table II shows the controls parameters of voice commands to control the accessibility of the home appliances.

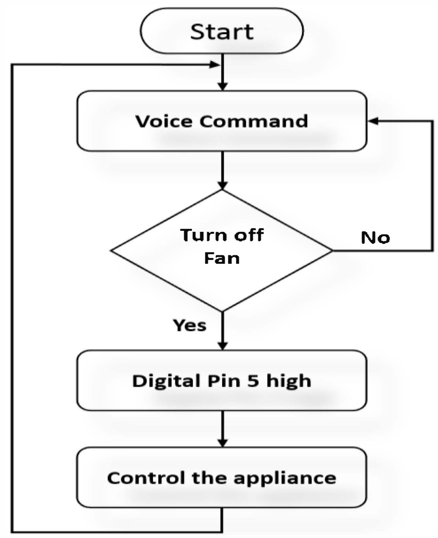

Figure 3. Flowchart for execution of the voice command to control the appliance.

TABLE II. VOICE CONTROL COMMANDS

Appliances	Command	Functions
Fan	On/Off	Switch On or Off the fan
Light	On/Off	Switch On or Off the light
T.V.	On/Off	Switch On or Off the T.V.
A.C.	On/Off	Switch On or Off the A.C.
Curtain	Open/Close	Open or Close the curtain
Others Utility	Home (On/Off)	All the devices connected to the home will be On or Off

B. *Gesture*

The proposed system also deals with gesture recognition [12,13] to control and interact the various home appliances with the hand position of the user [14,15]. In this prototype**,** accelerometer ADXl345 [16,17], which can accelerate the sensing data in the tri-axial mode of X, Y, Z plane and the home appliances to be controlled by the gesture, is connected with Arduino Mega microcontroller, and then the sensor is wrapped around the back of the user's hand. The hand gestures [18,19] are defined as flip up, flip down, left and right to control the sensed data. Fig. 4 shows the various hand position. If users want to turn on/off the home appliances, they will simply make a predefined gesture [20,21]. In this prototype, we used only two appliances. Table III describes the various control parameters for the home appliances.

Figure 4. Hand positions of the user.

TABLE III. GESTURE CONTROL COMMANDS FOR HOME APPLIANCES

Gesture	Command	Functions
Flip Up	On	Switch On the light
Flip Down	Off	Switch Off the light
Left	On	Switch On the T.V.
Right	Off	Switch Off the TV.

Using ADC (analog digital converter), the analog data from the sensor is converted into 12-bit digital data. The data received from the sensor is processed in the microcontroller then it responded to the respective appliance either to switch on or off. When the hand flips up the sensed data tells the microcontroller to send turn on data to *Light*, then it will decode the *light* rest of the appliances will be disused respectively.

C. Personal Monitoring System

Individuals are thriving hard to fit into the larger competitive dilemma of existentialism. With this, a desperate need is aroused to glimpse at the less-privileged group of people, especially in the elderly population. To improve health and social care, human activity recognition within smart homes is vital for overall wellness of a rapidly aging population. Concerning the entire individual's stress, fear or social isolation, we create an elderly smart healthcare environment system to control and monitor the health issues of individuals by connecting body temperature, heart rate sensor, PIR sensor, room temperature and humidity sensor to a microcontroller. Based on these sensors, a predictive model is a set-up to automate the room environment and functional ability to live well, safely satisfying the following conditions.

- Based on the parameters collected from the body temperature, room temperature, and humidity, we create a system to control the *light* on/off and AC temperature with the individual comfort level.
- The living space is fitted with alarm buzzer and emergency light, with the constant monitoring of individual heart rate, when an unexpected abnormal heart condition occurs the system will buzz the alarm and turn on the emergency light.

A PIR sensor is fixed in the room for the safety of the individual's by detecting intruders in the room. This has the potential to optimize the quality of life, reduce the stress, and provide greatest benefits of social isolation.

IV. CONCLUSIONS AND FUTURE WORK

Conferring to the prerequisites of elderly people in their daily day by day tasks, the proposed framework is to develop assisting home care platform to control various home appliances remotely within the living space of individual and to screened the elders in regular interim of health concerns. This design permits them to keep physically and psychologically fit from unusual wellbeing indications.

In future work, we will integrate all the control systems with a wearable gadget for both voice and gesture to provide easy accessibility and comprehensive home automation.

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