The User Health Companion Robot Using Raspberry Pi and IoT

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Abstract: **Care issues and costs associated with an increasing elderly population are becoming a major concern for many countries. The use of "companion robots" in homely environments has been suggested as a possible partial solution to these concerns. A challenge is the personalization of the robot to meet the changing needs of the elderly person over time. The approach is to design a sensorized "autonomous robot" to monitor the elderly person. Also this design includes an integrated circuit to control the home devices, the sensorized robot for health, safety and security to the home. This project also includes a health monitoring band to the elderly person, if any emergency the "companion robot" has wide cloud access using IoT (Internet of Things).**

Keywords: Autonomous robot, Cloud access, Companion robots, IoT (Internet of Things).

I. INTRODUCTION

Because of the graying of our today's population, there is a growing necessity for new technologies that can assist the elderly in their daily living. The main arguments for this is that the shortage of staff for health care, also people prefer more and more to live in their own homes instead of being institutionalized. To address these issues, we not only need sufficient health care personnel but also the presence and appliance of high-tech devices. Robotics is developing quickly nowadays to play an important role in assisting the elderly. An autonomous user companion robot might be viewed as a special kind of service robot that is specifically designed for personal use at home. Robots designed for the home are a growing industry from both a research and commercial perspective. Companion robots in the home should ideally be able to perform many tasks such as home surveillance, control home devices, diary duties, entertainment etc...

A companion robot makes itself 'useful' i.e.it is able to assist humans in a domestic home environment. The elderly person is always monitored by the user companion robot, also any intruders at the home is sensed by the sensorized autonomous robot to provide safety and security to the domestic environment. The design of user companion robot using Raspberry pi is discussed.

USER HEALTH COMPANION ROBOT

Assistive robots in "homely environment" have been Suggested as a possible cost and care solution to demographics changes characterized by an increasing elderly population. The vision is that service robots are available in the home to help and assist elderly residents. This paper describes an approach to service robot personalization based on end-user robot teaching and learning designed to be used by carers' users and elderly persons themselves.

The user health companion robot is an approach which is relevant in many different environments such as elderly care, their health monitoring, safety, security, emergency situation handling and controlling house hold devices. The main architecture of the user health companion robot is build using raspberry pi. The companion robot is able to monitor the health (heartbeat, temperature etc…) of the elderly person, home surveillance, any intruders can be sensed and provide necessary actions related to the situations. The companion robot can handle emergency situations such as calling an ambulance, informing police, or contacting any relative (of the elderly person) etc…through wide cloud access using IoT.

Also the person from wide access can instruct the robot, and can know the current status of the elderly person as well as the home. The companion robot also speaks text strings and reminds the elderly person to take medicines, do exercise etc…

II. PROPOSED ARCHITECTURE

The assistive robot and the person form a partnership which is ever changing and evolving to meet the changing needs of the elderly person as they age. The proposed architecture of the companion robot is built using Raspberry pi, and through IoT any relative of the elderly person can view and instruct the companion robot from wide access.

Another module in the system is a health monitoring band used by the elderly person, which is connected to robot through Wi-Fi unit.

The block diagram of the companion robot is shown in Fig. 1. The main element of the architecture is the Raspberry Pi module. It consists of a PIR sensor to detect the human being presence. A camera is interfaced; the robot is able to control any four home appliances such as light, fans, television etc… The motors are used for home surveillance. The companion robot communicates to the elderly person by speaking some

text strings and through Wi-Fi. In case of any emergencies, the robot can pass the message to relative, ambulance or police etc… through wide internet access IoT.

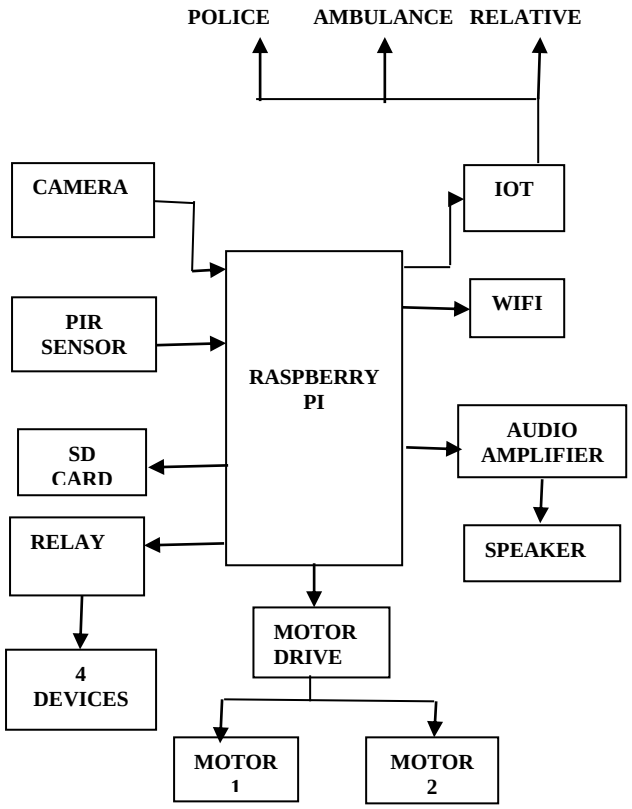

Fig. 1.User health companion Robot

Another implementation is health monitoring band used by the elderly person themselves, which can be monitored by the companion robot through Wi-Fi configuration is shown in Fig. 2.

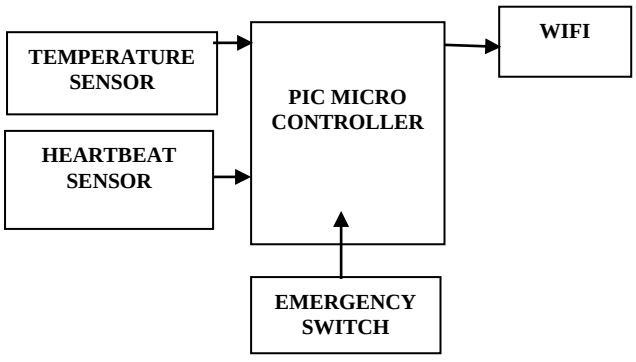

Fig. 2. Health monitoring Band

III. ARCHITECTURE DESIGN

A. SENSOR AND CAMERA INTERFACING

The Passive Infra-Red (PIR) Sensor has been used to detect humans. The PIR sensor is a pyro electric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects. This motion can be detected by the companion robot by checking for a high signal on a single I/O pin.

A high definition camera module compatible with the Raspberry Pi is used. It provides high sensitivity, low crosstalk and low noise image capture in an ultra-small and lightweight design. The camera module connects to the Raspberry Pi board via the CSI connector designed specifically for interfacing to cameras. The robot can capture images whenever necessary.

B. RASPBERRY PI

The Raspberry PI is a low cost credit card sized single-board computer developed by raspberry pi foundation. The core of the companion robot is this minicomputer. Here we use model B plus. The setting of raspi consists of selecting raspbian OS from prebuilt SD card. The prebuild SD card consists of raspbian, arclinux, pidora, open ELEC, risc OS operating system. After the OS selection we need to configure raspberry-pi using Raspi-config command. We can enter into the desktop using startx command.

Fig 3. Raspberry pi module

C. SD CARD

These uses the serial data card which is the SPI line from Raspberry module. That is a bus interconnects wire. In these uses the SPI protocol also the technique used are multiple input single output (MISO) and multiple output single input (MOSI).

D. RELAY

The relay used in this block is T90 Series, 30A PCB Relay, which is connected to Raspberry pi module using ULN2803. It is used in this system to control any of the four home appliances such as lights, fan, television etc…

E. DC MOTORS

A DC motor is a mechanically commutated electric motor powered from direct current (DC). The stator is stationary in space by definition and therefore so is its current. The current in the rotor is switched by the commutator to also be stationary in space. This is how the relative angle between the stator and rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque. The motor drive used here is the L293D which is a quadruple high-current half-H driver.

F. WIFI

HLK-RM04 is a new low-cost embedded UART-ETH-WIFI module (serial port - Ethernet -Wireless network) developed by Shenzhen Hi-Link Electronic co., Ltd. This product is an embedded module based on the universal serial interface network standard, built-in TCP / IP protocol stack, enabling the user serial port, Ethernet, wireless network (Wi-Fi) interface. Through the HLK-RM04 module, the traditional serial devices do not need to change any configuration; data can be transmitted through the Internet network. Provide a quick solution for the user's serial devices to transfer data via Ethernet.

G. CLOUD SERVER

It makes the system connectivity through World Wide Web. IoT makes the path efficiently. The process of information passing to the hospital, police and ambulance makes faster and accurately. It has many branches in the wide range.

H. MICROCONTROLLER-PIC

The main unit in the health monitoring arm band is PIC 16F877A. it has high performance RISC CPU, Operating speed: DC – 20 MHz clock input , DC – 200 ns instruction cycle • Up to 8K x 14 words of Flash Program Memory, Up to 368 x 8 bytes of Data Memory (RAM), Up to 256 x 8 bytes of EEPROM Data Memory.

I. TEMPERATURE SENSOR

LM35 is the temperature sensor exhibit -15 to150 degree Celsius temperatures. It can be read the value in voltage. It gets 1 degree Celsius as 10mv output voltage. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

J. HEART BEAT SENSOR

Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heartbeat. This digital output can be connected to microcontroller directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

K. EMERGENCY SWITCH

It is a common model switch as for the ON condition when VCC given and in OFF condition when ground is given. It just wants to initialize the microcontroller unit. When the elderly person has an emergency condition he/she press the switch to inform the robot.

IV. IMPLEMENTATION DETAILS

The implementation of this work starts with selecting the operating system that we prefer. In this project we have selected raspbian operating system. Now, we have boot the operating system that we have selected with the necessary configurations. The various configurations which can be done are such as enabling camera, interfacing sensor, etc… the configuration settings are done according to the users need.

After the configuration settings are done, the python program is to be typed in the leaf pad. Leaf pad is created by file manager-> click ok. Next the program is saved and executed by means of the LX terminal which is shown in the Fig. 4. LX terminal is used to view the status of the various interfaces and results of all the inputs given to Raspberry pi.

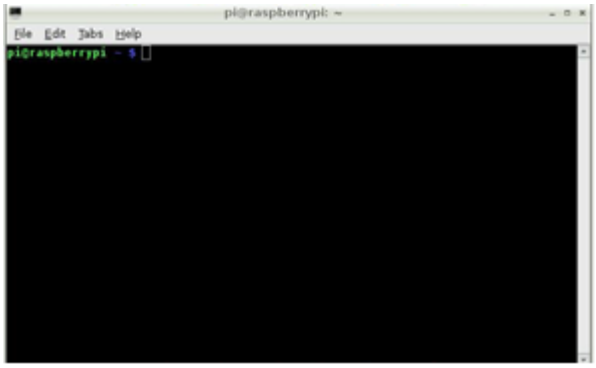

Fig. 4. LX terminal

All the devices are interfaced using python language with Raspberry pi the GPIO pins. The camera module interfaced with Raspberry pi is shown in Fig. 5.

FIG. 5. CAMERA INTERFACING

After all the devices are interfaced, the companion robot is able to control any of the 4 home devices and provides surveillance and security to the elderly person. Also the pulse and temperature of the elderly person is measured using a health monitoring band provided for the elderly person. This

unit is set up using PIC microcontroller and it can be run by using c programming.

The robot monitors the health of the elderly person frequently. And a setup is implemented using IoT such that in any case of emergency is detected by the robot; simultaneously it can inform police, ambulance or the relative. The relative can respond to the happenings from wide access through IoT.

V. RESULTS

The project is to be implemented using Raspberry Pi, which is used as a single board computer. The operating system used here is Raspbian OS. We discussed the user health companion robot for security and safety using Raspbian platform.

The python programming is used for coding which is simple, user friendly and structured line by line execution. The difference from other programming languages is that error anywhere in the program affects only that part and it does not affect the other results; else in other any error affects the complete program.

Also the health of the elderly person is monitored by the companion robot. Thus we discussed the user health companion robot for security and safety using Raspberry Pi and have a wide access using IoT.

VI. CONCLUSION AND FUTURE APPLICATIONS

We have described a robot system designed to be used by persons operating in assistive environments in homes, typically carers, relatives or the elderly person themselves.

In these studies the robot was operating primarily as a cognitive prosthetic. However a question that could be asked is "why use a robot?" and not simply another device such as a mobile phone? We would argue that the use of a robot differs in a number of ways to that of a mobile phone. First, the robots will find the person to inform them (a mobile phone may be somewhere else and ignored). Second, there is some evidence that the robot, by having a physical presence, is perceived as more authoritative, i.e., a person is more likely to follow a robot's instructions or suggestions rather than, say, a phone.

This area of research also presents some ongoing design challenges, however a sensorized autonomous robot is implemented.

In future, this companion robot can be further modified such that it can control more home appliances; more sensors are included other than PIR sensor. In case of health monitoring more health parameters such as EEG, ECG etc…can be measured other than heartbeat and temperature. Also the exploitation of IoT technology can further be extended.

REFERENCES

[1]. "Teach Me–Show Me"—End-User Personalization of a Smart Home and Companion Robot Joe Saunders, Dag Sverre Syrdal, Kheng Lee Koay, Nathan Burke, and Kerstin Dautenhahn, Senior Member, IEEE

[2]. Assistive social robots in elderly care: a review— Joost Broekens PhD Delft University of Technology, Delft, the Netherlands E: D.J.Broekens@tudelft.nl Marcel Heerink MSc University of Applied Sciences, Amsterdam, The Netherlands E: m.heerink@hva.nl Henk Rosendal PhD University of Applied Sciences, Leiden, The Netherlands E: rosendal.h@hsleiden.nl

[3]. The Rise of Social Robots: A Review of the Recent Literature— Riccardo Campa University of Cracow, riccardo.campa@gmail.com

[4]. A survey of socially interactive robots Terrence Fonga,b,∗, Illah Nourbakhsha, Kerstin Dautenhahnc

[5]. B. D. Argall, S. Chernova, M. Veloso, and B. Browning, "A survey of robot learning from demonstration," Robot. Auton. Syst., vol. 57, no. 5, pp. 469–483, May 2009.

[6]. Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications Ala Al-Fuqaha, Senior Member, IEEE, Mohsen Guizani, Fellow, IEEE, Mehdi Mohammadi, Student Member, IEEE, Mohammed Aledhari, Student Member, IEEE, and Moussa Ayyash, Senior Member, IEEE

[7]. the 1 4th issue of The MagPi - another fully loaded guide to all things Raspberry Pi!

[8]. Download the required operating system in http://www.raspberrypi.org/downloads/.

[9]. Y. Daniel Liang "Introduction to Programming Using Python" Copyright@ 2013 Pearson Education,Inc.,publishing as Prentice Hall.

[10].B.Przywara"ProjectingfuturehealthcareexpenditureatEuropeanlevel: drivers, methodology and main results, "inEuropeanEconomy, European Commission, Economic and Financial Affairs, 2010.