



## DESIGNING A INDOOR NAVIGATION AND ENVIRONMENTAL MONITORING AND CONTROL SYSTEM

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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 assistive robots in “smart-home” 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. One approach is to allow the elderly person, or their carers or relatives, to make the robot learn activities in the smart home and teach it to carry out behaviors in response to these activities. The overriding premise being that such teaching is both intuitive and “nontechnical.” To evaluate these issues, a commercially available autonomous robot has been deployed in a fully sensorized but otherwise ordinary suburban house. We describe the design approach to the teaching, learning, robot, and smart home systems as an integrated unit and present results from an evaluation of the teaching component with 20 participants and a preliminary evaluation of the learning component with three participants in a human–robot interaction experiment. Participants reported findings using a system usability scale and ad-hoc Likert questionnaires. Results indicated that participants

thought that this approach to robot personalization was easy to use, useful, and that they would be

capable of using it in real-life situations both for themselves and for others.

**Keywords:** *RFID, Zigbee, ultrasonic sensor.*

### I. INTRODUCTION

Assistive robots in “smart-home” environments have been suggested as a possible cost and care solution to demographics changes characterized by an increasing elderly population [1], [2]. The vision is that service robots are available in the home to help and assist elderly residents. Furthermore, the robot might also motivate and provide active support in terms of rabblement defined as “Support people ‘to do’ rather than ‘doing to / for people’” [3] and co-learning working together to achieve a particular goal. Thus, 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 robot effectively becoming a trusted companion to the person. We define this mechanism of providing support, assistance. [4] discussed about a project, in this project an automatic meter reading system is

designed using GSM Technology. The embedded micro controller is interfaced with the GSM Module. This setup is fitted in home. The energy meter is attached to the micro controller. This controller reads the data from the meter output and transfers that data to GSM Module through the serial port. The embedded micro controller has the knowledge of sending message to the system through the GSM module. Another system is placed in EB office, which is the authority office. When they send “unit request” to the microcontroller which is placed in home. Then the unit value is sent to the EB office PC through GSM module. According to the readings, the authority officer will send the information about the bill to the customer. If the customer doesn’t pay bill on-time, the power supply to the corresponding home power unit is cut, by sending the command through to the microcontroller. Once the payment of bill is done the power supply is given to the customer. Power management concept is introduced, in which during the restriction mode only limited amount of power supply can be used by the customer. This paper describes an approach to service robot personalization based on end-user robot teaching and learning designed to be used by carers. Personalization has been shown in longitudinal studies to reinforce rapport, cooperation, and engagement with a robot.

## II. HARDWARE SYSTEM

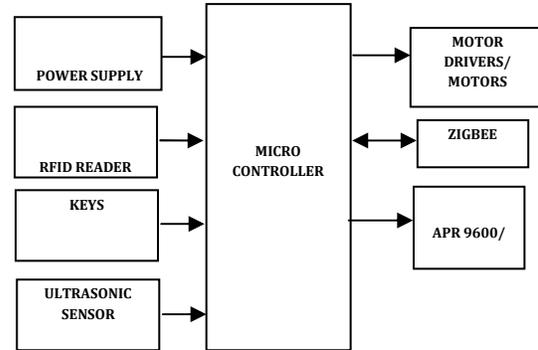


Fig:1: Remote Section

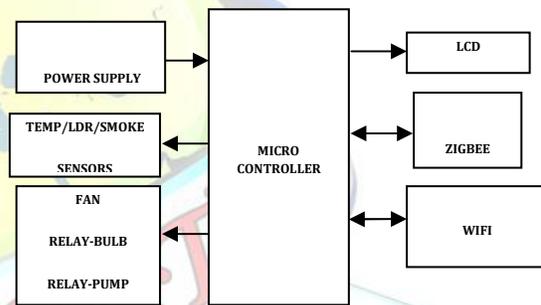


Fig:2: Indoor section

## III. METHODOLOGY

### Micro controller:

This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

### ARM7TDMI:

ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and

is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

### **Raspberry Pi :**

The Raspberry Pi delivers 6 times the processing capacity of previous models. This second generation Raspberry Pi has an upgraded Broadcom BCM2836 processor, which is a powerful ARM Cortex-A7 based quad-core processor that runs at 900MHz. The board also features an increase in memory capacity to 1Gbyte.

### **Liquid-crystal display (LCD)**

It is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

### **Temperature sensor:**

A thermistor is a type of resistor whose resistance is dependent on temperature. Thermistors are widely used as inrush current limiter, temperature sensors (NTC type typically), self-resetting over current protectors, and self-regulating heating elements. The TMP103 is a digital output temperature sensor in a four-ball wafer chip-scale package (WCSP). The TMP103 is capable of reading temperatures to a resolution of 1°C.



Fig:3: Temperature sensor

### **Ultrasonic sensor:**

The sensor is primarily intended to be used in security systems for detection of moving objects, but can be effectively involved in intelligent children's toys, automatic door opening devices, and sports training and contact-less-speed measurement equipment. Infrared sensors are characterized by high sensitivity, low cost and are widely used. But, these sensors can generate false alarm signals if heating systems are active or temperature change speed exceeds some threshold level. Moreover, infrared sensors appreciably lose sensitivity if small insects penetrate the sensor lens. Ultrasound motion detection sensors are characterized by small power consumption, suitable cost and high sensitivity. That is why this kind of sensor is commonly used in home, office and car security systems. Existing ultrasound sensors consist of multiple passive and active components and are relatively complicated for production and testing. Sensors often times require a laborious tuning process.



Fig:4: Ultrasonic sensor

**LDR:**

LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically. The animation opposite shows that when the torch is turned on, the resistance of the LDR falls, allowing current to pass through it. This is an example of a light sensor circuit: When the light level is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. Consequently the LED does not light. However, when light shines onto the LDR its resistance falls and current flows into the base of the first transistor and then the second transistor. The LED lights on. The preset resistor can be turned up or down to increase or decrease resistance, in this way it can make the circuit more or less sensitive.



Fig:5: Ldr sensor

**ZIGBEE:**

Zigbee modules feature a UART interface, which allows any microcontroller or microprocessor to immediately use the services of the Zigbee protocol. All a Zigbee hardware designer has to do in this case is ensure that the host's serial port logic levels are compatible with the XBee's 2.8- to 3.4-V logic

levels. The logic level conversion can be performed using either a standard RS-232 IC or logic level translators such as the 74LVTH125 when the host is directly connected to the XBee UART. The X- Bee RF Modules interface to a host device through a logic-level asynchronous Serial port. Through its serial port, the module can communicate with any logic and voltage Compatible UART; or through a level translator to any serial device. Data is presented to the X-Bee module through its DIN pin, and it must be in the asynchronous serial format, which consists of a start bit, 8 data bits, and a stop bit. Because the input data goes directly into the input of a UART within the X-Bee module, no bit inversions are necessary within the asynchronous serial data stream. All of the required timing and parity checking is automatically taken care of by the X-Bee's UART.

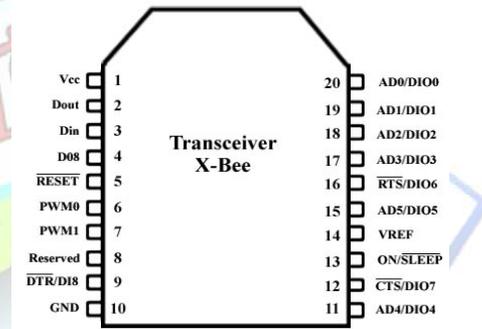


Fig: 6:ZIGBEE pin diagram

**RFID:**

Radio Frequency Identification (RFID) is a silicon chip-based transponder that communicates via radio waves. Radio Frequency Identification is a technology which uses tags as a component in an integrated supply chain solution set that will evolve over the next several years. RFID tags contain a chip

which holds an electronic product code (EPC) number that points to additional data detailing the contents of the package. Readers identify the EPC numbers at a distance, without line-of-sight scanning or involving physical contact. Middleware can perform initial filtering on data from the readers. Applications are evolving to comply with shipping products to automatically processing transactions based on RFID technology RFID Reader Module, are also called as interrogators. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers, which can make use of it. RFID tags and readers have to be tuned to the same frequency in order to Communicate. RFID systems use many different frequencies, but the most common and widely used & supported by our Reader is 125 KHz.

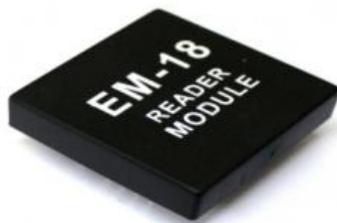


Fig:7: RFID Reader

Tags are classified into two types based on operating power supply fed to it.

1. Active Tags
2. Passive Tags

**Active Tags:** These tags have integrated batteries for powering the chip. Active Tags are powered by batteries and either have to be recharged, have their batteries replaced or be disposed of when the batteries fail.

**Passive Tags:** Passive tags are the tags that do not have batteries and have indefinite life expectancies.

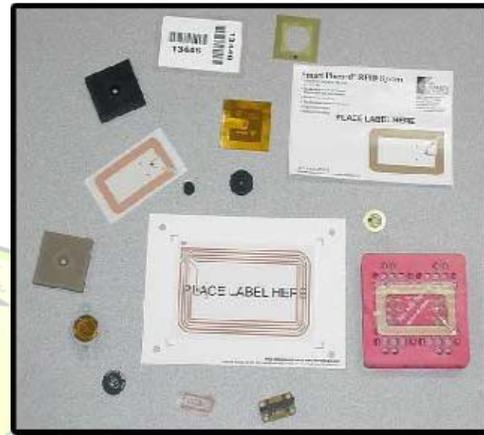


Fig:8:Different types of tags

#### WIFI:

Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. A common misconception is that the term Wi-Fi is short for "wireless fidelity," however this is not the case. Wi-Fi is simply a trademarked phrase that means *IEEE 802.11x*. Wi-Fi works with no physical wired connection between sender and receiver by using radio frequency (RF) technology, a frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space. The cornerstone of any wireless network is an access point (AP). The primary job of an access point is to broadcast a wireless signal that computers can detect and "tune" into. In order to connect to an access point and join a wireless network, computers



and devices must be equipped with wireless network adapters. Wi-Fi is supported by many applications and devices including video game consoles, home networks, PDAs, mobile phones, major operating systems, and other types of consumer electronics. Any products that are tested and approved as "Wi-Fi Certified" (a registered trademark) by the Wi-Fi Alliance are certified as interoperable with each other, even if they are from different manufacturers. For example, a user with a Wi-Fi Certified product can use any brand of access point with any other brand of client hardware that also is also "Wi-Fi Certified". Products that pass this certification are required to carry an identifying seal on their packaging that states "Wi-Fi Certified" and indicates the radio frequency band used (2.5GHz for 802.11b, 802.11g, or 802.11n, and 5GHz for 802.11a). VSD03 is the new third-generation embedded Uart-Wifi modules studied by VSD TECH. Uart-Wifi is an embedded module based on the Uart serial, according with the WiFi wireless WLAN standards. It accords with IEEE802.11 protocol stack and TCP / IP protocol stack

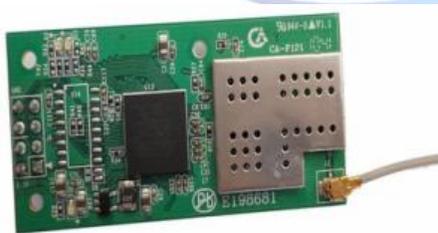


Fig:2:WIFI Module

and it enables the data conversion between the user serial and the wireless network module. through the Uart-Wifi module, the traditional serial devices can

easily access to the wireless network. VSD03 does a comprehensive hardware and software upgrades based on the products its main features include:

**Interface:**

- 2\*4 pins of Interface: HDR254M-2X4
- The range of baud rate: 1200~115200bps
- RTS / CTS Hardware flow control
- single 3.3V power supply

**Wireless**

- support IEEE802.11b / g wireless standards
- support the range of frequency: 2.412~2.484 GHz
- support two types of wireless networks:
  - Ad hoc and Infrastructure
- support multiple security authentication mechanisms:
  - WEP64/WEP128/TKIP/CCMP(AES)
  - WEP/WPA-PSK/WPA2-PSK
- support quick networking
- support wireless roam

**DC Motor:**

A DC motor relies on the fact that like magnet poles repels and unlike magnetic poles attracts each other. A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. By switching the current on or off in a coil its magnetic field can be switched on or off or by switching the direction of the current in the coil the direction of the generated magnetic field can be switched 180°.



Fig:9:DC Motor

**Motor driver (L293D):**

DC motors are typically controlled by using a transistor configuration called an "H-bridge". This consists of a minimum of four mechanical or solid-state switches, such as two NPN and two PNP transistors. One NPN and one PNP transistor are activated at a time. Both NPN and PNP transistors can be activated to cause a short across the motor terminals, which can be useful for slowing down the motor from the back EMF it creates. H-bridge. Sometimes called a "full bridge" the H-bridge is so named because it has four switching elements at the "corners" of the H and the motor forms the cross bar. The switches are turned on in pairs, either high left and lower right, or lower left and high right, but never both switches on the same "side" of the bridge. If both switches on one side of a bridge are turned on it creates a short circuit between the battery plus and battery minus terminals. If the bridge is sufficiently powerful it will absorb that load and your batteries will simply drain quickly. Usually however the switches in question melt.

**Smoke sensor:**

They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, i-butane, propane, methane, alcohol, Hydrogen, smoke. The surface resistance of the sensor  $R_s$  is

obtained through effected voltage signal output of the load resistance  $R_L$  which series-wound. The relationship between them is described:

$$R_s \backslash R_L = (V_c - V_{RL}) / V_{RL}$$



Fig:10:Co2 sensor

**IV. RESULTS**



Fig:11: Hardware for Remote Section



Fig:2:Hardware for Indoor section

**V. CONCLUSION**

We have described a robot personalization system designed to be used by persons operating in assistive



environments in smart homes, typically carers, relatives or the elderly person themselves. This approach avoids the complexity of robot behavior generation for a large set of tasks which we believe would be required by such persons, clearly however more complex tasks would still need technical personnel involvement.

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