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Smart Home Control System

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Abstract:
At home, we generally operate (switch on/off) all the electrical and electronics appliances such as fan, light, cooler, air conditioner, and so on through switches of the regular switch board. This manual switching of any home appliance is an inconvenient method for physically disabled or elders or even for normal young guys when frequent switching operation is required. Nowadays, home appliances manufacturers are increasingly relying on wireless sensor network and single chip embedded technologies to build smart environment. Many existing systems are already in the market, however, they were designed without envisioning the need of residents with special needs.

This work presents a framework that enables the integration and control of devices within a smart home environment for residents with disabilities. The framework supports the integration of multiple control devices for different residents with different disabilities. Here we are using a technology known as Zigbee, in which we can wirelessly operate the any home appliances by communicating module with the controlling system. The main system of the project is Raspberry pi microcontroller to which all input & output are interfaced. The input to system is control switches and outputs are LCD and then Zigbee acts as transceiver i.e both as input and output.We have three different units near different places at home. Master unit is present at a patient. First unit is placed at entrance door for access control. Family members will have a RFID card which should be placed near RFID reader to enter inside.

If others want to come inside then they can ring a calling bell. So that the mater can open the door using Zigbee and camera is used to identify the person who want to enter into home.Lighting can also be controlled using this wireless technology in hall/living room.

Keywords:
Raspberry Pi 3, ATmega328, LPC2148,Zigbee, RFID, Video monitoring.

1.INTRODUCTION:

Smart grid communications are based on wireless and wired networks technologies. Regardless of the technology, these networks can be classified based on their functionality within the smart grid. This classification as reported in the literature are: home area network, neighborhood area network, access network, backhaul network, core and external network . These networks connect many smart grid objects such as home appliances, smart meters, switches, reclosers, capacitors bank, integrated electronic devices (IEDs), transformer, relays, actuators, access points, concentrators, routers, computers, printers, scanners, cameras, field testing devices, and the list can go on to many devices. This work proposes a framework for homes to enable people with different types of disabilities the control of appliances and devices within their home environment. Home Area Networks (HAN) are implemented and operated within houses or other small boundary offices to enable communication between user's peripheral devices to various home appliances.

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Such appliances are: televisions, air conditioning systems, security systems, and other devices like fax, printers, as well as small network attached storages. Moreover, HAN technology allows the user to control and monitor many digital devices throughout the house. The basic HAN includes devices such as, an access point, the home appliance(s), and a smart meter. The HAN's access point has network switch services that provide users with wired LAN ports or wireless connectivity. Wireless Sensor Network (WSN) is being implemented to monitor and broadcast information from different applications. It is being developed in various fields such as homes and hospitals. WSN consists of a large number of wireless sensor devices working together to achieve a common objective. A wireless sensor device is a battery-operated device that has the capability of sensing physical quantities, provides efficient wireless communication and data storage. Moreover, a WSN has one or more base-stations that gather information all the sensor devices. The base stations provide an interface through which the WSN interacts with the outside world.

This work designs and implements a wireless sensor nework inside a house that provide users with special needs essential and basic control within a home environment. The proposed work enables the user to perform his/her daily activities by remotely monitoring and controlling home appliances without depending on others. The input and output are automatically adjusted depending on the user's special needs and environment. The smart home area network (HAN) technology offers users a wide range of services. Users that integrate HANs into their homes can monitor and/or control their appliances remotely and within the house using smart phones or control panels. However, most of the monitoring and control system in the HAN technology are not feasible to people with disabilities such as visually impaired, deaf, and handicapped. A blind person cannot see whether the window is open/close, similarly a deaf person cannot hear the fire alarm.

A handicapped person (with hand disability) one the other hand cannot use his/her phone to check if the refrigerator door is open or closed. Hence, most of the existing HAN technologies are aimed at healthy people. Other specialized devices are developed; however, the devices operate only based on one specific disability. This work proposes a framework that enables the integration, monitoring, and control of events within a HAN. This work also proposes a device that integrates with HAN that is targeted for people with special needs such as deaf and blind people. This work is organized as follows, section II presents related work, section III presents the functional requirements, section IV presents the proposed framework for HAN, section V presents the prototype implementation, and section VI presents a brief conclusion.

2. Block Diagram

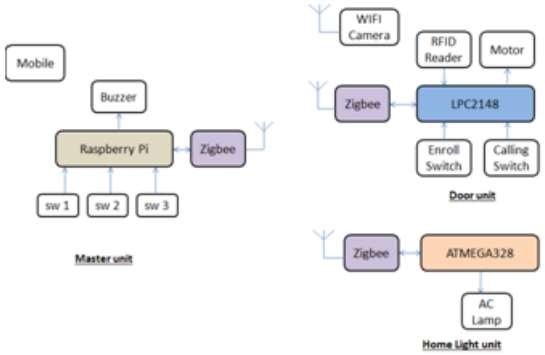

Figure:1

The above figure shows the block diagram of the proposed system. It contains three units they are master control unit, door unit ,light unit. The master unit is acts as a master and door unit and light unit are acts as a slave. The master unit contains Raspberry pi as a main controller which is like a mini computer. This is a wireless communation based system which uses zigbee for communication. It is a serial communication which receive and transmit the data. where sw1,sw2 and sw3 are switches used to control the door unit and light unit remotely using zigbee. A buzzer is used for indication if calling switch is pressed at door unit.

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The door unit contains LPC2148 as a main controller, here an RFID reader is used to read the RFID unique cards. This is used to access the door unit by which door will be opened using motor. Whenever RFID card is detected the door will opened and after some time it will close automatically. An RFID cards are allocated to every family member by using that they can enter into the home. If any unauthorized person want to enter they need to press calling switch by that user will get the indication buzzer at master unit and also camera is used for live monitoring to identify the person by that he will decide to allow that person or not. If he want to allow to enter then user will press the door switch in master unit then the door will be opened. The home light is controlled using switch2 and switch3 where we can ON and OFF the loads.

3.Flowchart:

The flowchart represents the flow of operations of the proposed system. The below figure shows the master and door unit communication. If an RFID card is identified then the door will be opened if not the bell switch and door switch should be pressed to open the door. The figure shows that any one the condition must satisfy to open the door otherwise door will not be open.

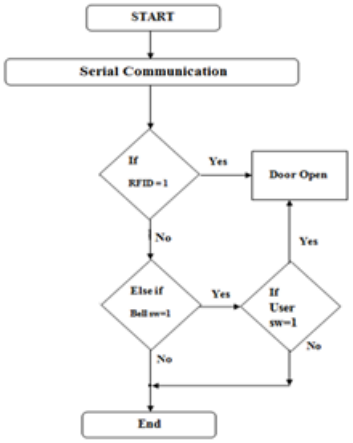

Figure:2

The figure3 represents the operation of the light unit from the master unit. If switch2 condition execute then the light will be ON and if switch3 condition is execute then the light will be OFF.

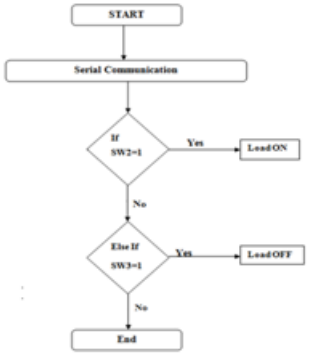

Figure:3

4. Hardware

4.1 Raspberry Pi 3:

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can

Figure:4

be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B. Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processer, 10x faster than the first generation Raspberry Pi. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

Specifications:

- Processor Broadcom BCM2387 chipset. 1.2GHz Quad-Core ARM Cortex-A53.
- 802.11 b/g/n Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE) .

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- GPU Dual Core VideoCore IV® Multimedia Co-Processor. Provides Open GL ES 2.0, hardware-accelerated OpenVG, and 1080p30 H.264 high-profile decode. Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure .
- Memory 1GB LPDDR2 RAM.
- Operating System Boots from Micro SD card, running a version of the Linux operating system or Windows 10 IoT.
- Dimensions 85 x 56 x 17mm .
- Power Micro USB socket 5V1, 2.5A.

4.2 LPC2148:

Figure:5

The LPC2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2148 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

Features

- 64-pin High-Performance ARM Microcontroller
- Flash Program Memory: 512 kbytes
- SRAM Data Memory: 32 kbytes
- I/O Pins: 45
- Timers: Two 32-bit
- A/D Converter: 10-bit Fourteen Channels
- DAC: 10-bit
- Real-Time Clock (RTC): Independent Power and Dedicated 32kHz Input
- I²C: Two Modules with Master or Slave Operation
- SPI: Full Duplex Serial Operation
- UART: Two Modules
- USB: 2.0B Fully Compliant Controller with RAM
- External Oscillator: up to 25MHz with integrated PLL for 60MHz Operation

4.3 ATmega328:

The high-performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts,serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs

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approaching 1 MIPS per MHz, balancing power consumption and processing speed.

Figure:6

Features

- 28-pin AVR Microcontroller
- Flash Program Memory: 32 kbytes
- EEPROM Data Memory: 1 kbytes
- SRAM Data Memory: 2 kbytes
- I/O Pins: 23
- Timers: Two 8-bit / One 16-bit
- A/D Converter: 10-bit Six Channel
- PWM: Six Channels
- RTC: Yes with Separate Oscillator
- MSSP: SPI and I²C Master and Slave Support
- USART: Yes
- External Oscillator: up to 20MHz

4.4 Zigbee

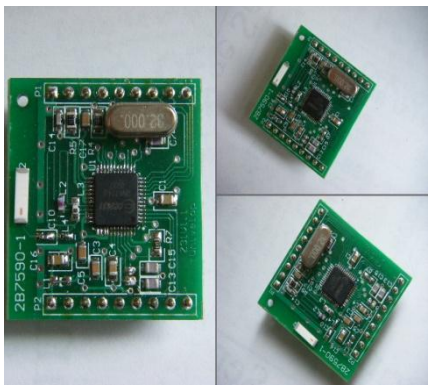

Figure:7

Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, zigbee is a low-power, low data rate, and close proximity (i.e., personal area) wireless ad hoc network. The technology defined by the zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer. Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. Zigbee is typically used in low data rate applications that require long battery life and secure networking (zigbee networks are secured by 128 bit symmetric encryption keys.) Zigbee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device.

4.5 RFID Reader:

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Active tags have a local power source such as a battery and may operate at hundreds of meters from the RFID reader. Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture for Automatic Identification and Data Capture (AIDC).

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Figure:8

RFID tags are used in many industries, for example, an RFID tag attached to an automobile during production can be used to track its progress through the assembly line; RFID-tagged pharmaceuticals can be tracked through warehouses; and implanting RFID microchips in livestock and pets allows for positive identification of animals. Since RFID tags can be attached to cash, clothing, and possessions, or implanted in animals and people, the possibility of reading personally-linked information without consent has raised serious privacy concerns.[2] These concerns resulted in standard specifications development addressing privacy and security issues. ISO/IEC 18000 and ISO/IEC 29167 use on-chip cryptography methods for untraceability, tag and reader authentication, and over-the-air privacy. ISO/ IEC 20248 specifies a digital signature data structure for RFID[3]and barcodes providing data, source and read method authenticity. This work is done within ISO/ IEC JTC 1/ SC 31 Automatic identification and data capture techniques.

4.6 Wifi camera

Figure:9

Features

- PTZ control.
- 1 Megapixels (1280*720) with IR Cut, no color-cast.
- Two-way audio.
- 128 GB Card slot.
- Dynamic alarm , motion detection via email of FTP.
- Remotely control by IP address.

5. Software

5.1.1 Raspbian OS

Raspbian whissy is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi.The initial build of over 35,000 Raspbian packages, optimized for best performance on the Raspberry Pi, was completed in June of 2012. However, Raspbian is still under active development with an emphasis on improving the stability and performance of as many Debian packages as possible.

Figure:10

5.1.2 Fedora Installer

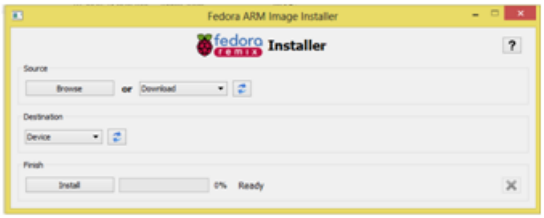

Figure:11

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Fedora installer is used to install a Raspbian OS into the sd card.We cannot install Raspbian OS directly into Raspberry pi board.Here we required an installer to install Raspbian OS.

5.2 Keil IDE:

The Keil development tools for the 8051 offer numerous features and advantages that help you quickly and successfully develop embedded applications. They are easy to use and are guaranteed to help you achieve your design goals.The µVision IDE is a Windows-based software development platform that combines a robust editor, project manager, and make facility. µVision supports all of the Keil tools for the 8051 including the C compiler, macro assembler, linker/locator, and object-

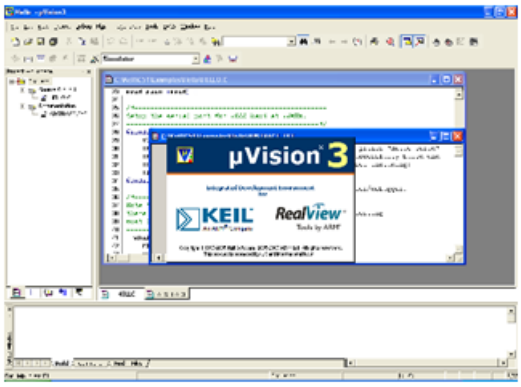

Figure:12

HEX converter. µVision2 helps expedite the development process of your embedded applications by providing the following:

- Full-featured source code editor,
- Device database for configuring the development tool setting,
- Project manager for creating and maintaining your projects,
- Integrated make facility for assembling, compiling, and linking your embedded applications,
- Dialogs for all development tool settings,
- True integrated source-level Debugger with high-speed CPU and peripheral simulator,

Links to development tools manuals, device datasheets & user's guides.

5.2.1 Flash Magic

Flash magic is a software tool used for burning the .hex files to Controllers.

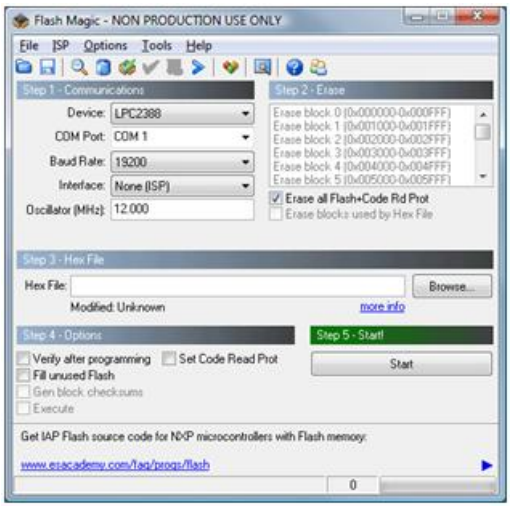

Figure:13

5.3 Arduino IDE

The software used by the arduino is Arduino IDE. The Arduino IDE is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring project. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. There is typically no need to edit makefiles or run programs on acommand-line interface. Although building on command-line is possible if required with some third-party tools such as Ino. The Arduino IDE comes with a C/C++ library called "Wiring" (from the project of the same name), which makes many common input/output operations much easier. Arduino programs are written in C/C++, although users only need define two functions to make a runnable program.

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Figure:14

6. Output

6.1 Door opening using RFID

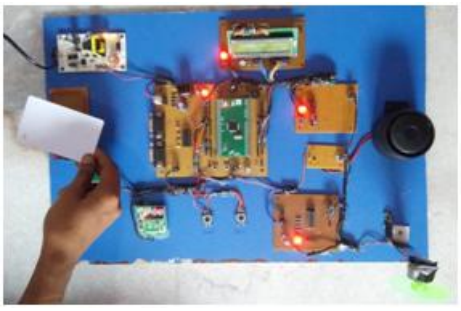

Figure:15

First unit is placed at entrance door for access control. Family members will have a RFID card which should be placed near RFID reader to enter inside.

6.2 For Unauthorised persons:

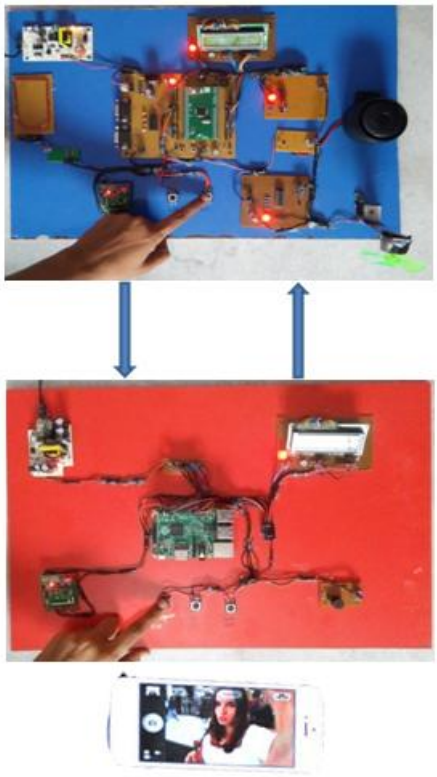

Figure:16

If any unauthorized person want to enter into home they need to press calling switch then indication will send to master unit in the form of buzzer.The user which are at master unit they can view a person in the mobile who are pressing call switch to enter into home.If he want to allow that person the user will press the door switch then door will be open.

6.3 Light ON

Figure:17

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Whenever user want swich ON the light they will press switch2 in master unit by that the light will get ON in the Light unit.

6.4 Light OFF:

Whenever user want swich OFF the light they will press switch3 in master unit by that the light will get OFF in the Light unit.

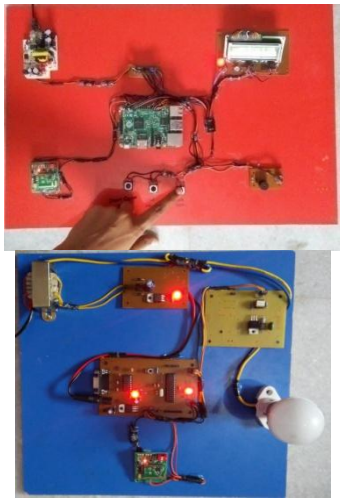

Figure:18

7. Conclusion:

This paper represents the design and implementation of Smart home control system that gives the user complete control over all remotely controllable aspects in home.This can be used for security and safety for multiple disabilitiy persons.This is helpful to access all the electronic devices and door locking mechanism remotely.

8. Future scope:

We can implement Smart home control system for multiple disability persons to control all aspects remotely in his/her home through voice commands using android and iot based technologies.

10. AUTHOR PROFILES

Mr.Perumandla Babu is currently pursuing his M.Tech in Embedded Systems from CMR College of Engineering & Technology, Hyderabad.

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Mr.A.Praveen Kumar received his post-graduation degree in Digital Electronics and Communication System and is currently working as Assistant Professor in the Department of Electronics and Communication Engineering, CMR College of Engineering & Technology, Hyderabad.

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