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ZIGBEE BASED SMART HOME FOR PERSONS WITH PHYSICAL DISABILITY

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ABSTRACT

Day by day as the technology is growing it is reducing the human effort. Home Automation/Smart home system is getting more importance as it increases the security, comfort and improves the quality of life. In this proposed system a smart home monitoring and control system for disabled person is being developed. This system gives security, and comfort for the elderly people and person's with disability. The framework supports the integration of multiple control devices for different residents with different disabilities. Moreover, the work addresses the safety of the users by providing warnings and notifications in case of an emergency. A prototype was designed, implemented and tested.

1. INTRODUCTON

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 [1]. 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. 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 [2]. 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 [2], 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 [2]. 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.

2. RELATED WORK

The work in [3] proposes a wireless sensor network based system consists of three major blocks namely; Intelligent Door Control system, a Gas Detection system and Warning Hearing Impaired people (for the doorbell). Each block has sensor nodes that monitor physical and environmental conditions such as detection of access card, gas level in the kitchen and pressure on the doorbell. A Wireless Smart Home Monitoring systems for assistive independent living is presented in [4]. The system has various functions to help elderly and people with special needs. The system consists of a base station, sensor nodes that contain RFID tags, accelerometer and buzzer. Each node monitors a specific home appliance. The system in [5] introduces a ZigBee-based smart home monitoring system that supports multiple user. The system allows users to monitor their home appliances simultaneously. The work in [6] discussed a system that recognizes and monitors the daily activities of living of elderly people on wheelchairs using triaxial accelerometer. A study was conducted on a spinal cord injury user who needs to communicate with other people through text-voice conversation and control the home appliances in [7]. An assistive dialog agent was proposed for the case using a dialog agent requirements modeling methodology. The Intelligent Home Environment (IHE) controller provides an interface between hardware and software to gather data from the environment and monitor the home appliances according to the commands from the application senor devices. Semantic matching framework is

proposed in [8] that matches the environment infrastructure and the user's capabilities.

Integration of Bluetooth and Wi-Fi technology in Controlling home appliances can help and improve lifestyle of all user groups especially to the disabled and elderly people in term of safety and comfortable. The implementation of combined wired and wireless systems would be of most practical in designing a smart home system especially in cutting the system‟s installation cost for conventional home. The smart elderly home monitoring system (SEHMS) is divided into three different modules which are safety monitoring system, telehealth system and telecare system. The smart phone is then connected to the monitoring system by using the TCP/IP networking method via Wi-Fi. A graphical user interface (GUI) is developed as the monitoring system which exhibits the information gathered from the system. The GUI opens an option to the user to examine the fall as well as making the confirmation or cancellation. A remote panic button has also been tested and implemented in the same android based smartphone. In addition, the monitoring system can also answer the call automatically after the emergency alarm has started. The SunSPOT development kit will be used to simulate smart home devices. In this paper, the functionalities of a digital home temperature reader, as well as light switches will be demonstrated on the SunSPOTs. Possibilities of remote access to the SunSPOTs can be breakdown into two alternatives that can be either through the Internet cloud or through the GSM cloud. Appliance control subsystem enables the user to control home appliances remotely whereas the security alert subsystem provides the remote security monitoring. The system is capable enough to instruct user via SMS from a specific cell number to change the condition of the home appliance according to the user‟s needs and requirements. The second aspect is that of security alert which is achieved in a way that on the detection of intrusion the system allows automatic generation of SMS thus alerting the user against security risk. In addition, the monitoring system can also answer the call automatically after the emergency alarm has started. This project will also not be a research or analytic based system to monitor human behavior. It will only provide ease of access to control house appliances and also monitor certain areas of

the house. In terms of connection variant, this project proposed mixture of wired and wireless connection, where wired connection will run from the home appliances to the main control board while wireless connection will only exist in between the main control board and the UI platform, which is the phone or PC connected via Bluetooth.

3. EXISTING SMART HOME TECHNOLOGIES

Home based system automations can range from systems as simple as for heating, ventilation, and air conditioning, Lighting control, or Audio and Video distribution to multiple sources around the house, to more complicated systems such as for security (involving presence simulations, alarm triggering and medical alerts) and robotics for home care or home management. Smart home applications; or task automations in a general household can be grouped by their main functions such as,

i) Alert and sensors – heat/smoke sensors, temperature sensors

ii) Monitoring – Regular feed of sensor data i.e. heat, CCTV monitoring

iii) Control – switching on/off appliances i.e. sprinklers, lightings

iv) iv) Intelligence and Logic – Movement tracking i.e. security appliances

v) v) Telecare/telehealth – distress sensor, blood pressure monitoring

Current smart home devices are usually a customized hybrid of one or more of these applications for broader applications. Access to these applications can be generally grouped into 4 access types that are the hardwired type using bus line or power line based technology, as well as the wireless type utilizing radio, infra-red or Bluetooth technology. Future smart-home appliances are moving towards the wireless environment and hence the Bluetooth and radio spectrum will be widely used. It is to date, a rather new

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technology that needs to be further proven in terms of stability and security.

4. PROPOSED SYSTEM

The figure 3.1 depicts proposed block diagram of system. The system consist of master controller and its remote controlling unit.

Remote Unit:

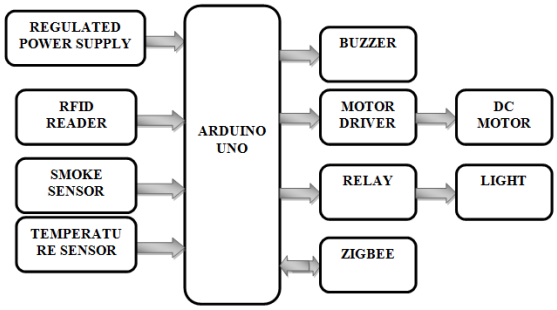

Fig. 3.2 : Block diagram of Remote Unit

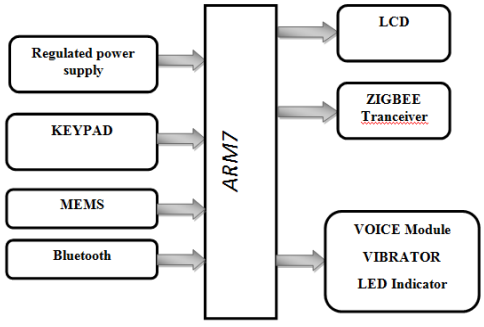

Fig. 3.3 : Block diagram of Master control unit

4. WORKING OF SYSTEM

The master registers the capabilities of the control device such as LCD screen, and a voice module. The master controller allocates the request to the control device capbility based on the user special need. Figure 3.1, and Figure 3.2 shows various sections of system which will be designed at respective ZigBee Node. And the total system working is briefly depicted in figure 3.3 which is a flowchart.

For example, if the user is visually impaired, then all notifications from the master controller will be voice based. Different notifications will provide different voices. For example, if there's fire, the voice alert will keep running until the smoke goes back to normal. On the other hand, to notify that a light or refrigerator door is open, the voice will play with a delay. Similarly, if the user is deaf, all alerts and notifications will be displayed on the LCD. The fire alarm node is connected to a smoke sensor, LED and Xbee board. The node keeps monitoring the smoke of the surrounding. If the smoke reaches beyond a certain limit, the node alerts the master controller and turn ON the LED connected to the node. The Door and Doorbell are connected to an RFID tag

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reader and which allows the node to perform two operations. First, when the user swipes the RFID card that matches that connected to node, the door opens for a specific amount of time then automatically closes. Secondly, when a person (visitor) presses the pressure sensor (demoed as doorbell), the node will notify the master controller of this event and the master controller will transform into an output action based on the user special need through the control device. The refrigerator monitoring node has a magnetic reed sensor connected to it. When the reed switch is closed, it means that the fridge-door is closed. When the reed swith is open, it means that the door is open and the LED is lite. This node notifies the master controller of the status of the refrigerator‟s door (opened/closed) and automatically close the door if the user forgot to do so. The node waits until it receives the appropriate command from the master controller, check the status of the door, and send the status back to the master controller. For auto closing the door, the system will start a timer when the refrigerator's door is open, the timer checks every 10 seconds if the door is closed. The system also provides the suitable alerts when the devices will be operated.

5. FLOW CHART

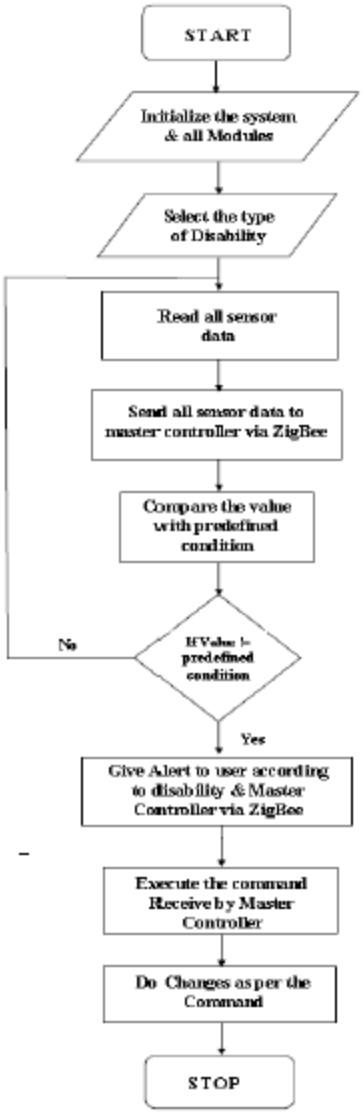

Fig.5.1 Flow chart

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6. RESULT

The proposed system was fully developed and tested to demonstrate its feasibility and effectiveness. The proposed system is more user friendly than existing system. And it also gives greater performance. The screenshots of the smart home app developed has been presented in Figure bellow.

The proposed system was fully developed and tested to demonstrate its feasibility and effectiveness. The proposed system is more user friendly than existing system. And it also gives greater performance. The screenshots of the smart home for disabled developed has been presented in Figure bellow.

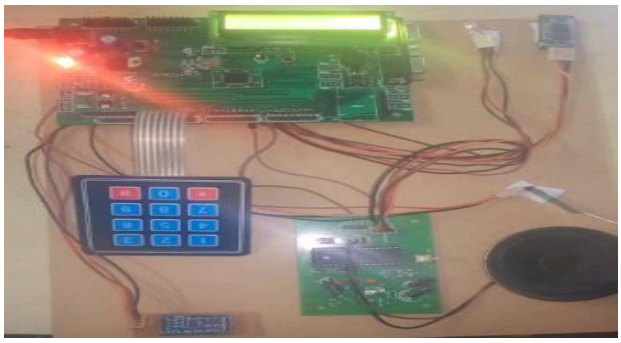

Fig 6.1(a) Output Screenshot of Master control unit

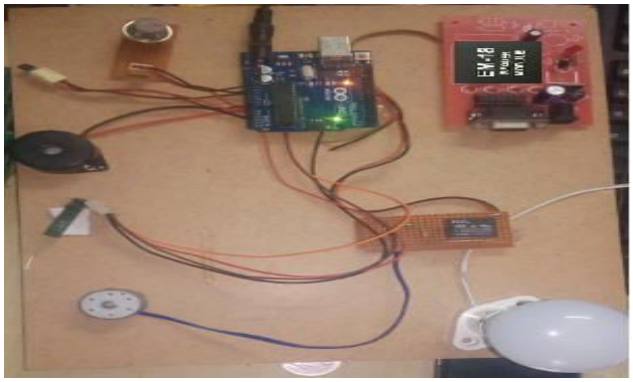

Fig 6.1(b) Output Screenshot of Remote uni

RESULT ANALYSIS

In this we will observe the output in the form of voice alerts, led indicator and home appliances which are generated from corresponding actuators. The pictures of experimental setup of actuators and sensors used in the proposed system are as shown in the following figures.

Fig 6.2. Voice actuator

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Fig 6.3 Led indicator

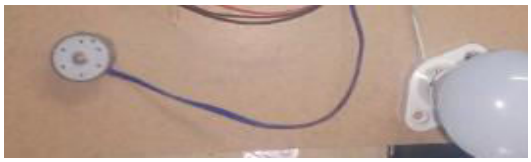

Fig 6.4 Home appliances Fan and Light

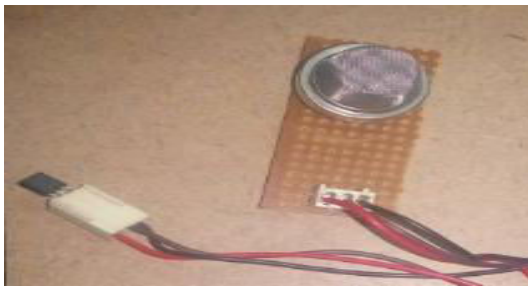

Fig 6.5 Temperature and Smoke sensor

7. CONCLUSION AND FUTURE SCOPE

Most of the existing smart home monitoring and control systems do not accommodate special needy users to manage their home appliances. A wireless sensor network based system for smart home automation was designed, built and tested to address such missing functionality. The implemented system's major contribution is that it is customized to provide the special need residents with tools and services to monitor and operate home appliances remotely. The implemented system provides home residents with disabilities to take advantage of the advancement in technology. It enables them to perform their daily activities by remotely monitoring and controlling their home appliances without having to depend on others. The system is programmed so that it can be configured to adjust to the customer's disability providing them with better and convenient lifestyle. It is worth mentioning that the system is scalable and can be extended to include more and different services and tools. The system is portable, compact, affordable and easy to use.

Further the system will be interfaced with IoT module to control and monitor the home through internet.

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