Assistive Technology using IoT for Physically Disabled People

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Abstract: An assistive technology can help in improving communication between disabled people and their caregiver by providing an opportunity of continous help to patients by providing services such as Monitoring Patient, Home Automation, Voice to speech / SMS or Touch to speech/SMS. The objective of this research work was to propose and develop an Internet of Things (IoT) based system for physically disabled people. A dynamic system consisting of sensors, ARM7 processor, Bluetooth, speaker, relays and GSM connected over an internet was developed. Communication between hardware and software was done using RS232 communication. With this system, patient on reaching the Higher Limit (HL) or Lower Limit (LL) can send alerts to all the mobile numbers entered over the network. The android application was used to send the SMS through voice or touch on buttons. This system was tested by sending SMS to caregivers who is at remote location. This application not only promotes healthy relationship between the patient and caregiver but also increases the zest for life.

I.   INTRODUCTION

An Internet of Things (IoT) is one with which different physically connected objects can be accessible via an internet. The 'thing' in IoT could be an automobile with built-in-sensors or a person with a heart monitor. The sensors and relays embedded in the hardware and linked to the application helps to interrelate with internal states or the external environment[1].

Figure 1.1. Internet of things.

The above fig 1.1 shows, IoT connects anything and everything allowing them to communicate and exchange data. "Things" in IoT refers to a variety of devices includes health monitoring systems, automobiles, environmental monitoring etc. These could be a combination of hardware, software and data or service. Based on existing technologies collecting useful data.

A.   Scope of IoT

IoT reduces human intervention, enables devices/objects to observe, identify and understand a situation IoT can connect devices embedded in various systems to the internet. These objects can be controlled from anywhere. The connectivity helps us to capture more data from different places, ensuring increasing efficiency and improving safety and IoT security. IoT platforms can help organizations in reducing cost by improving process efficiency, asset utilization and productivity. The growth and convergence of data, processes and things on the internet would make more relevant and more opportunities for people, businesses and industries. An IoT application involves electrical, medical, information technology, universal space research.

B.   Assisting Physically Disabled Via IoT

Patients suffer from wide variety of disabilities can range in severity from limitations of stamina to paralysis. Physical disability results in physical difficulties of different levels. The IoT technology provides proactive help to patients with it advanced human machine interaction by internetworking physical devices and embedded sensors which enables these objects for collecting and exchanging data. Physical disability results in physical difficulties of different levels. The IoT technology provides proactive help to patients by internetworking physical devices and embedded sensors.Paralyzed patients are provided with unobtrusive support by the caregivers with the help of an application where a combination of services such as Home Automation, Patient Monitoring and Speech to SMS or Touch to SMS. Providing help to patients when caregivers are on remote location is a major issue which may to inattentiveness to some serious issues. The patient can operate electrical appliances through this application using Touch/Voice commands which reduces dependency. To accomplish his daily routines such as "need water" , "need food" etc. which are sent as text messages to the caregivers mobiles as well as played in the speaker. By the patient using voice or touch commands. Caregivers on receiving the message can attend the patient immediately or he can provide a substitute to help the patient. Person even nearby can attend the patient as the messages are played on the speaker in the absence of the caregivers. Patient's heartbeat and temperature are monitored, by the application through sensors. Doctors can provide necessary first aid on reaching the threshold of temperature and heartbeat. ARM 7 Processor and SIM 900 modem is used for high speed communication and enabling GPRS communication to control the electrical appliances over mobile. Heartbeat and temperature of the patient are sensed using LDR and LM35 sensors.

Figure1.2 (a) (b). Android based Paralyzed using IoT for dumb user and for Voice user.

As shown in figure 1.2(a) and 1.2(b) An Android based system gives the doctor, caregiver's and family members to provide an unobtrusive help to the patient. The system presented in this report includes sensors, Bluetooth, modem, mobile phone, android application. The android application allows remote system handling thus, making the system more reliable and efficient

II. LITERATURE SURVEY

Various models have been developed for health monitoring, home automation and voice to speech recognition systems. They are all separate models. The below section describes related work. Kumar Mandalu et.al [2] proposed a mobile based home automation system using IoT with two prototypes as Bluetooth and Ethernet with a microcontroller based Arduino board and Android mobile app. Relays are used to show switch on and switch off of the appliances. The disadvantage of the system is the range between the mobile and appliances is limited because of Bluetooth. M. Tharaniyasoundhari et.al.[3] proposed a Home Automation System through Speech Recognition using Super Vector Machine and General Packet Radio Service which can control appliances within a home. The electrical appliances can be switched on or switched off using voice commands. The disadvantage is there may be loss of packets if there is a fluctuation in the signal. Gagan [4], proposed Automation System for electrical appliances and monitored gas, smoke thresholds to provide safety for physically disabled People using Intel Galileo board. The sensors used in the system provide safety features as added advantage to the smart appliances. The cost of the system increases with the increase of the sensors. Maradugu Anil Kumar, Y. Ravi Sekar [6] proposed a Health Care System using a mobile application that constantly monitors heart rate, oxygen level and temperature of the patient using Zigbee, ATMEGA8L processor and sensor technology. The patient can be monitored continuously but in a limited area because zigbee uses personal area network. B.Sneha, et.al [7] proposed a System using ATMEGA328 processor and Bluetooth technology. The health of patient is monitored continuously but Bluetooth range is limited. D. Gulbakshee et.al.[8] proposed Speech based SMS system on Android which uses Hidden Markov Model Method to send SMS. HMM algorithm is used. This system can be used for recognizing various types of speech from the users according to their voice modulation. The disadvantage is the time taken for recognizing the speech is more for simpler systems. Mc.Ian et.al. [9] proposed mobile based personalized Speech Recognition using dictionary search. The disadvantage is the time taken for recognizing the speech is more for simpler

systems as it has to search the whole dictionary and pronunciation may vary. P. Sanja et.al. [10] proposed speech based SMS system on Android which uses HMM Method to send SMS. The advantage of the system is it can be used for recognizing various types of speech from the users according to their voice modulation. The disadvantage is the time taken for recognizing the speech is more for simpler systems. V. Sharon [11] proposed different ways for improving differently abled people using IoT technology. Proposed ways how an assistive technology can change the lives of differently abled people and how they can reduce the dependency on other people. B.K. Bhoomika et.al. [12] proposed an IoT based smart secured health care monitoring system using compression techniques in transferring the messages as the data related to the patients are very important and loss of data in emergency may provide danger to the patient. S.M. Raizul et.al.[13] proposed Comprehensive Survey on Health Care with different methods for accessing and transferring the data of the patient are mentioned and different parameters are used to monitor the health of different kinds of patients. T. Sapna et al. [14] proposed the use of IoT in health care sector and its technological aspects. This system developes network among all entities communicating to the cloud. A. Alexandru et al. [15] developed a monitoring system prototype which focused on remote patient monitoring in wards, following an ICU discharge using sensor arrays for EKG, SpO2, temperature and movement. S. M. Riazul et al. [16] proposed an collaborative security model using different technologies addressing various IoT and eHealth along with IoT security and privacy features. M. Hasmah, et.al. [17] proposed body Temperature measurement for remote monitoring, the patient's temperature can be sensed remotely and medication can be prescribed by the doctor immediately. Manohar, S.et.al [18] Proposed E-Mail based Interaction for Home Automation System. The disadvantage of the system is the user may not check his emails very frequently and some mails may not reach the recipient which in turn effects the performance of the system.

III. PROPOSED DESIGN

Understanding the IoT enabled systems for disabled is very necessary to provide an automated system. Using the Wide applicability of Iot, an efficient and automated system can be created. In the past years health monitoring is difficult for doctors and family members to provide quality of services, patient is totally dependent on the caregivers to do small jobs. Healthcare IoT can boost patient engagement, satisfaction by allowing the patients to spend more time to interacting with their doctors. The application has potential to not only keep patients safe and healthy, but to improve patients care as well. Another major issue with the previous methodologies is the inefficiency of giving proper treatment during the right time, unavailability of doctors. Home Automation provides the patient liberty to be independent. Messaging system helps to understand the needs of the patient properly, provides a high level of satisfaction to the patient.

ARM 7 Processor has a processing speed and can execute the commands faster, therefore integration of the applications and commands from different modules are executed which increases the reliability and performance of the system.

A. Proposed Methodology

Though various systems have previously been developed for the healthcare, home automation and voice to speech systems, most of them did not support ease of access. So, a dynamic system must be developed which integrates all the systems with ease of access and use IoT potentiality efficiently to create an automated system. The proposed system is as shown in figure 3.1.
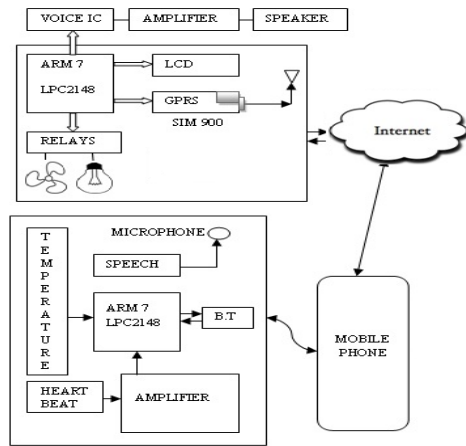

Figure 3.1. Proposed Block Diagram for an Android based Integrated System Using IoT.
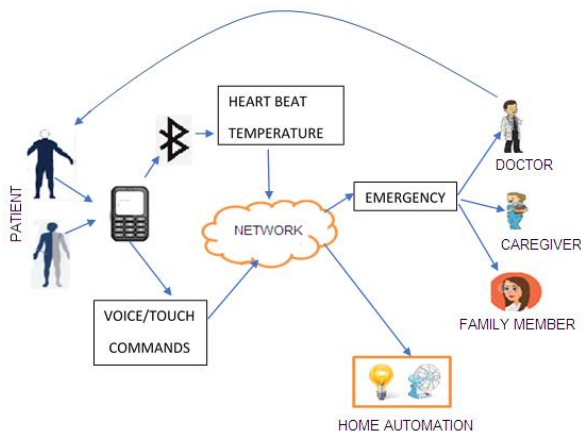

Figure 3.2. Working of Proposed system for physically disabled people using IoT.

All the components sensors, ARM7 processor, Bluetooth, speaker, relays and GSM are connected over an internet. Digital convertor is the way to convert the sensors signal into digital value which is controlled by Microcontroller. communication between hardware and software can be done using RS232 communication. Patient on reaching the Higher Limit (HL) or Lower Limit (LL) sends alerts to all the mobile numbers entered over the network. The android application is provided to the patient and text messages are sent to the doctor, caregiver and family member.

IV. RESULT AND DISCUSSION

A. Hardware Implementation

The hardware implementation for the proposed system requires designing of the hardware to be incorporated near the patient. This consists of PCB (printed circuit board) designing. After the PCB designing is completed, connections done between the components are as follows

a) Home Automation Board

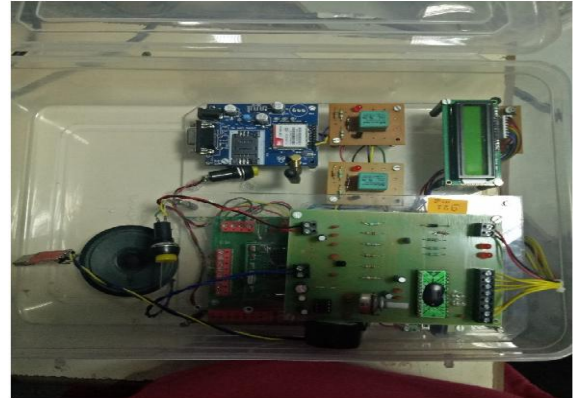Relays, LCD, Voice IC are connected to the ARM Processor pins.

Figure 4.1. Home Automation board

b) Health Care System board

Heart Beat Sensor, Temperature Sensor, LCD are connected to the ARM Processor pins .

Figure 4.2. Health Care board

B. System Execution Steps

The two boards are placed near the patient with an android phone with heart beat and temperature sensor attached to the patient. Patient uses the android application to send the SMS through voice or touch on buttons. Temperature and Heartbeat are automatically sensed by sensors.

The Patient can press start to enter the application.

Figure 4.3. Main Page

The above Figure shows the Main page of the application. When connected with Bluetooth the temperature and heartbeat values are displayed, on reaching the threshold values an SMS is sent to the doctor and caregiver's mobiles. The patient can use buttons Need Help and Emergency to send SMS on the mobile numbers entered. Patient can select SMS to send more SMS using buttons or Start Voice to send voice commands. Patient can operate fan and bulb using buttons or voice after pressing Start Voice button.

Figure4.4. Temperature and Heartbeat values via Bluetooth.

The above Figure shows the Main page of the application. When connected with Bluetooth the temperature and heartbeat values are displayed.

Figure 4.5. SMS triggers for the patient

The above Figure shows the SMS triggers page where the patient can send SMS to the care givers by pressing buttons he can express his feelings to the caregivers and help them to get served properly and when needed.
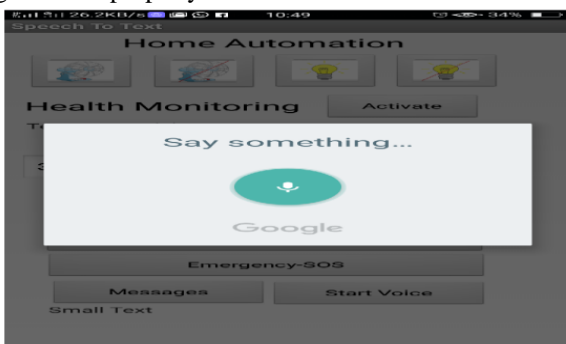

Figure 4.6.Voice Commands Page

The figure shows the voice commands page where the patient can send SMS to the care givers through voice commands and operate the appliances bulb and fan using voice commands.
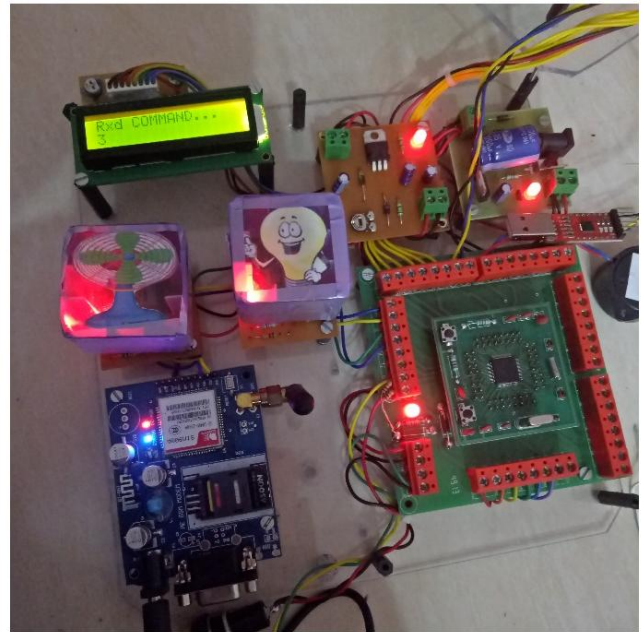

Figure 4.7.Home Automation Board

The above Figure shows the Home Automation Board where the bulb and fan are switched on by the patient using voice commands or buttons. The application helps the patient to operate appliances independently, help the doctor and caregivers to provide proper attention to the patient. Caregiver can understand the patient properly in his daily routines with the messages. The experiment was tested by 7 Patients and with the proposed system SMS was successfully sent to caregivers. The results were compared with previous applications which works separately on home automation, health care system and voice to text application, An integrated system works well with reliable results as ARM processor is used instead of Arduino board and capable of sending multiple SMS at a time without any delay, An integration of the modules made ease to the patient to make ease of use having many options on finger tips.

V. CONCLUSION

IoT is a technology which if used carefully, can help in improving the life style of everyone. One step ahead, it can be the greatest help to physically disabled people. Our system tries to focus on improving the facilities for supporting the patient using IoT technology that not only realizes the needs, but may help in health care services. The motivation behind the system is to enhance the self-dependency on thyself which makes them satisfied by improving their capability of doing things.

FUTURE SCOPE

As the demand for android applications are increasing day to day, there is lot of scope to increase the number of devices and use wearable devices for Home Automation and healthcare systems. Parameters such as ECG, blood pressure and different techniques for SMS can increase the reliability and efficiency of the system.

REFERENCES

1. http://www.happiestminds.com/Insights/internet-of-things/
2. Kumar Mandalu, RamuParupalli, CH.A.S.Murty, E. Mangesh, Rutul Lunagariya "Mobile based Home Automation using Internet of Things (IoT)" International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT), pp. 340-343, Dec 2015.
3. M.Tharaniyasoundhari, Ms.S.BrillySangeetha "Intelligent Interface Based Speech Recognition For Home Automation using Android Application" IEEE Sponsored 2nd International Conference on Innovations in Information Embedded and Communication Systems ICIIECS'15,pp 1-11,March 2015.
4. Gagan,"IOT based system for person with physical disability", International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, pp 157-160, Vol. 4, Special Issue 2, April 2016.
5. Freddy K Santoso, and Nicholas C H Vun, "Securing IoT for Smart Home System", 2015 IEEE International Symposium on Consumer Electronics (ISCE)", June 2015
6. Maradugu Anil Kumar, Y.RaviSekar, "Android Based Health Care Monitoring System", IEEE Sponsored 2nd International Conference on Innovations in Information Embedded and Communication Systems ICIIECS'15, March 2015.
7. B.Sneha, Bhavana V, Brunda.S, Murali.T.S, Puneeth.S, Ravikiran.B.A "A Wireless Based Patient Monitoring System Using Android Tecnology", 2015 International Conference on Applied and Theoretical Computing and Comhmunication Technology (iCATccT), Oct. 2015.
8. GulbaksheeDharmale, Dr. Vilas Thakre, Dr. DiptiD.Patil, "Intelligent Hands Free Speech based SMS System on Android", InternationalConference on Advances in Human Machine Interaction (HMI - 2016), March 03-05, 2016.
9. Ian McGraw, Rohit Prabhavalkar, Raziel Alvarez, Montse Gonzalez Arenas, Kanishka Rao, David Rybach, QuaisAlsharif, HasimSak,AlexanderGruenstien, Francoise Beaufays, Carolina Parada, "Personalized Speech Recognition On Mobile Devices", International Conference on Acoustics, Speech and Signal Processing (ICASSP), pp 5955-5959, 2016
10. SanjaPrimorac and MladenRusso , "Android application for sending SMS messages with speech recognition interface", MIPRO 2012,pp: 1763-1767, 2012.
11. Sharon Varghese, "Application of IoT to improve the life style of differently abled people", International Conference on Emerging Trends in Engineering & Management 29 |Page (ICETEM-2016), pp 29-34, 2016.
12. Bhoomika B.K., Dr. K N Muralidhara "Secured Smart Health Care Monitoring System Based on IoT" International Journal on Recent and Innovation Trends in Computing and Communication, vol. 3, pp. 4958-4961, July 2015.
13. [13] S.M. Raizul, Daehan Kwak, MD. Humaun Kabir, Mahmud Hossain   Kyung-Sup Kwag "The Internet of Things for Health Care: A Comprehensive Survey" IEEE Access, vol. 3, pp. 678-708, April 2015
14. [14] Sapna Tyagi, Amit Agrawal, Piyush Maheswari "A Conceptual framework for IoT-based Health Care System using Cloud Computing" Sixth International Conference Cloud System and Big Data Engineering, July 2016, pp. 503-507.
15. AlexandruArchip, Nicolae Botezatu, Elena Serban, PaulCorneliuHerghelegiu and Andrei Zal "An IoT Based System for Remote Patient Monitoring" Senenteenth International Carpathian Control Conference, June 2016, pp. 1-6.
16. S.M. Raizul Islam, Daehan Kwak, MD. Humaun Kabir, Mahmud Hossain and Kyung-Sup Kwag "The Internet of Things for Health Care: A Comprehensive Survey" IEEE Access, vol. 3, pp. 678-708, April 2015.
17. HasmahMansor, Muhammad Helmy Abdul Shukor, Siti Sarah Meskam, Nur Quraisyia Aqilah MohdRusli and NasihaSakinahZamery "Body Temperature Measurement for Remote Health Monitoring" IEEE International Conference on Smart Instrumentation, Measurement and Applications, Nov. 2013.
18. Manohar, S., and Kumar, D. M, "E-MAIL INTERACTIVE HOME AUTOMATION SYSTEM"," International Journal of Computer Science andMobile Computing (IJCSMC)", Vol. 4, Issue. 7, July 2015, pg.78 – 87,2015.