Object Detection Application for Visually Challenged People Using Internet of Things

[1]Arun Vignesh. M, [2]Madheswari. K

[1,2]Dept. Of Computer Science & Engineering, SSN College of Engineering, Chennai, India.

[1]arunvignesh31@gmail.com, [2]madheswarik@ssn.edu.in

Abstract - **The Internet of Things (IoT) is one of the most prominent technologies, which primarily deals with inter-connecting, controlling and managing digital and electronic devices that are connected to the internet through an IP address. The evolution of high speed network technologies like Long Term Evolution (LTE) and upcoming 5G network technology had already led the path to simulate the whole electronic and digital services and applications at the finger tips. However, the physically challenged people especially the visually challenged people could not utilize the whole of technologies and yet this makes them feel more distressed about themselves. Braille is vital for communication and education purposes for the visually challenged persons. In this paper, a novel design of using IoT for supporting the visually challenged people and its implementation in a smart home is presented. The idea is to make a low cost automation system that help the visually challenged people survive at their home alone without an aid for themselves. In this paper, a device using "Braille smart device" embedded with Braille controller and a Wi-Fi transceiver to detect object location was designed. The objects are embedded with a Wi-Fi receiver module and a buzzer that enable the visually challenged people have things at their reach. The subtle motive of this design is to pauperize those visually impaired persons feeling depressed about their inability.**

Keywords: Intel Galileo, Wi-Fi transceiver module ESP8266, IOT, Braille smart gears, home automation.

I. INTRODUCTION

The internet has brought a new revolution in connecting people across the globe and brought us closer as a single race.   The   first net wave created it attainable to attach one billion users via personal computers within the decennium. The advent of mobile has changed the entire paradigm in more than 2 billion additional connected users since start of the millennium. The next wave, which has already begun, will connect up to 50 billion "things" to the internet by 2020, up from the 10 billion which are already connected today. We are at the cusp of realizing the full potential of the information collected through these internet of things (IoTs).

Among many IoT applications, smart homes play an important role in realizing smart cities. Smart homes can be used for remotely monitoring and controlling electrical appliances fitted inside the home using smart & intelligent physical infrastructure. The present Government of India (GoI) has proposed to develop 100 smart cities[1] across the country which will create a huge demand for smart home automation solutions in near future. In "smart home" the word "smart" means context aware which can be realized using Information and Communication Technology

(ICT) and IoT. The idea behind smart home not only makes our life ease, sophisticated with the use of technologies but also helps the physically challenged people to a very large extent.

Globally, it is estimated that there are around 37 million people are totally blind, and over 15 million are from India. Some have low vision and some people have occurred some kind of visual impairment. As indicated by (WHO) it is evaluated that more than seven million individuals get to be visually impaired each year. It was reported that, 75% of visual deficiency is avoidable, 80% of visual impairment is avoidable and 90% of people with visual impairment live in developing countries. Most of the people with visual impairment are older and female are more at risks at every age, in every part of the world [2]. Blindness is the condition of lacking visual perception. The blind and visually impaired persons have many problems in their daily life and many activities are greatly restricted by loss of eyesight.

There are many technologies which have been designed for them, so that they can easily communicate with other persons. Many efforts have been made to improve their daily life difficulties by the use of technology. My idea is to make a low-cost automation system that would help them

survive at their home all alone without an aid for themselves. In this paper the proposed system enables visually challenged people to use a Braille controller embedded in their Smart device called a "BRAILLE SMART GEAR" to detect the objects embedded with a Wi-Fi receiver module and a buzzer around them so that they have everything at their reach and at the same time, they don't feel depressed over their inability.
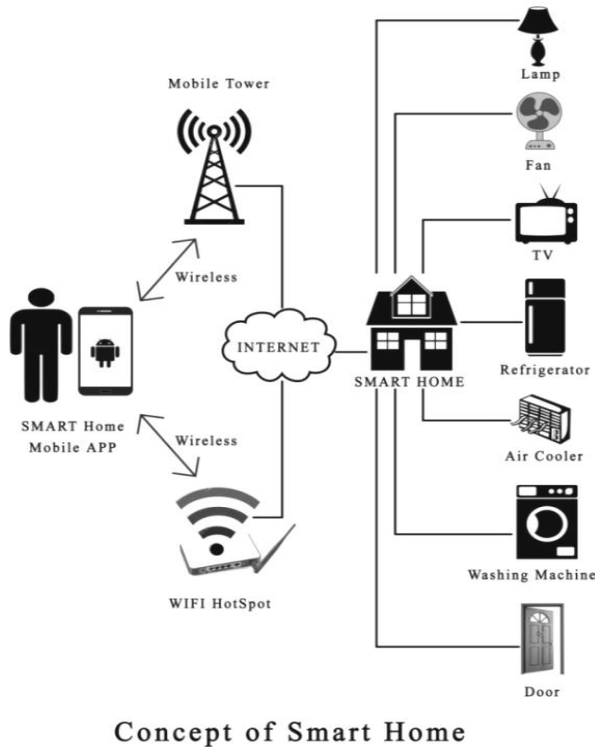

Fig.1 Concept of Smart Home

II RELATED WORKS

Though the concept of smart homes is new in India, considerable amount of work has been carried out in other countries, where smart homes are already in place. Many technologies have been designed for them to aid them to lead their life comfortable. Ruxandra Tapu, Bogdan Mocanu, Andrei Bursuc, Titus Zaharia [3] discusses about a real-time obstacle detection and classification system designed to assist visually impaired people to navigate safely, in indoor and outdoor environments, by handling a smartphone device . Jeya Padmini [4] discusses about effective power utilization and conservation in smart homes using loT. A. Aladrén, G. López-Nicolás[5] discusses the Navigation Assistance for the Visually Impaired using RGB-D Sensor With Range Expansion. Pranay P.Gaikwad [6] discusses about challenges and problems arise in smart home systems for the blind using loT and propose possible solutions. Navya Amin and Markus Boschbach[6] proposed various Object detection techniques for navigation assistance of the Visually Impaired. Smart phones for the blind people are also available with the help of which different gestures can be

recognized. There are Braille screen readers as well as an iPhone application for typing in Braille on the touch screen [7]. The wearable technology for the visually impaired was proposed in [8]. A configurable and refreshing type Braille display was studied, which helps in writing running information on a Braille board [9]. The IOT implementation for helping the visually challenged was well derived form the automation for smart home proposed in [10]. The proposed solution is to make a low-cost automation system that would help them survive at their home all alone without an aid for themselves. Though similar works are carried out elsewhere, hereby an unique architecture for IoT based home automation application for supporting visually challenged people using low cost android phones connected to Braille smart gears and Wi-Fi modules embedded with "Smart wearable device" is proposed. Two important enabling technologies are discussed.

a. *Wi-Fi SiP Chip*

The Wi-Fi SiP (System in Package) chip is designed to support IEEE 802.11 b/g/n single stream with the state of-the-art design techniques and process technology to achieve low power consumption and high throughput performance. The SIP WLAN low power function uses the innovative design techniques and the optimized architecture which best utilizes the advanced process technology to reduce active and idle power, and achieve extreme low power consumption at sleep state to extend the battery life.[11] This basically reduces the space and power consumption of the Wifi module.

b. *Braille Smart Gear*

As useful as smart watches can be, they primarily rely on visual cues to convey information. A vibration alert may call your attention but the key information, such as an incoming call or text or a social media update, is show on the display. As such, they are of limited value to the visually impaired. South Korean designer Jihoon Kim came up with a solution: The Braille Smart Gear [12]. This device takes the world of smart phones to the hands of Visually challenged in an almost near imperforate state.
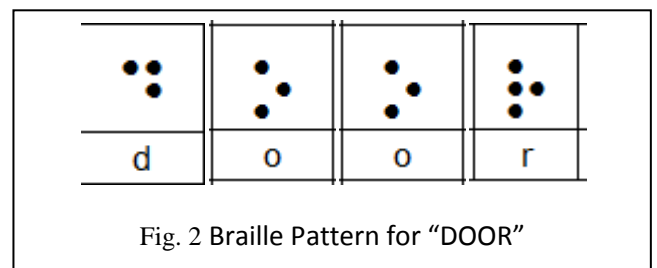

Fig. 2 Braille Pattern for "DOOR"

III PROPOSED WORK

Everyone is aware of the fact that the physically challenged people, especially the visually challenged don't taste the fruits of technology. They are forced to invest so much

effort to lead their daily life. Concerning to their struggles, A solution for the above problem is proposed which would aid the visually challenged to navigate to the location of objects or places they need without any additional equipment apart from their daily reach. This is more similar to a "Home automation system" aiding the blind.

- Every non-static necessary objects like keys, pens, remote controllers, etc. and static places like kitchen, bed room, rest room, pen stand, etc. are embedded with Wifi receivers and a short range proximity sensor with each receiver having unique IP address in a network.

- The handheld Braille smart-stick has a vibration module attached to it. This device once switched on will connect all the devices in the network using the Wifi ESP-8266 module connected with the Intel Galileo framework.

- The visually challenged people will be given a training session to operate the device and of course it will take a day or two to get used to the device and the object locations with the aid of trainers.
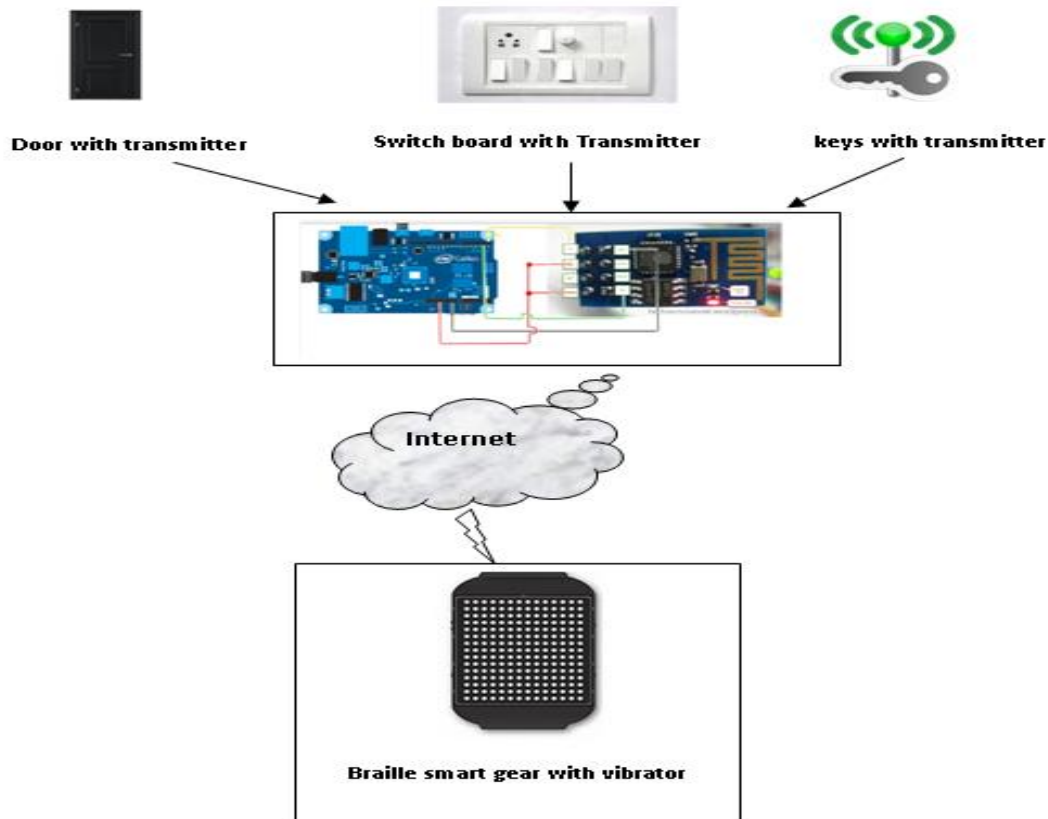

Fig. 3 Proposed Automation system for the visually challenged

- The visually challenged people when come in proximity to any of the embedded device the Wi-Fi module in the smart device sends a alert to the base station which is a Galileo Intel frame work. The user is reached through the cloud and the wearable device vibrates. The user can read the information about the device in their proximity using Braille smart gear system.
- A buzzer present in the to the proximity object is alarmed and they can reach the spot with their high hearing sensory abilities.

a. Home Automation System with Object detection using Intel Galileo WiFi transceiver module

The concept of home automation system for visually challenged people with object detection using IoT is realised using low cost Wi-Fi module based on Intel (Gen-2) embedded in a smart device with a Braille controller and a voice recognition system(If needed). The features of the

Intel Gallileo board is shown in the figure 2. The board is specifically designed to support IOT operations.
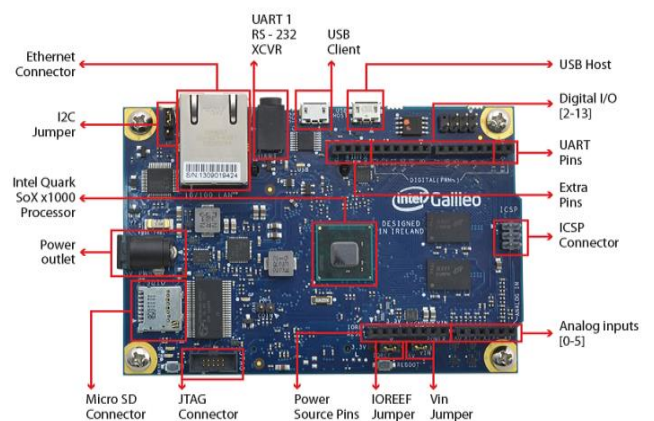

Fig. 4   Features of Intel Galileo

The fig. 3 shows the architecture of the proposed prototype being developed. The objects has a sensor and buzzer attached to a Wi-Fi transiever. Each object of interest have

a unique Id which can be classified by the central processor. When the user nears the object or the place the proximity sensors senses the intervention of the smart device and alerts the person by means of vibration and Braille smart gear. The user can read the information about the object. Each visually challenged person is provided with a Smart embedded device where a Braille controller/keypad with inbuilt Braille to text translator that triggers the Wi-Fi transceiver module to inter-connect with all the receiver modules provided. The fig. 4. Gives how a person reads the information from the Braille gear.

b.   Arduino AT Commands

COMMAND	COMMAND EXPANSION	COMMAND DESCRIPTION
AT	**At**tention	Ensures Wi-Fi module connection is perfect
AT+RST	**At**tention+**R**es**et**	Resets the connection
AT+CWLAP	**At**tention+**C**onfigure **Wi-Fi** and **L**ist **A**ccess **P**oints	Lists all the Networks nearby
AT+CWJAP="Id"	**A**ttention+**C**onfigure **Wi-Fi** and **J**oin **A**ccess **P**oints	Join with the specified Network
AT+CIFSR	**A**ttention+**C**onfigure	Prints IP address , MAC address of the connected Access Point

c.   Arduino simulation

The commands to authenticate, connect and configure the proximity devices to the network and the Wifi transceiver, i.e. the Braille controller have been simulated and the screenshot is attached to the following.

```
                                          COM3

AT

OK
AT+CWLAP
+CWLAP:(3,"AndroidAP",-56,"f8:84:f2:df:a7:34",6,-4,0)

OK
AT+CWJAP="AndroidAP","iuqu1627"
WIFI DISCONNECT
WIFI CONNECTED
WIFI GOT IP

OK
AT+CIFSR
+CIFSR:APIP,"192.168.4.1"
+CIFSR:APMAC,"62:01:94:09:49:57"
+CIFSR:STAIP,"192.168.43.192"
+CIFSR:STAMAC,"60:01:94:09:49:57"

OK
```

Fig. 5 Arduino Screenshot

d.   Why and why not intel galileo?

The Intel Galileo board is genuinely Arduino, and source code is available for download with no software license agreement other than open source licenses. Hardware and software source files, including schematics, are provided for download. Intel has good documentation and has seeded the community by giving away several thousand Galileo boards. The Galileo has some differentiating attributes such as PCI Express (PCIe) and a Real Time Clock (RTC), whereas the RPi has peripherals well-suited for graphics-intensive applications for HD 1080p streaming video.

Galileo is a memory-rich, fairly high-performance 32-bit x86 with traits well-suited to embedded portables or wearable devices: small in size (highly integrated), low power, and fairly low cost with respect to the value that is packed in this SoC. Some major differences: RPi has a Graphics Processing Unit (GPU.) Galileo does not. Galileo has an I2C-controlled I/O expander that runs at 200Hz. I/O that runs through the any of the three "GPIO PWM" blocks on the Galileo schematic is going to be limited to only 200 updates per second. IO13 avoids the limitations of the expander, as well as the UARTs, SPI, I2C, and the ADC. Galileo boots from on-board memory. RPi can only boot from the SD card. Galileo has the first PCIe slot supported by Arduino.

IV. OUTCOMES & CHALLENGES

This paper demonstrates an automation concept that would aid the visually challenged people to detect every object around them using voice recognition or the Braille controller either by the object ID or the name. This proposal, not only supports "Smart Home System" but also gives the visually challenged people, a motivation to live being self-supported.

Since IoT is one of the upcoming technologies that can be used for home automation, there are many challenges that are associated with it. One of the major challenges is the lack of standards for integrating various sensors, applications and other existing intelligent embedded devices. Providing unique IP addresses for connected devices and privacy & security in a smart home environment is another big challenge. As IoT deals with huge amount of data collected from various sensors deployed in a smart environment, proper care should be taken in handling, storing and securing the data. In future, data analytics and visualization can be used for effective monitoring and management of IoT devices in a smart home environment. Also it will be difficult to implement this system at once for the major population of visually challenged across the country. But once it is kicked off, this

will surely enhance its presence and reach their hands at the earliest.

V. CONCLUSION & FUTURE SCOPE

In this paper, a prototype of home automation for visually challenged using IoT is presented. With aid of the smart device and Braille gears, the visually challenged can easily have everything they need at their reach. They can find the location of any objects they need or the place they need to move within their home with their sensory abilities more effectively than what normal people do. This work will be carried forward by integrating relays to Arduino board for controlling home appliances using the Braille controllers in a real scenario which will make upto the conventional smart home systems. As an extension, there are many hypothesis that propose a generic IoT framework and use cloud computing infrastructure for connecting and managing remote devices and also store sensor data. A futuristic view to use gesture controllers like Microsoft's Kinect sensor kit to support advanced automation will be proposed with a solution.

REFERENCES

[1] http://smartcities.gov.in

[2] World health organization sheet "*visual impairment and blindness*: world health organization august [2014].

[3] Ruxandra Tapu, Bogdan Mocanu, Andrei Bursuc, Titus Zaharia, *"A Smartphone-Based Obstacle Detection and Classification System for Assisting Visually Impaired People",* 2013 IEEE International Conference on Computer Vision Workshop(ICCVW), 2013.

[4] "*Portable refreshable E- Braille*" in International Journal of Engineering research and applications.

[5] A. Aladrén, G. López-Nicolás, *"Navigation Assistance for the Visually Impaired using RGB-D Sensor With Range Expansion",* IEEE Systems Journal, Vol. 10, No. 3, September 2016.

[6] Navya Amin, Markus Borschbach, "*Obstacle Detection Techniques for Navigational Assistance of the Visually Impaired*", 2014 13th International Conference on Control, Automation, Robotics & Vision, (ICARCV 2014) Marina Bay Sands, Singapore, 10-12th December 2014.

[7] Shreya Gandhi, Bhaskar Thakker and Shreelal Jha, "*Braille cell actuator based teaching system for visually impaired students*", IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), May 2016.

[8] Ramiro Velázquez, "*Wearable Assistive Devices for the Blind*", Wearable and autonomous biomedical devices and systems for smart environment. Springer Berlin Heidelberg, pp.331-349, 2010.

[9] Russomanno, Alexander, et al. "Refreshing refreshable braille displays." *IEEE transactions on haptics* vol.8, issue3, pp. 287-297, 2015.

[10] Mayer, Simon, et al. "Smart Configuration of Smart Environments." IEEE Transactions on Automation Science and Engineering vol.13, issue3, pp.1247-1255. 2016.

[11] Mr. Pranay P. Gaikwad, Mrs. Jyotsna P. Gabhane, Mrs. Snehal S. Golait, "A Survey based on Smart Homes System Using Internet-of-Things", 2015 International Conference on Computation of Power, Information and Communication, 2015.

[12] www.iotworkshop.com/index.php?route=product/category&path=152_153&gclid=COeOnJOBwdECFc4SaAodgysJ1g.

[13] http://www.eyeonmobility.com/2015/concept-sunday-braille-smart-gear-smartwatch-for-the-visually-impaired/

[14]www.sciencedirect.com/science/article/pii/S037859551 53 00174