ARDUINO LILYPAD SHOES FOR VISUALLY CHALLENGED

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Abstract - Arduino Lilypad shoes are intended primarily to assist blind people to reach their destination and also help them to avoid walking into things on their way. It consists of a pair of shoes in which one is fitted with vibrators, proximity sensors and a bluetooth pad. These devices are connected to an android mobile phone that calculates directions and real time location using google maps, built-in GPS and compass module. In arduino Lilypad, proximity sensors are used to detect the obstructers in the way of visually challenged people. So this arduino Lilypad device offers a non-obtrusive navigation for these people. A voice recognisable technique is used to know the desired destination of the blind people. A bluetooth device sends signal to the arduino Lilypad using the concept of internet of things. Internet of things wirelessly connects an object to the cloud and abstracts the necessary information from the internet.

Key Terms - Vibrators, proximity sensors, google maps, GPS, compass module.

I. INTRODUCTION

The arduino Lilypad shoes mainly offer a non-obtrusive navigation for visually challenged [3]. The system describes about the arduino Lilypad device attached with the shoes and its working principle. The arduino Lilypad shoes are attached with the devices such as bluetooth and the proximity sensors [4]. The arduino Lilypad is the main device which controls the vibrators placed at the sole of the shoe. This arduino Lilypad recognise the instructions sent by the bluetooth device and the proximity sensors then it works accordingly. The google maps also play a vital role in locating the geographical area around the world. Firstly it would discuss about 1) Explanation on arduino Lilypad 2) Working of arduino Lilypad shoes 3) Usage of arduino Lilypad shoes and its functionality. This is also called as *Le chal* which means 'take me there' in Hindi. Lechal shoes are not only used by visually challenged people but also by common man for navigating them to various destinations.

II. ARDUINO LILYPAD

2.1 Overview:

The Arduino Lilypad is designed to be sewn by clothes and other fabric with conductive thread. The Arduino Lilypad can be powered either from the USB connection, bluetooth or a 3.7V LiPo battery [2].

The board runs at 3.3V; applying more voltage such as 5v to the device may damage its pin. If the user connects a USB cable from a computer and a LiPo battery to the Arduino Lilypad, it will charge the battery. The Arduino Lilypad switch allows the user to turn the board on or off. Similar to the Arduino Leonardo and Micro, the Arduino Lilypad uses a single microcontroller called the Atmel-ATmega which is used to run both the sketches and communicate over USB with the computer. This means that would need a USB cable to program the Arduino Lilypad USB (as opposed to an FTDI USB-serial adaptor as with other Lilypads) [2] but it also means that there are some differences in the way that the USB communication works.

Arduino Lilypad is a set of sewable electronic pieces designed to build soft interactive textiles. A set of sewable electronic modules, consisting of a small programmable computer called an Arduino Lilypad – can be stitched together with conductive thread to create interactive garments and accessories. Arduino Lilypad can sense the information about environment using inputs like light and temperature sensors and can act on the environment with outputs like LED lights, vibrator motors, and speakers. Arduino Lilypad designing was done by Leah Buechley. The commercialised version of the kit was collaboratively designed by Leah and SparkFun Electronics.

2.2 Comparison of Arduino Lilypad board with other board:

The Arduino Lilypad USB uses a single processor (the ATmega32U4) to run both the sketches and communicate over bluetooth with the mobile phones. This gives more flexibility.

2.3 Comparison of Arduino Leonardo with Micro:

The Arduino Lilypad USB is limited to an 8 MHz clock speed vs 16 MHz for the Leonardo and Micro. The sketches should behave the same on either board, but it is important to correctly select the appropriate board in the boards menu

[2]. Uploading to Arduino Lilypad USB with the board set to "Arduino Leonardo" or "Arduino Micro" won't be able to communicate over USB (and the timing of other things will be off). If this does happen, the user needs to recover the device using the method described in the next section.

2.4 Uploading Sketches to the Lilypad Arduino:

To upload the Lilypad Arduino USB as you do with other Arduino boards: select "Lilypad Arduino USB" from the Tools Board menu and the appropriate serial port from the Tools Serial Port menu and press the upload button. The Lilypad will be reset, launching the boot loader that receives the new sketch from the computer and stores it on the board. The boot loader then automatically launches the new sketch. Then it tells at what time the boot loader has to be run because the on-board pin 13 LED will fade in and out.

Sometimes, however, this automatic reset fails. This can happen, for example, upload a sketch to the Lilypad with a different board selected in the Tools menu. When this happens, then press the reset button on the Lilypad twice in quick succession to initiate the boot loader. To upload with this technique, the upload button has to be pressed first in the Arduino software; then, when you see the status message "Uploading" press the reset button twice. This should initiate the boot loader, and the Arduino software will upload your sketch. The double press on the reset button should be done as soon as the uploading message occurs.

2.5 Pin configuration of Lilypad Arduino:

The Lilypad simple has fewer inputs and outputs when compared to the Lilypad Arduino Main Board. Totally there is of 9 I/O pins on the Simple board, one exposed pin for +3.3VDC, and the other pin for ground. Each of the 9 digital I/O pins on the Lilypad Arduino Simple can be used as an input or output, using a mode called pinmode(), digitalwrite(), and digitalread() functions. They operate along with 5V. Each pin in the device can provide or receive a maximum of 40mA and they also have an internal pull-up resistor (disconnected by default) of 20 kOhms. In addition to that some pins have specialized functions:

1) PWM: 5, 6, 9, 10, 11 Provide 8-bit PWM output them along with the analogwrite() function.
2) Analog Inputs: A2-A5. The Lilypad Simple Arduino has 4 analog inputs, labelled A2 through A5, all of which can also be used as digital I/O. Each analog input provides 10 bits of resolution (i.e. 1024 different values). By default the analog inputs measure from ground to 5V, even though it is possible to change the upper end range using the analogreference() function.

The Lilypad arduino's pin configuration is represented as a schematic diagram in the Figure 2.5.1. The ATMEGA328 microcontroller is used in Lilypad arduino. In this microcontroller there are totally 32 pins used which are elaborately explained in Figure 2.5.1.Each pin has its own functionality and they are connected with various capacitors and resistors accordingly. The MCP73831/2 devices are highly advanced linear charge management controllers for use in space limited, cost-limited applications. The MCP73831/2 is available in an 8-Lead, 2 mm x 3 mm DFN package, SOT-23 package. Along with their small sized, less number of external components required makes the MCP73831/2 suited for portable applications. The switch of the Lilypad shoes is explained in detail when the power should be switched on and off. This pin diagram design was given by L.Buechley and N.Seidle.They developed this arduino Lilypad pin configuration in the year 2009.The document number of the following pin diagram is Spark Fun Electronics. The elaborate functioning of arduino Lilypad is used for fitting various vibrators connecting them in their respective pins in the microcontroller. Their proximity sensors are also connected to this arduino microcontroller pin and they function accordingly. The functioning and other explanations are mentioned in the working section.

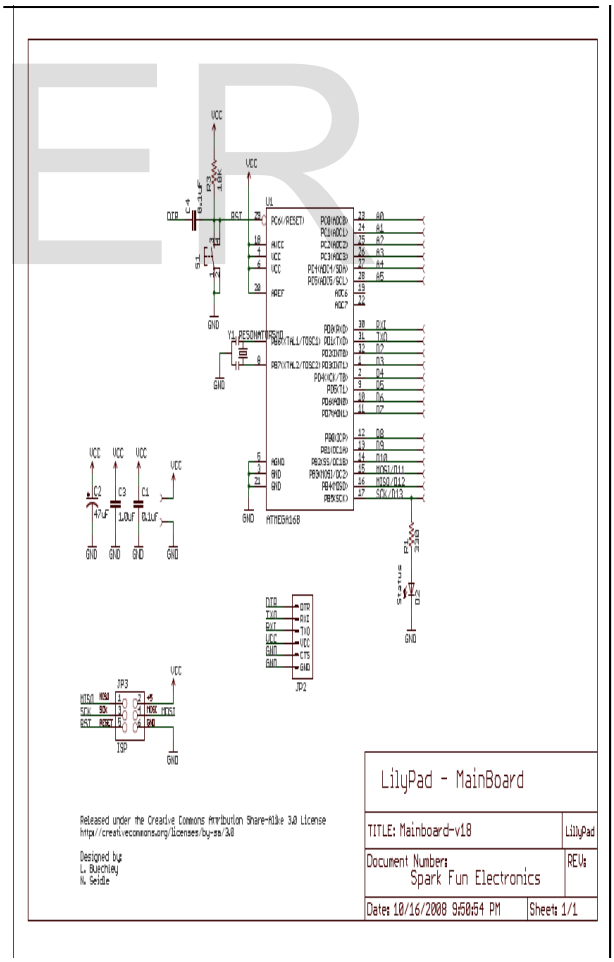

Figure 2.5.1 Pin configuration of Arduino Lilypad

2.6 Programming and Physical Characteristics:

The Lilypad Arduino can be programmed with the Arduino software. The Lilypad Arduino should only be programmed along with software versions 0010 or higher versions [7]. The ATmega 328V on the Arduino Lilypad comes along with a preburned boot-loader that allows the user to upload new code to it with the Arduino software. The user can also bypass the bootloader and program the ATmega through the ICSP (In-Circuit Serial Programming) header is seen with the instructions [3]. The Lilypad Arduino is a circular device, approximately 50mm (2") in diameter. The board itself is 0.8mm (1/32) thick. It can also be washed if needed. Table2.6 describes the configurations and specifications along with their units of the arduino Lilypad.

Table 2.6. Physical characteristics and configuration of Lilypad arduino

Specification	Values
Microcontroller	ATmega328V
Operating Voltage	2.7-5.5 V
Input Voltage	2.7-5.5 V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 Ma
Flash Memory	16 KB (2 KB of flash memory is used by bootloader)
SRAM	1 KB
EEPROM	512 bytes
Clock Speed	8MHZ

III. WORKING OF LILYPAD SHOES

The Lilypad shoes contain a pair of shoes, but the aurduino is fitted only in one of them which receives information from the mobile phones via bluetooth and sends signals to the vibrators accordingly [1]. The user simply needs to speak the final destination before the start of his journey and the Android app which formulates the route and calculating turn by turn directions which is sent to the shoe wirelessly via bluetooth. Different vibrators within the shoe are placed at different positions based on the directions of GPS to coordinate and compass, which may activates the system to provide feedback to the user depending on the turn he/she needs to take. So essentially, the system converts the navigation data into haptic feedback [4]. The vibrators also get the feedback from proximity sensors, which detect physical obstructions upto a range of 10 feet [1].

The intensity of the vibrations differs depending upon the proximity from the destination. For example, at the beginning of the user's journey the feedback signal is weaker, while as the user reaches closer to the destination the strength of the signal increases. Voice instructions may be distractive and wearable gear is obtrusive and it may attract unnecessary attention [9]. So that the system has been designed to make it non obtrusive for the users. At a Bangalore based Blind-school the arduino Lilypad shoes have been tested by Anirudh Sharma [1]. The system costs about a few hundred rupees along with all the assemble 8 mini vibrational motors , a sole of specified dimensions, an Arduino Lilypad GSM and GPS shield custom estimated for about Rs 400 or a wired version costing about Rs 150 for all the components [4].

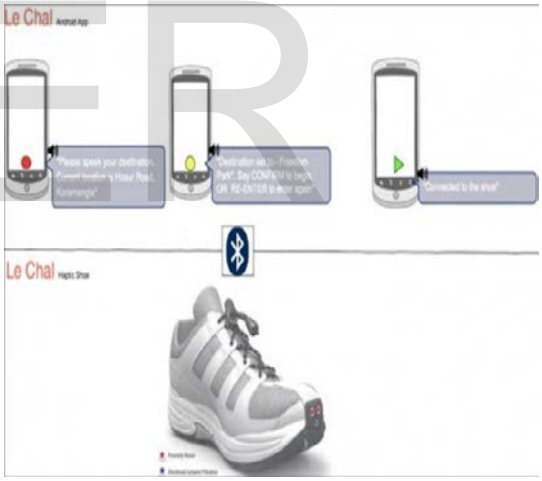

Figure 3.1 Working of Lilypad Arduino

There are a very few steps which are to be followed to use this device efficiently.The steps to be carried out are:

1) The person should switch on the GPS in his/her mobile phone first to locate their current position.
2) The user should then speak out the destination.
3) Once the destination is all set then say CONFIRM or RESET to re-enter the destination place.
4) The google maps then calculates the route maps for the destined place and sends signals via Bluetooth to

the arduino. The proximity sensors are used to sense the nearby physical obstructions to a range of 10 feet distance [6].

5) According to the signals received the vibrators vibrate at the particular corners indicating the person to turn to appropriate direction.
6) The proximity sensors within the arduino liypad shoe would sense the objects or any obstructers on their way and would indicate them to take an alternate path accordingly.
7) The person should first switch on the GPS in his/her mobile phone to locate their current position.
8) He should then speak out the destination.
9) Once the destination is set then say CONFIRM or RESET to re-enter the destination place.
10) The google maps then calculates the route maps for the destined place and sends signals via Bluetooth to the arduino. The proximity sensors are used to sense the nearby physical obstructions to a range of 10 feet distance [6].
11) According to the signals received the vibrators vibrate at the particular corners indicating the person to turn to appropriate direction.
12) The proximity sensors within the arduino Lilypad shoe would sense the objects or any obstructers on their way and would indicate them to take an alternate path accordingly.

The following steps are represented in the Figure 3.1.

IV. INTERNET OF THINGS

A thing in the Internet of Things, can be a human with a heart monitor implant, an animal with a bio-chip transponder, a vehicle which has built-in sensors which would alert the driver when the pressure in the tire is low or other natural or man-made object which can be assigned with an IP address and given with the ability to transfer data over a network. So far, the Internet of Things is closely associated with machine-to-machine (M2M) communication in manufacturing and power, oil and gas utilities. Products which are built with M2M communication capabilities are often referred to as a smart. IPv6's huge increase in address space which is an important factor in the development of the Internet of Things.

According to Steve Leibson, who identified himself as "occasional docent at the Computer History Museum," the address space expansion which means that one could "assign an IPV6 address to every other atom on the surface of the earth, and they still have enough addresses left to do another hundreds of earth." In other words, human beings could easily assign an IP address to every "thing" on the planet [11]. An increase in the number of smart nodes, as well as the amount of upstream datas then the nodes will be generated. This is expected to raise new concerns of data privacy, data sovereignty and data security. Even though the concept wasn't named until 1999, the Internet of Things has been in the process of development for many decades. The Arduino lily pad which is a device that is connected to the cloud using the concept on internet of things and the routes are extracted from the google map finder. Using this, arduino Lilypad passes a set of instruction to the vibrators and the intermediate nodes to direct them to their destination.

V. COMPONENTS OF LILYPAD

In the Lilypad shoes, Figure 4.1 shows its component. There are totally eight vibrators present at the corners of the shoe's soul in which four vibrators are present in all the four directions such as east, west, north and the south.

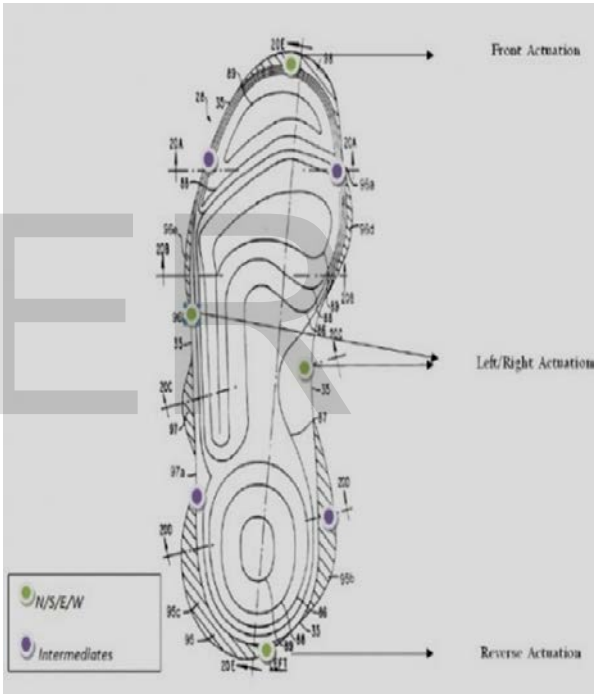

Figure 4.1 Components of Lilypad shoes

The other four vibrators fitted over the souls of the shoes are used as intermediates which are also used as vibrators. The intermediate directions indicate the obstructers on their way. There are two actuations such as Front actuation and Reverse actuation. The in-between actuation represents the left and right actuation.

VI. USAGE AND ADVANTAGES

These shoes can be used in all blind schools and by all visually challenged people as the cost of it is very minimal and it is simple to use [10]. They just need to speak out their desired destination and they would reach the destined place without others guidance to the maximum level. It would change their lifestyle because they could tend to lead a normal life by being independent in few ways. They require minimal inputs to make this Lilypadshoes. They are as follows:

1) 1 Smart phone with compass enabled GPS to pull location data from satellites
2) 2 Shoes with soles of the defined dimensions to house the components
3) 1 Bluetooth Arduino Lilypad to sync devices
4) Mini vibrational motors to inform the user about the directions
5) 1 Proximity sensor

One could even make their own Lilypad shoes by just fitting in the arduino within the shoe and few other connections are to be made.

VII. LIMITATION

This is a great idea and even though the implementation in first hand has not been experienced, it's superior to see that this technology is being influenced to solve everyday problems faced by the differently abled. Not too sure about the quality of navigation and GPS modules fitted in the smartphone devices, because they aren't always more accurate – especially in the Google Maps. Also, the naming convention for various places is not that much of coherent in India, which makes offering the perfect directions difficult.

A step in the right direction that must be taken up by a big product brand for a wider scale. When shoe companies and gadget makers can collaborate on fitness tracking devices, why can't they do something with the direction control.

VIII. CONCLUSION AND FUTURE WORKS

The arduino Lilypad shoes have multiple purposes. It need not be used only by the visually challenged instead it can be used by normal people for their navigation purpose. For example mountaineers, trekkers, etc. It can also develop as a lifestyle product that tracks the number of steps you take, the number of calories you burn and also lets you take fitness goals. More than all this, you can also share routes with your friends who too are using the shoe. Ballet shoes are also available wherein the dancers fit these arduinos in their shoes [5].

IX. REFERENCES

[1] Anirudh Sharma,"anirudh.me\"-2011

[2] Alahmad, Mahmoud A.; Wheeler, Patrick G.; Schwer, Avery; Eiden, Joshua; Brumbaugh, Adam, "A Comparative Study of Three Feedback Device Residential Real-Time Energy Monitoring", IEEE Transactions on Industrial Electronics, vol. 59, Issue: 4, pp, 2002-2013, 2012 .

[3] Lechal: Android powered shoes reference.

[4] Haptic shoes lechal reference"http://anirudh.me/2011/06/le-chal-a-haptic-feedback-based-shoe-for-the-blind/ M. Ghanbari.

[5] Ballet shoes arduino-"https:// blog.arduino.cc/ e-traces-creates-visual-sensations-from-ballerin**".**

[6] Arduino announces new brand, "Genuino manufacturing-partnership with adafruit-make"- Dec 2011.

[7]Simon Monk-"Programming Arduino getting started with Sketches"McGraw hills publication, 2011.

[8]Maberley, DA; Hollands, H; Chuo, J; Tam, G; Konkal, J; Roesch, M; Veselinovic, A; Witzigmann, M; Bassett, K (March 2006). "The prevalence of low vision and blindness in Canada.". *Eye (London, England)* March 2006.

[9]Keim D.A,Mansmann.F,Schneidewind.J,Ziegler.H-"Challenges in Visual Data analysis"-Information visualisation,2006,10th International conference.

[10]Kim.W,Mechitov.K,Jeung,Yoon choi,Ham.S-"On target tracking with binary proximity sensors"-Information processing in sensor networks,2005,IPSN 2005,Fourth International symposium.

[11]Lu Tan,Neng Wang-"Future internet:The Internet of things-Advanced computer theory and engineering,2010 3rd International conference".

[12]RH Weber,R Weber-"Internet of things"-version 6-2010 Springer publications.

[13]H Lane-Disability & Soceity,Taylor,Francis-"Constuctions of deafness"-1995.

[14]Tae-Hee Kim,Cheon Sig Sin,"Automation & System analysis of performance of GPS signal'-2014 14th International conference-Pages 1006-1009.

[15]Zaruba.G.V,Gupta.V,"Simplified Bluetooth device discovery-analysis and simulation"-Annual Hawaii International conference-Pg. 9.