International Journal of Research in Advent Technology, Vol.6, No.9, September 2018
E-ISSN: 2321-9637
Available online at www.ijrat.org

Health Monitoring Wearable Glove

Ribin Jones S.B[1], Dr. N. Kumar[2], Swaraj S Paul[3]
School of Computer Science and Engineering[1,2,3],Vels Institute of Science, Technology and Advanced Studies[1,2,3]
Email: ribinjones@gmail.com[1], kumar.se@velsuniv.ac.in[2] ,spaul.se@velsuniv.ac.in[3]

Abstract- Wearable Technologies are devices which can be worn by the user & simultaneously process and display relevant information on the wearer. Wearable technology has a variety of applications which grows as the field itself expands. The technology that these new devices are employing is innovative to say at the least. Smart technology is certainly something that will be the key to the optimal operating of our future society, especially when it comes to healthcare. In this project, we will build a Health Monitoring Wearable Glove which can be worn and used to display the heart rate of any individual on the display mounted on the glove. The pulse on a person is sensed using a pulse sensor, which sends information to the Lilypad Arduino board & it subsequently processes the information and commands the display module to display the heart rate. A person need not be a professional to check the pulse.

1. INTRODUCTION

Wearable technologies are now an integral part of our daily lives. They live in our wrist, our glasses, track activities and take us into a virtual world. Wearable technology devices are nothing but devices which can be worn by anyone which displays relevant information on the wearer. Wearable technology has a variety of applications which grows as the field itself expands. The wearable technology devices use technologies which are very innovative. Future society will depend mainly on smart technology for optimal operating, especially in the field of healthcare industry[1]. The need of wearable technology in healthcare arises due to the need for monitoring patients over an extensive period of time [5].

1.1. *Wearable technology applications*

• Medical: Wearable Technology plays a very important role in today's Healthcare transformation. In the medical field wearable tech could be used to monitor vital signs, manages diseases, and monitor patients at all time [3].
• Security: For security and safety purposes, wearable Tech could be used in a military to provide environment surveillance, remote monitoring and real time data acquisition.
• Sports/Fitness: In the field of sports and fitness, devices could be made for physiological monitoring, energy monitoring, sports performance, posture monitoring etc. to provide insight and prevent injuries.
• Lifestyle: Wearable Tech are also being used to improve our lifestyles through organising, interactive gaming or decorative displays.
• Communication: They can also be used for faster communication during an emergency or area sharing experiences more personally.

1.2. *Wearable technology products*

Some prominent wearable technologies that we have already used include Fitbit Activity tracker, which monitors our physiological processes and help us track and analyse the data obtained from these processes, VR headsets which transports us to a virtual world. Google Glass which provides functionality that is integrated with the user's current experience of the world and the Athos smart cloth which monitors muscle activity and posture to help us exercise correctly and prevent injuries. Demand is always high for wearable non-invasive devices which do not interfere in the daily routine of the person wearing them [2].

2. METHODOLOGY

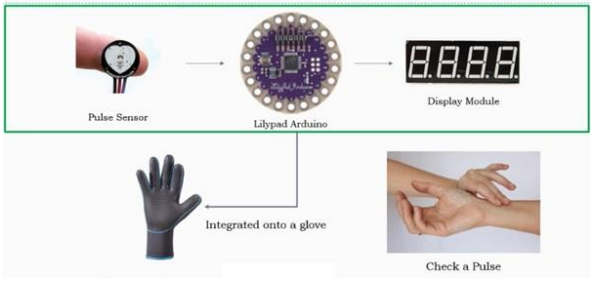


Fig. 1. Project Idea

A pulse sensor is used to detect the pulse of an individual and process the data on the lilypad arduino board and finally display the pulse reading on the display module. This system must be integrated onto a

glove such that the entire system can work as a standalone pulse measuring device.

A pulse is basically a pressure wave that travel across all the arteries. Every time Heart beats, arteries carry oxygenated blood from the heart to the extremities of our bodies. Pulses can be felt in the places where an artery can be pressed against the bone. One such artery is the radial artery below the wrist. Pulse oximetry is a technique used to measure the blood oxygen content and blood volume in the skin. Such devices are called pulse oximeters. These devices work based on the amount of light absorbed or reflected by blood which varies based on the volume of the blood or the oxygen content in the blood. Devices which sense the amount of light that has passed through the blood are transmissive type oximeters and those that sense the amount of light that is reflected from the blood are reflective type. The output graph of the acquired pulse is called a Plethysmogrpah. The pulse sensor that we used in this project is a reflective type pulse oximeter.

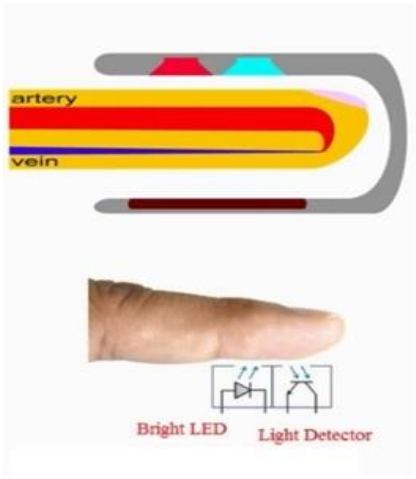
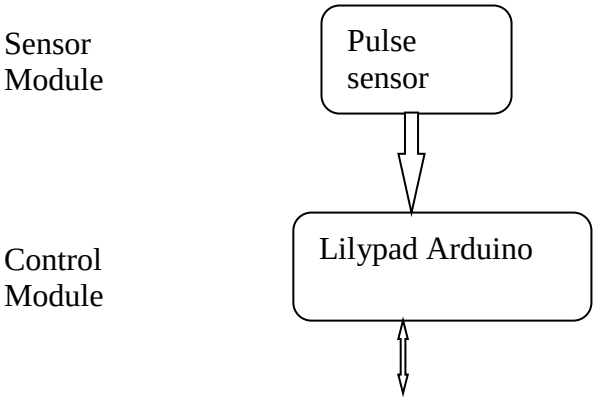


Fig. 2. Reflexive Pulse Oximeter

2.1. *Pulse Glove – Block Diagram*

The system has a Sensor module, Control module and a Display module for its effective functioning.



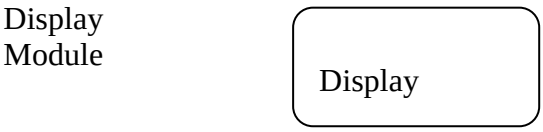


Fig. 3. Block Diagram

2.1.1. Sensor Module

A pulse sensor will be used for detecting the pulse of a patient. This sensor will be stitched to a glove for easy handling. The sensor module senses the pulse and sends the information to the Control module.

2.1.2. Control Module

Information from the sensor will be received by a Lilypad Arduino board. The information is then processed and appropriate command to the Display module is sent.

2.1.3 Display Module

This section will comprise of a display unit which display the pulse rate.

3. HARDWARE AND SOFTWARE

This project uses software as well as hardware for its implementation

3.1. *Hardware Used*

- Arduino Lilypad
- FTDI Board
- Pulse sensor
- TM 1637 Display
- Pin Connectors
- Battery connector and holder
- AA batteries

Arduino is an Open source electronics platform based on easy to use hardware and software. It is a combination of microcontroller based arduino boards, arduino programming language and the arduino software for development and compilation. Arduino has evolved from being just an embedded environment to helping build advanced products for internet of things applications, wearables, 3D printing etc. Also, being an open source platform the hardware design schematics, PCB files and the code for the software

are freely available. This gives users the flexibility to adapt and develop the design for their own projects. Arduino is used in thousands of different projects, thanks to its simple and accessible user experience. Some of the other reasons why people are going for arduino are because they are inexpensive, it works cross-platform, simplicity and clear programming environment, open source and extensible software and hardware.

Future Technology Devices International, also known as FTDI, is a Scottish privately held semiconductor device company, specializing in Universal Serial Bus (USB) technology. To allow support for legacy devices with modern computers, FTDI develops, manufactures and supports devices and their related software drivers for converting RS-232 to USB signals. FTDI provides application-specific integrated circuit (ASIC) design services. They also provide consultancy services for product design, specifically in the realm of electronic devices.

TM1637 used in this work is a chip for driving 7-segment displays. Several modules used in this chip form a 4 digit numerical display module. There are seven LEDs arranged in the shape of numeric 8, each called a segment and hence the name. Each of these seven segment LEDs are represented by a character for reference. In some displays, there will be an additional LED for decimal point indication.

Table 1. Truth table for 7-segment display

Segments Input							7 Segment Display
a	b	c	d	e	f	g	
1	1	1	1	1	1	0	**0**
0	1	1	0	0	0	0	**1**
1	1	0	1	1	0	1	**2**
1	1	1	1	0	0	1	**3**
0	1	1	0	0	1	1	**4**
1	0	1	1	0	1	1	**5**
1	0	1	1	1	1	1	**6**
1	1	1	0	0	0	0	**7**
1	1	1	1	1	1	1	**8**
1	1	1	1	0	0	1	**9**

There are two types of 7-segment displays namely Common Cathode and Common Anode type. In the common cathode display, all the cathode connections of the LED segments are joined together to ground. The individual segments are illuminated by "HIGH" signal. In the common anode display, all the anode connections of the LED segments are joined together to VCC. This is the most commonly used display module. In this project, we use Common Anode type display.Shown below is the common anode type display and its pin description.

Table 2. Common Anode type display

3.2. *Software Used*

The Arduino Software (IDE) runs on Windows, Macintosh OSX and Linux Operating Systems. But most microcontroller system software requirements are limited to Windows only. The Arduino Software is provided as an open source tool for the beginners and students to write and upload the program onto the microcontroller. Programming of the Uno board is denoted by "Sketches". Each sketch contains variable declaration, initialization and control code. The setup function contains the Initialization variables and Loop function contains the Control code. The program/sketch is saved in .ino format and the various sketch operations like opening, verifying, saving etc. can be done from the tool menu. We should select the suitable board and serial port number from the tools menu. Upload button is used to upload the code to microcontroller.

4. SETUP

4.1. *Project Schematics*

As we know there are three primary components in the health monitoring glove. The pulse sensor, the lilypad arduino and the TM 1637 display Module.

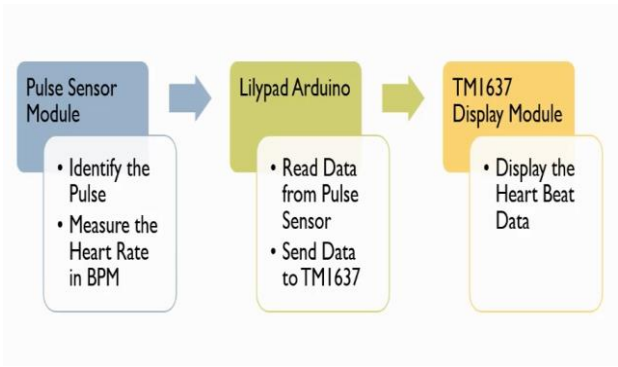
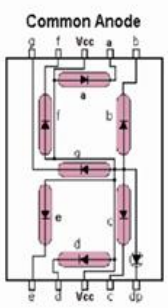


Fig. 4. Project schematics

The pulse sensor module is necessary to detect the pulse and measure the rate of the post in Beats Per Minute. The Lilypad Arduino read the data from the pulse sensor at regular intervals and sends the same [4]

to the TM 1637 display module. Finally TM 1637 display module receives the data in digital format and displays it using the four seven segment display. In addition to the above primary components there are also the power supply, a glove and conductive thread that form the wearable.



Pin Name	Description
a, b, c, d, e, f, g	LEDs to Display numeric
Vcc	Pin to connect Common Anode
DP	Decimal Point LED

4.2 Connection Schematics

Below table shows how the three components are interfaced with each other.

Table 3. Connection Schematics

Component 1	Pin	Pin Description		Pin	Pin Description	Component 2
Pulse Sensor	+	5V Positive	→	+	5V Positive	Lilypad Arduino
	-	Ground		-	Ground	
	S	Signal Pin		A0	Analog Pin	
TM1637 Display Module	VCC	5V Positive	→	+	5V Positive	Lilypad Arduino
	GND	Ground		-	Ground	
	DIO	Data Input/Output		9	Digital Pin	
	CLK	Clock Signal		10	Digital Pin	

Pulse sensor has 3 pins. The + ve and –ve pins are connected to the +ve and GND pins of the Arduino Lilypad respectively. Signal Pin which transmits the data read by the pulse senor is interfaced with the Analog pin A0 of the Lilypad.

4.2. *Programming Logic*

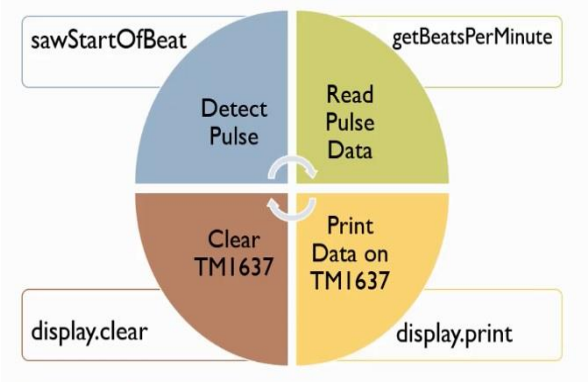


Fig. 5. Programming Logic

Pulse sensor first detects the pulse based on the threshold value set for it. Sensor measures the change in volume of blood through any organ of the body which causes a change in light intensity through that organ]. This is accomplished by the sawStartOfBeat function. Once the pulse is detected, the data is read in Beats Per Minute using the getBeatsPerMinute function. This data in then printed on the TM 1637 display module using the display.print function. Finally, once the data is displayed, the display is cleared soon after so as to make it ready for the next set of data. This cycle is repeated every set of seconds or whenever a pulse is detected, whichever takes longer. Some of the functions used in the code are:

- sawStartOfBeat()

Returns true if a new heartbeat pulse has been detected. Type = boolean.

- getBeatsPerMinute()

Returns the latest beats-per-minute. Type = int.

- display.print()

To print data in TM 1637 display module

- display.clear()

To clear the TM 1637 display module

The various components are mounted in a hand glove for easy usage. By just holding the hands in such a way that the pulse sensor touches his/her artery, we will get a display of the pulse rate of the person. A person need not be a professional to check the pulse.

Acknowledgments

This work was fully funded by Vels Institute of Science, Technology and Advanced Studies, Chennai.

We thank the management of the University for their full support in completing this work.

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