Department of Electronic & Telecommunication Engineering
University of Moratuwa

BM1190 - Engineering Design Project

Project report

Fall Detection Device for elderly people

Submitted by

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1 Introduction

1.1 Problem description

In most Sri Lankan houses, adults stay alone at home during the daytime. Because of their low income, many people can't afford a caretaker for them. There is a probability of accidents happening from sudden falls due to a lack of physical strength and mental health. And it may cause death if someone doesn't take immediate action.

Our aim is to develop a device for these homealone adults which can send an immediate notification to a respective person if this kind of accident happens.

1.2 Product Idea Validation

As per our survey, over 50% of adults over the age of 60 years old had experienced a sudden fall or heart attack. And most importantly, many of them live alone in their homes. Almost all the participants wanted a solution for this matter.
And Most Importantly, There isn't a product specifically for this purpose in the Current market.

2 Our Device

A fall detection device is a wearable device to stomach area. By using the given belt. To turn on the power, there is a side button and after turning it on it will automatically connect to wifi by using the esp 8266 wifi module. When the sensor identify a sudden fall it will send a message to the server using wifi, and then the server will send data to the mobile app and it will display the message that there is a fall. The device is rechargeable and can last one day.

3 Technical Spesifications

3.1 Performance in quantitative terms

Sensitivity
Based on a fall detection algorithm which identifies a fall by the sudden change of acceleration and angle

Operating time
Estimated to work 24-29 hours per one full charge. Power is provided by 3 LiPo batteries of 3.7V each in series
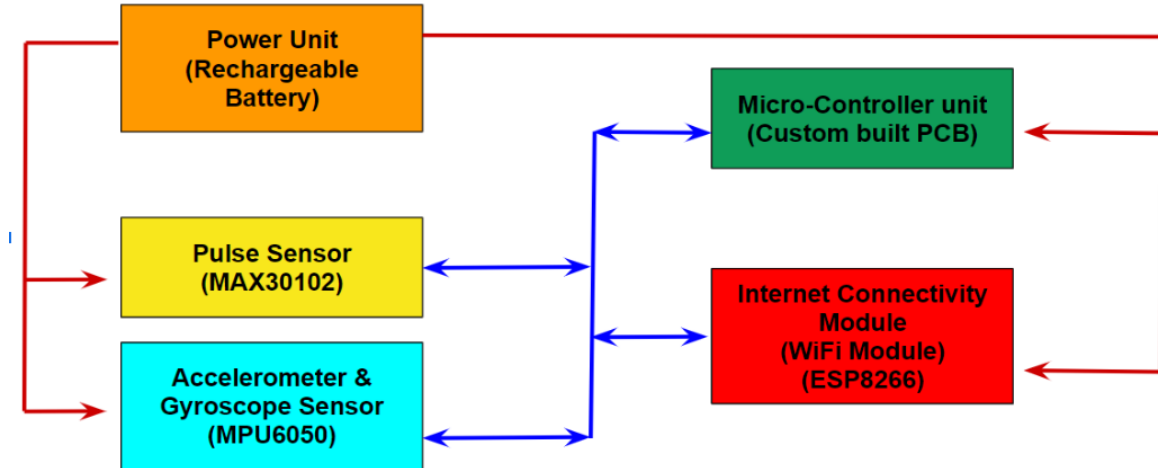
Dimensions
Without belt: 10 cm x 5.5 cm x 5 cm, 200g approximately

Warrenty terms
A 1 year warranty for the device will be provided with free services and replacements.

4 Product Architecture

4.1 Block diagram abstraction of the device

4.2 Functionality of the Blocks

Micro-Controller Unit

This is the Brain of our Product. This unit is based on an ATmega328 Microcontroller chip. We have developed a fully customized electronic circuit using the functionalities of the Microcontroller. Each and every other component are connected to this PCB via wires to transmit control, input, and output signals to and from the microcontroller

Power Unit

This unit supplies power to each and every component of the system. This unit includes LiFePO4 battery pack of 12v with a typical BMS circuit to enable charging and discharging functionalities of this unit.

Charging can be done through the power input jack, which we added to the unit and power supply to each unit will be done through wires.

Also there is an LED to indicate the SOC of the Battery pack for give a proper idea to consumers about when to charge the battery.

Charging can be done using the usual battery chargers or they can buy our custom built charger with the product as they desire.

Internet Connectivity Module

We have used the ESP 8266 module to enable the internet connectivity of the circuit to use it as an IOT device. Falls detection alerts can be sent to the server through this module.
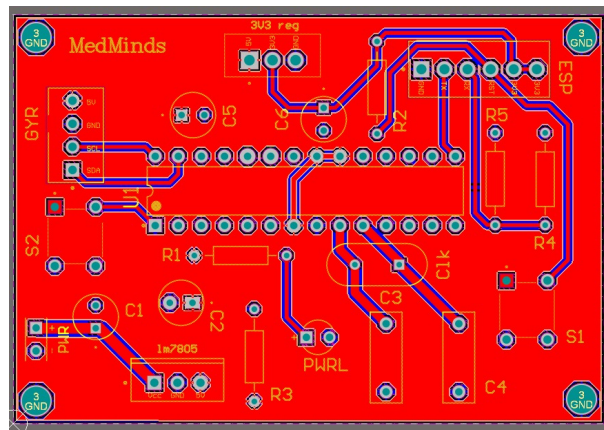
Accelerometer and Gyroscope Sensor Module
This is the unit which sends signals regarding the orientation and the motion of the user to the Microcontroller unit. we have used the MPU6050 module for this purpose. we can process these signals using a microcontroller and identify whether the user has fallen or not.
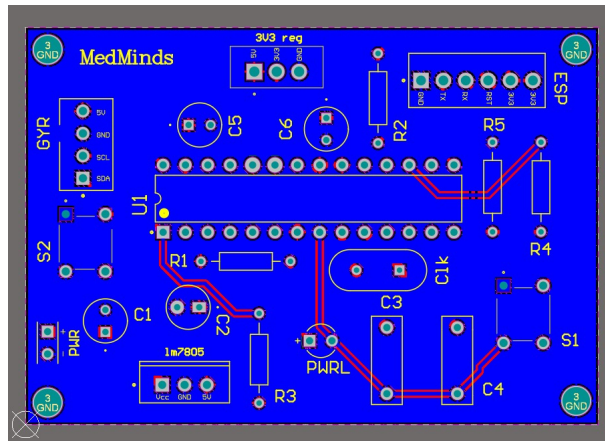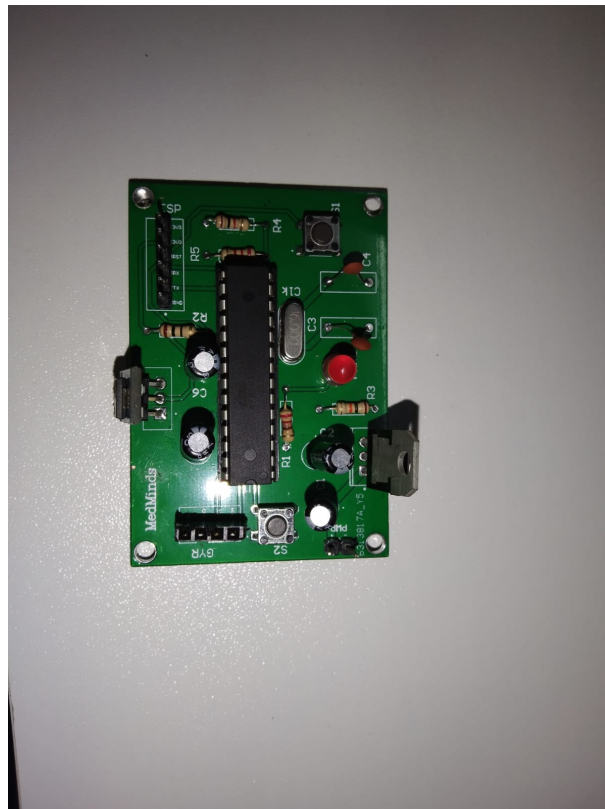
5 PCB Design
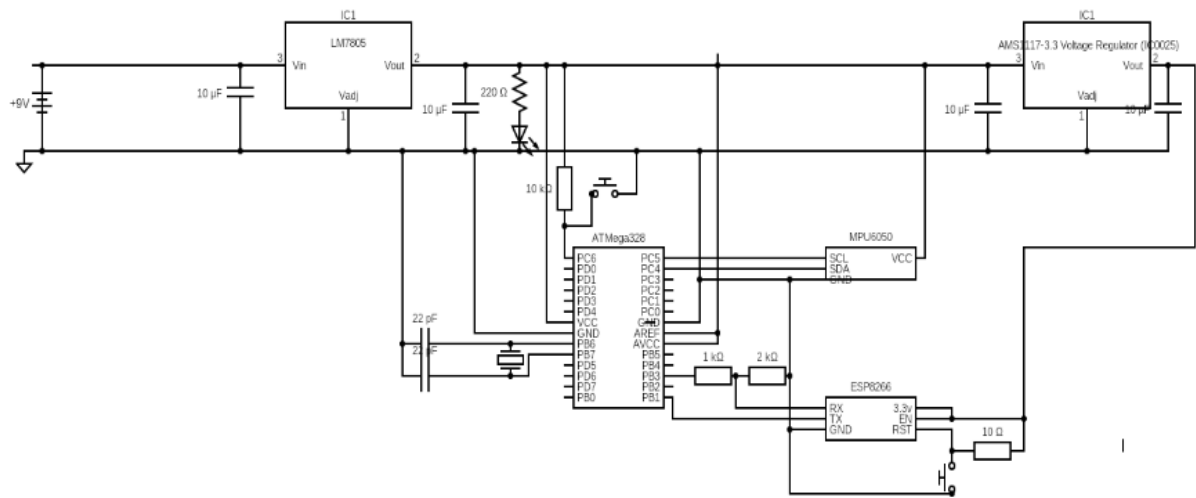
Schematic of the circuit

Top layer of the PCB

Bottom layer of the PCB

Soldered PCB

6   Enclosure Design

The product is a wearable device that is worn throughout the day. Therefore it is lightweight so as to not affect the daily essential tasks of elderly patients. The device should be worn on a belt or a similar article of clothing.
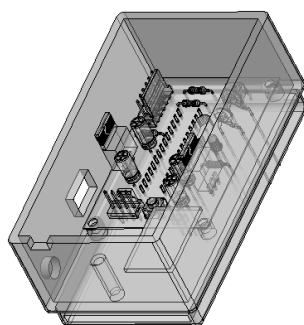
Considering the safety, manufacturability and user experience, the final enclosure design is as follows.
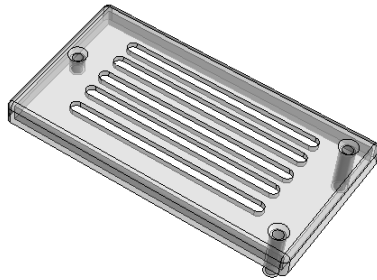
Upper part of the enclosure
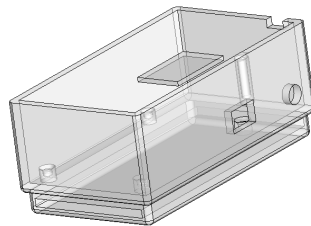
Lower part of the enclosure

inside of the enclosure

7 Marketing and Sales Plan

7.1 Marketing and sales considerations:

As the survey we did on a local sample we found out that this is a big problem for everyone who had/has elders to care for. But we can't find a reliable and cost-friendly solution for this not only in Sri lanka but also worldwide. So this would be a great problem to solve.And we predict that there will be a really good demand for this device not only locally but also internationally.

When marketing a device like this, it is essential to target the appropriate audience effectively. The marketing messages should be crafted to appeal to the elderly and their caregivers, highlighting the benefits of using the device, such as increased safety and peace of mind. The messaging should focus on how the device works and about the easy-to-use features.

Additionally, the marketing strategy should include targeting healthcare professionals, such as physicians and nurses, who can recommend the device to users. Social media platforms can also be used to target the elderly and their caregivers effectively.

We can use digital marketing strategies like paid video promotions(product reviews),google and social media ads campaigns(display,search,...etc). Also we can use our own Ecommerce website and other reputed multi vendorOnline shopping platforms to sell the product globally.

7.2 After-Sale Service Considerations:

Providing excellent customer service is crucial in maintaining a positive reputation and ensuring customer satisfaction. The after-sale service should include technical support and troubleshooting for the device, as well as easy-to-access customer support options, such as phone or email.Also that more than 99% uptime of the real time monitoring server is very essential. Providing educational materials and user guides can also be helpful in ensuring customers understand how to use the device properly.Also we can maintain a webpage as a forum,so the customers can share their ideas and problems with others and we can actively involve them to further development of the product.

Additionally, offering device maintenance services, such as battery replacement or driver/software updates, can help extend the device's lifespan and improve customer satisfaction. Regular follow-ups to check in on customer satisfaction and offer additional support can also enhance the after-sale experience.

8 Project so far
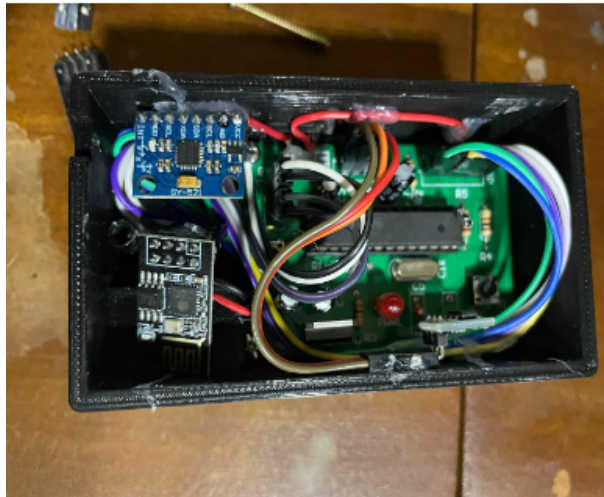
9 Project Budget

Item	Unit Price	QTY	Total Price(LKR)
Electronic Items			
Max30102 MH-ET LIVE Oximeter Heart Rate	700.00	1	700.00
Jumper wires Male-to-Male	220.00	1	220.00
Jumper wires Male-to-Female	200.00	1	200.00
Atmel ATMEGA328P-PU Microcontroller with TM0018	1,480.00	1	1,480.00
28-pin Normal IC Base 2.5mm	20.00	1	20.00
L/805CV 5V Voltage regulator	50.00	1	50.00
16MHz Crystal Osillator	40.00	1	40.00
Ceramic Capacitor THT	5.00	2	10.00
ESP8266 ESP-01S Serial WIFI Wireless	480.00	1	480.00
5V Mini Buzzer	60.00	1	60.00
Tactile push button	10.00	2	20.00
100uF 50V Electrolytic Capacitor THT	5.00	2	10.00
Resistors	3.00	10	30.00
MPU6050 Accelerometer	650.00	1	650.00
18650 battery	450.00	4	1800.00
PCB Printing	1500(Estimated)	1	3000.00
Enclosure	1500(Estimated)	1	1500.00
Total			**10270.00**

10   Task Allocation

Task	Member/s
Electronic Circuit Designing	Kaveendra Alwis
Microcontroller Program Development	Lohan Atapattu,Kaveendra Alwis
Product Enclosure Design with Solidworks	Lohan Atapattu,Imasha Nethmal
PCB Designing using Altium	Sandun Herath, Kaveendra
Soldering and Assembling the product	Kaveendra Alwis,Sandun Herath,Lohan Atapattu,Imasha Nethmal
Testing and Troubleshooting	Kaveendra Alwis,Sandun Herath,Lohan Atapattu,Imasha Nethmal

11   Areas of possible improvement

- Most suitable as a necklace or a watch hence plan to build more compact device using SMD electronic components for that purpose
- More suitable database support, APP development for the device,SMS and Email Enabled Notification
- More improvements to the algorithm using machine learning concepts to get much-optimized output.
- With use of smaller batteries, the enclosure can be further miniaturized.The size and weight of the device could be reduced to make the ability to wear and engage in daily tasks easier

Fall Detection Device User Manual

Table of Contents:

1. Introduction:

Thank you for choosing our Fall Detection Device. This user manual will guide you through the setup, usage, and maintenance of the device. The device is designed to provide an added layer of safety by detecting falls and sending alerts to predefined contacts.

2. Package Contents:
- Fall Detection Device
- Charging Cable
- User Manual

3. Device Overview:

3.1 Front View:
- LED Indicator

3.2 Back View:
- Charging Port
- Sensor Array

4. Getting Started:

4.1 Charging the Device:
- Connect the charging cable to the charging port on the back of the device.
- Connect the other end of the cable to a power source such as a USB charger or a computer.

4.2 Powering On/Off:
- Switch inside breaker to turn on the device.

5. Using the Fall Detection Device:

5.1 Wearing the Device:
- Wear the device tightly to abdominal cavity using given belt.

5.2 Normal Usage:
- The device will monitor sudden falls.
- Regularly check the LED indicator to ensure the device is active.

5.3 Fall Detection:
- In the event of a fall, the device will automatically detect the impact and sudden change in orientation.
- If a fall is detected, the device will send a notification to mobile app.

6. Alerts and Notifications:

- When a fall is detected, the device will send alerts to the designated emergency contacts through notification via dedicated app, depending on the setup.

7. Maintenance and Care:

- Keep the device clean and dry. Use a soft, dry cloth for cleaning.
- Avoid exposing the device to extreme temperatures or water.
- Regularly check the battery level and recharge as needed.

8. Troubleshooting:

- If the device fails to power on, ensure it is charged.
- If fall detection is not working, ensure proper placement and contact with the body.

9. Technical Specifications:

- Sensors: Accelerometer, Gyroscope
- Connectivity: WIFI
- Battery Life: Up to 27 hours
- Charging Time: 40min for 20watt charger
- Compatibility: Android 7.0+

10. Warranty and Support:
- The device comes with a 1 year limited warranty.
- For technical support or warranty claims, contact our customer support.

For more information, troubleshooting steps, and updates, please visit our website

Thank you!