Rep Counter for Weightlifting
ECE 445 Proposal

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1 Introduction

1.1 Rep Counter for Weightlifting

Losing track of reps is a common problem with weightlifters. The problem arises when all the focus is put into achieving correct form and not the number of reps the weightlifter is on. This project plans to solve this problem, as well as eliminate the notepad and paper most serious weightlifters use to track their repetitions and the weights.

1.2 Objectives

1.2.1 Benefits

- The device will accurately keep track of the lifters workout data by logging the reps, weight, time, and sets.
- The device will have a library that will provide the user with a variety of exercises to use and potentially be introduced to.
- The device will also be able to keep track of good form and notify the user if bad form starts to be implemented.

1.2.2 Features

- Good form can be maintained by monitoring all six axes of movement.
- Upload workouts and track progress on an organized spreadsheet
- A library of pre-loaded workouts with calibrated data of angles and positions
- Notification of achieving desired number of repetitions via vibration and light
- Streamlined interface that will allow the user to easily save the number of reps and the weight used. The device will achieve this using minimal buttons: up, down, select, back/menu, and power.

2 Design

2.1 Block Diagram

The block diagram for our project is shown in Figure 1.

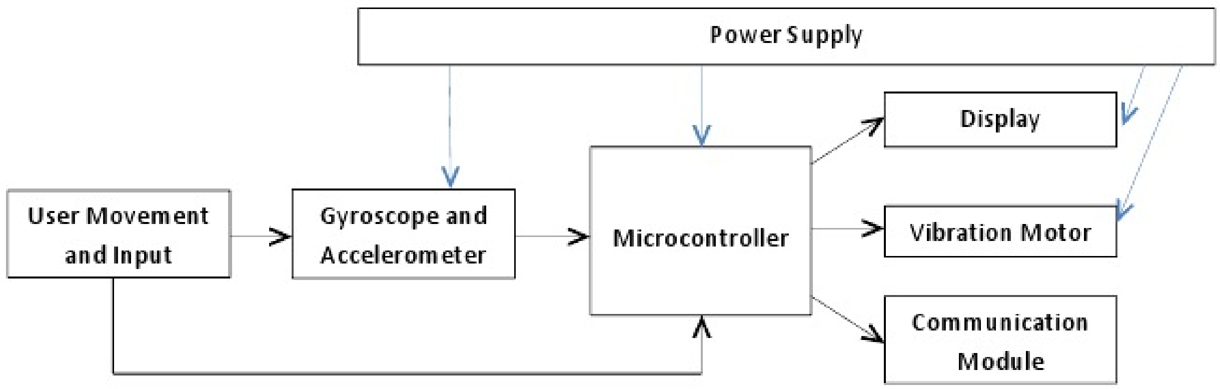

Figure 1: Block diagram of the rep counter.

2.2 Block Descriptions

Power Supply- This comes from a simple supply of rechargeable AAA batteries.

Accelerometer and Gyroscope - The accelerometer is used to measure movement of the device via gravitational force. This will be useful for lifts that do not require any angular motion (Ex. Bench presses). The Gyroscope will be used to detect any angular motion that the user implements on all six axes of motion. This will be useful to check form as well as lifts that require a lot of angular motion (Ex. Curls)

Microcontroller- This is the heart of the project. It receives information from the gyroscope and accelerometer and processes it. A significant portion of the project would involve coding this controller and making it interface with all our peripherals. It will store the real-time data (acceleration and angles) temporarily in flash memory and crosscheck it against conditions for that particular exercise. Based on the results of the crosscheck, the controller would send signals to the peripherals (LED and vibration motor). In addition, the code will incorporate a simple UI that will take the users keypad inputs as interrupts and respond to it accordingly via the display.

Display- This is a vital part of the user interface. It receives its data from the controller through the display driver. The micro uses this display to respond to the users keypad inputs. Some of the functions the display will be used for are to list the available exercises and to display the real-time workout data.

Vibration Motor- When performing the exercise, it is not practical for the user to keep looking at screen (or the LEDs) which is why a secondary means of indication is required. The vibration motor allows the system to alert the user when the desired reps have been met or when the user is using bad form.

Communication Module- This is the means by which the device will transfer data to the computer. The data will be transferred in a format that can be easily imported into Microsoft Excel.

User Input-This block contains all of the keypad inputs. The keypad consists of 5 push buttons (up, down, select, back/menu, and power) that are used to navigate the menu and select a desired weight, lift, and max rep count.

2.3 Performance Requirements

There are numerous performance requirements that will make this project a success.

- The device must be able to accurately detect reps and differentiate between good and bad form.
- The device must be able to effectively notify the user of both completion of the set and when reps with poor form have occurred.
- The device must be able to last for at least 5 hours without changing batteries.
- The device must be able to export the data to a computer in a manageable format.

3 Verification

3.1 Testing Procedures

Accelerometer testing- We will be testing the accelerometer to determine its response to various exercises, including squats, bench presses, dead lifts, and bicep curls. We will test the accelerometer for its response to both reps with good form and reps with poor form. Good reps should only produce a response on one axis, or a minimal response on the other two axes. A poor rep should result in a sizeable response on multiple axes. We will also need to test the accelerometers response to minute movements that may occur before the lift.

Gyroscope testing- We will also be testing the gyroscope to determine its response to various exercises. Specifically, we will need to look at the response due to poor reps on squats, bench presses, and deadlifts. Because those lifts only consist of movement in a linear direction, any rotational movement detected will be an indicator of a rep with poor form. We will also test the response to exercises such as the bicep curl, in which a rep with proper form will involve motion in two linear directions and some amount of rotational motion. As with the accelerometer, we will also need to test the gyroscopes response to minute movements that may occur before the lift.

Microcontroller testing- We will test the microcontroller in a few different ways. We will first need to test to the ability to detect an actual rep from the response of the accelerometer and the gyroscope, as opposed to any small movements before a lift. After this, the microcontroller will be tested to make sure it can differentiate between a rep with correct form and a rep with incorrect form, from the data provided from the accelerometer and the gyroscope. Finally, we will test the microcontroller to ensure it is able to drive both the vibration motor and the LEDs. We will test multiple levels of vibration for the motor, and a few different LED configurations to determine which setup will 1) be activated without drawing a tremendous amount of power and 2) effectively indicate to the user whatever information needs to be conveyed.

Display and button testing- We will test the display to ensure that it is able to effectively convey information to the user. We will also need to ensure that it is not drawing too much power from our source. In addition to the display, we will need to test our buttons to make sure that they can properly input information to the microcontroller.

3.2 Tolerance Analysis

We will test the tolerance of both the accelerometer and the gyroscope. Both components need to be able to withstand a reasonable amount of acceleration that may be expected to occur during the course of a workout, and still be able to function properly.

4 Cost and Schedule

4.1 Cost Analysis

Parts	Quantity	Total Cost ($)
MIcrocontroller	1	5
Accelerometer	1	8
Gyroscope	1	6
LEDs	2	0.50
Display Unit	1	30
Vibration Motor	1	5
Communication Module	1	7
Rechargeable Batteries	2	6
Battery Casing	1	1
Device Casing	1	3
Strap/Armband	1	3
Push Buttons	5	6
Printed Circuit Board	1	20
Resistors and Capacitors	-	2
-	Total:	$102.50

Labor	Rate (per hour	Hours	Total	Multiplier (x2.5)
Fahim Kadhi	$40	200	$8,000	$20,000
Andrew Mast	$40	200	$8,000	$20,000
Ben Rosborough	$40	200	$8,000	$20,000

Category	Total
Labor	$60,000
Parts	$102.50
Grand Total:	$60,102.50

4.2 Schedule

Week of	Tasks	Group member
February 6th	Introduction	Mast
	Block diagram and descriptions	Rosborough
	Verification process	Kadhi
	Cost and schedule	Mast
	Research micro controller and communication module	Rosborough
	Research display unit and gyroscope	Kadhi
	Research accelerometer and vibration motor	Mast
February 13th	Sign up for design review	Rosborough
	Order parts	Kadhi
	Research programming the communication module	Mast
February 20th	Get microcontroller to control vibration motor and LEDs	Rosborough
	Start writing code for display	Kadhi
	Design power unit	Mast
February 27th	Get micro controller to interface with PC	Rosborough
	Assemble power unit with micro controller	Kadhi
	Get push buttons to interface with microcontroller	Mast
	Design plastic casing for unit	Rosborough
March 5th	Program subroutines for different exercises	Kadhi
	Get plastic casing built	Mast
	Test and debug code	Rosborough
	Start writing individual progress reports	Kadhi
March 12th	Finalize and submit all individual progress reports	Mast
	Final test with all components integrated into the unit	Rosborough
	Package system with armband	Kadhi
March 19th	Spring Break	X
March 26th	Mock-up demo	Mast
	Sign up for mock presentation	Rosborough
	Prepare for mock presentation	Kadhi
April 2nd	Mock presentation	Mast
	Gather info for final report	Kadhi
April 9th	Address any issues with presentation	Kadhi
	Continue working on final report	Mast
April 16th	Sign up for demo	Rosborough
	SIgn up for presentation	Kadhi
	Finish first draft of final report	Mast
April 23rd	Final demos and presentations	Rosborough
April 30th	Final demos and presentations (continued)	Kadhi
	Finalize and submit final report	Mast
May 3rd	Checkout	ALL