<u>UCF Senior Design I</u>

Energy Generating Platform

Department of Electrical Engineering and Computer Science

University of Central Florida

Dr. Lei Wei

Initial Project Document

Divide and Conquer

<u>Group 8</u>

Michael Lin	Electrical	Engineer	michaellin91@knights.ucf.edu
Kiara Rodriguez	Electrical	Engineer	kmrodriguez@knights.ucf.edu
Travis Badall	Electrical	Engineer	travisbadall@knights.ucf.edu
Sanjay Khemlani	Electrical	Engineer	skhemlani@knights.ucf.edu

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1. Project Background

Electricity has become a basic necessity of life in today's world, and therefore, is in need of efficient and innovative ways to be produced. Several of the natural resources available are nonrenewable, requiring us to resort to other methods that provide constant energy. The use of wind power, hydroelectric power, and geothermal energy are dependable sources of energy while nuclear fission, fossil fuels, and coal are nonrenewable and will eventually become unusable.

These resources, some better than others, all have their downfalls. Fossil fuels and coal produce greenhouse gases which gets trapped in our atmosphere, thus raising the overall temperature of our planet. Wind farms require very long transmission lines seeing as most are built in open landscapes far away from cities and they also interfere with migration paths of birds. Hydroelectric turbines are very expensive and require the building of dams that disrupt the natural habitat for sea creatures.

However, there is a method of safely creating renewable energy that does not have any disadvantages and does not disrupt any natural habitats. In fact, it has the capability of producing an unlimited amount of energy! So, what can possibly provide that much energy? The answer is simple; humans. We can become our own source of electric power by doing what we do on a daily basis. Walk. This concept compliments the theory of crowd-sourcing as one of the most innovative ways to a goal that benefits people.

Using technology that converts mechanical energy to electrical energy, we can create and store that energy to use as a power source. The most effective way to apply this theory is to design a platform made of tiles that people would walk over. It would use the pressure applied from the feet combined with the piezoelectric effect to create a voltage that can be used for several purposes such as charging a phone, lighting up street lamps or street signs, providing electricity for low power consumption devices, for entertainment purposes such as lighting up dance floors, or simply as a backup or emergency power supply. The tile platform design would be implemented as a sidewalk or pathway that could be placed in areas with high amounts of foot traffic such as amusement parks, shopping malls, zoos, and universities.

1.1 Objectives

Our main objective for this project is to design an efficient source of renewable energy that can provide power for multiple uses. The secondary objectives include managing a low-cost design, high durability of the product regarding extreme weather conditions, convenient dimensions for the platform to fit in various places, and the sensitivity consisting of how much pressure would be needed to create a voltage. The objective regarding software would involve feedback from the system of productivity and efficiency displayed on an LCD containing information such as how much voltage is being obtained from each tile, the total amount of voltage produced, the amount of power supplied to use, and reading a pressure sensor to monitor the maximum amount of pressure that can be endured.

1.2 Requirements and Constraints

- Provide enough voltage to power a charger for a phone
- Collect and provide data to users
- Dimensions within acceptable range to be placed in various areas
- Durable enough to withstand extreme weather conditions
- Product safety to be approved by government standards
- Longevity of rechargeable battery
- Placement in high foot traffic areas
- Cost effectiveness for manufacturing
- Investment in marketing
- Seamless design to prevent falling sensation

1.3 Block Diagram

This section describes the overall flow and necessary components needed to complete this project. Since our project relies on converting mechanical energy to electrical energy, one of our biggest focuses is on creating/choosing the most efficient piezoelectric sensor. We will research cost and efficiency of both, the individual components that create the sensor as well as pre-existing sensors, and ultimately determine which best suits our project design.

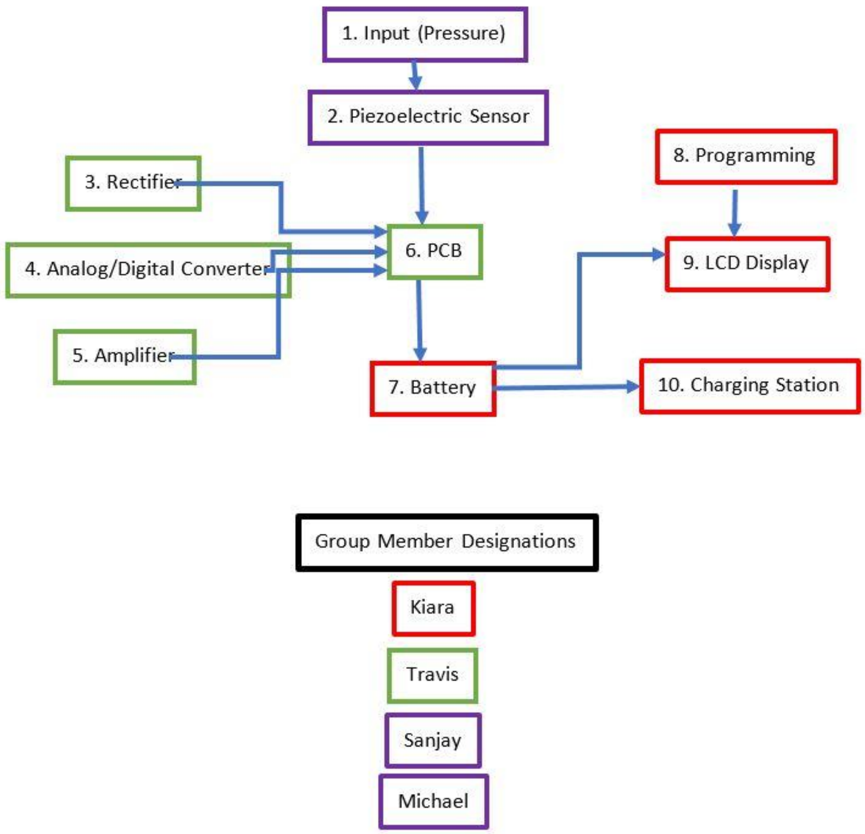

Figure 1. Block Diagram of Design

Block Status:

1. Research: Will research how much pressure is needed to produce a functional sensor
2. Research: Will investigate the types of crystals, contacts, as well as types of existing piezoelectric transducers and reviewing the advantages and disadvantages of both to ensure we are using the most efficient sensor for our project
3. Design: Will design a rectifier that will convert the negative AC voltages into positive AC voltages
4. To be Acquired
5. Design: Will design an amplifier with high gain, high input resistance and low output resistance.
6. Design/Research: Will research which circuit design and printed circuit board that will be able to implement all necessary components of our project
7. To be Acquired
8. Research: See below
9. Research: Will research what software and microcontroller will best meet our requirements
10. To be Acquired

Component Requirements:

- Input: Vertical depression of less than 5mm
- Piezoelectric Sensor: Generation of AC Voltage of more than 6V
- Amplifier: Have a gain of at least 2
- Battery: Should be rechargeable, Minimum capacitance of 20000 mAh
- LCD Display: Should display how much power is being generated, total power capacitance and power consumption
- Charging Station: Should be able to output at least 5W

1.4 House of Quality

This section provides an engineering-marketing tradeoff matrix where customer desires and product engineering characteristics are identified and evaluated to aid in achieving an optimal design. Said evaluation observes the negative and positive correlations between each requirement, essential to design and development. The matrix can be seen below.

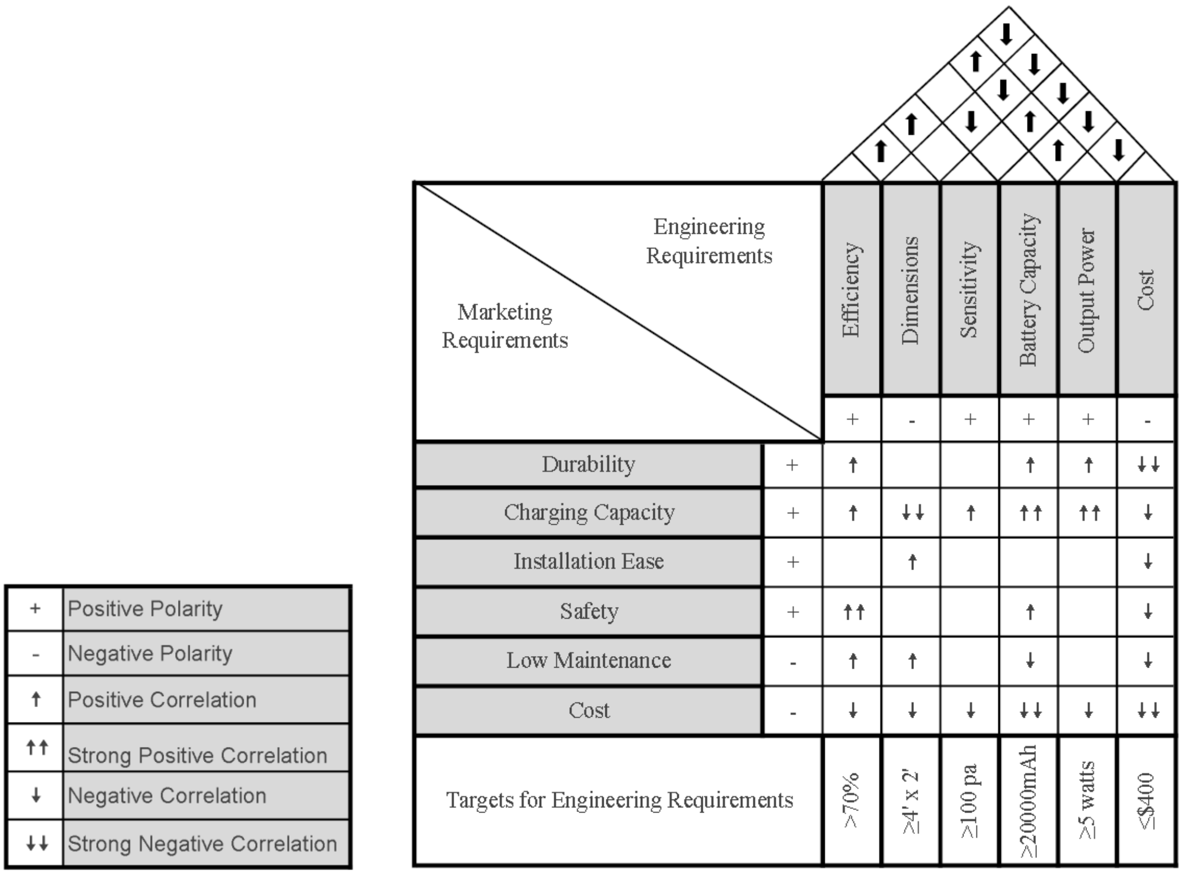

Figure 2. House of Quality

The engineering requirements shown were selected to achieve maximum performance with accurate pressure readings, enough energy storage to avoid compromising the product, and a design that varies in dimension to suit the location or environment it’s in. The marketing requirements selected show key features for the product that offer longevity, safe energy input/output, productivity and convenience. These requirements are set for the purpose of achieving our set objectives for this product which are shown in previous sections of this document.

1.5 Flowchart for Software Program

This section provides an overview of how the program used in this project will run allowing the user to see via an LCD how much power per plate their step creates, the total stored power and the charging capabilities.

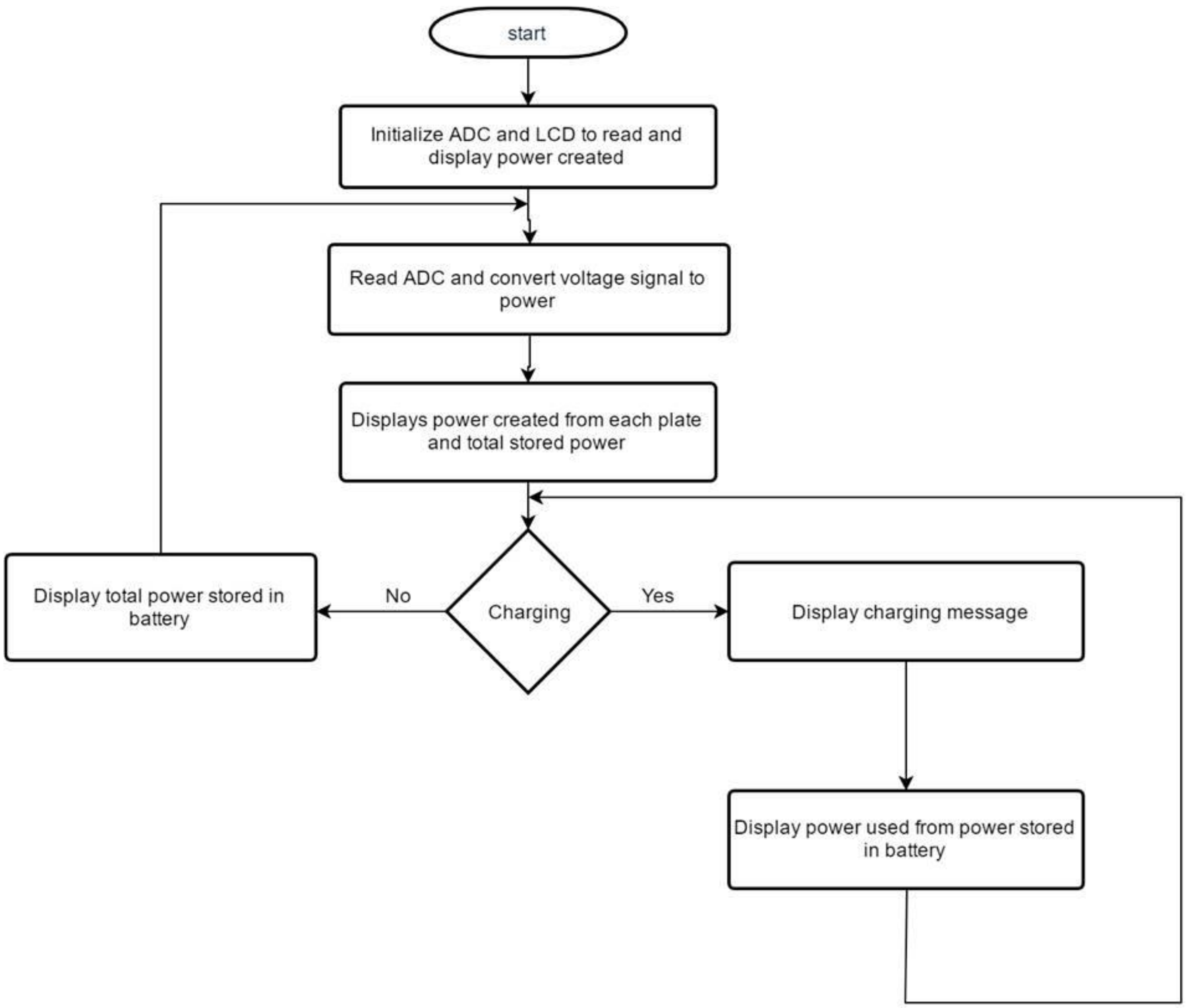

Figure 3. Code Flowchart

2. Administrative Contents

This section describes the management portion of the project, including finance and budgeting, and milestones. The times and due dates for the milestones will be spread out for the documentations and updated as needed.

2.1 Estimated Budgeting and Finances

The following table displays the estimated budgets and finances for the project. The table includes the cost per item, the quantity required and the total estimated cost for the devices.

Item Description	Cost per Item	Quantity	Estimated Cost
Crystals, self-made	$25	1	$25
Piezoelectric Sensor Pack of 3	$14	2	$28
Copper Sheet	$2	1	$2
Aluminum Sheet	$5	1	$5
LCD Display	$15	1	$15
Battery	$50	1	$50
LED Diodes (100)	$10	1	$10
A/D Converter	$25	1	$25
Amplifier	$15	1	$15
Rectifier	$10	1	$10
Microcontroller	$20	1	$20
Chassis	$20	4	$80
PCB (5)	$30	1	$30
Miscellaneous	$15	1	$15
Energy Reading Sensors	$20	1	$20
Estimated Total Cost: $350			

Table 1. Estimated Budget and Finances

Possible Sponsorship from Duke Energy, Orlando Utilities, PCB Way, and Siemens.

2.2 Milestone Discussion

This section describes the milestones, tasks, and deadlines throughout the project for each member to focus and complete to ensure the project will be completed. The table includes the tasks for both Senior Design 1 and Senior Design 2. The milestones will be updated as the project becomes more finalized and more information is obtained.

Number	Task	Start Date	End Date	Status
Senior Design 1				
1	Project Selection	5/16/2017	6/2/2017	Completed
2	Initial Project Documentation	5/23/2017	6/2/2017	Completed
3	Initial Project Documentation Update	6/2/2017	6/9/2017	In Progress
4	Develop Table of Contents	6/2/2017	6/12/2017	In Progress
5	Parts List	6/2/2017	6/30/2017	Researching
6	Draft Document	6/2/2017	7/30/2017	In Progress
7	Final Document	6/2/2017	8/1/2017	In Progress
8	Design Overview	6/2/2017	7/1/2017	Researching
Senior Design 2				
9	1st Prototype	8/19/2017	8/31/2017	Planning
10	CDR Presentation	TBD	-	-
11	Peer Review	TBD	-	-
12	Conference Paper (8 page)	TBD	-	-
13	2nd Prototype	TBD	-	-
14	Mid-term Demo	TBD	-	-
15	Project Completion	TBD	-	-
16	Final Presentation	TBD	-	-
17	Web Exit Interview	TBD	-	-

Table 2. Milestones

2.3 Table of Decision

Idea	**Description**	**Requirement**	**Choice**	**Reason for Choice**
Charging Station Locator	Scans and locates a charging station for electric cars	• Scanner • Software for location detection	No	Multiple software Location detection
Automatic Book Reader	Scans books and reads out loud. Automatically turns pages and books.	• Robot vision • Software for word deciphering	No	Too much software
Energy Sidewalk	Produces energy while someone walks on it. An LCD screen shows the power gained through the steps. Can be used to charge phones, blink LED, etc.	• Sensors for energy reading • Stores energy to battery • Charger for other devices	Yes	Can be implemented immediately Basic software
Bike Rack	Allows user to store bicycle with password and can be remotely checked through app.	• App • Remote status check • Password lock programming	No	Too much software

Table 3. Decision Table on Why We Chose the Project