Converting Kinetic Energy into Electricity- Increasing Energy Sufficiency in Las Vegas Casinos Using Load Cell Panels

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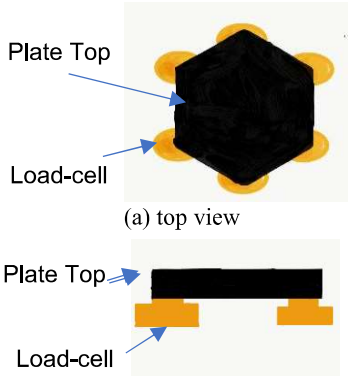
ABSTRACT
Approximately 46 million tourists (equivalent to Spain's population) visited Las Vegas in 2016. The Las Vegas Strip known as "The Strip", is located on Las Vegas Boulevard, spanning 4.2 miles (6.8 kilometers) in length, where there are more than 32 world class level hotels and casinos. The Strip uses roughly 20% of all the consumed power in the state. This paper explores a city-based and pedestrian-based sustainability that utilizes kinetic energy creating from walking on the street as a sustainable source in generating electricity. A pressure plate model is presented as the concept for sustainability.

I. INTRODUCTION
Since the founding of Las Vegas on May 15, 1905, Las Vegas has boomed and prospered. Capitalizing on the new expanse of the region, it has grown to be a city filled of attractions with more than 32 world class hotels and casinos [1]. In 2016, according to the Las Vegas Convention and Visitors Authority, almost 46 million people visited Las Vegas [2]. In comparison, this is 93% of the entire population of Spain, and 66% of the current population of the United Kingdom. Over the span of those 4.2-miles, the Las Vegas strip uses roughly 20% of all the consumed power in the state [3] which comes out to be about 1,430 GWH (Gigawatt Hour) a year of electricity.

II. CHALLENGE AND PROPOSED SOLUTION
Due to an increased demand for energy on the Las Vegas Strip, it has become clear that an alternative method of energy is required to alleviate high consumption of energy. According to the recordings and statistics of the Las Vegas Convention and Visitors Authority, on average at any given hour of any given day there are about 5,000 tourist present on the strip, which led to an idea of generating energy from the Strip's high foot traffic by using pressure plates as seen from the previous approaches [4][5]. This mechanism utilizes the crowded walkways of the Strip to convert kinetic energy from visitors into electricity that can be harnessed. The concept of the pressure plate is visualized in Figure 1. As seen in the figure, the pressure plates will utilize a six load cells shown in yellow and the kinetic energy created by walking over it. One step on one of these plates is equivalent to about 5 watts of power through a converter [6].



(a) top view
(b) front view
Figure 1. Pressure plate design

III. ENERGY GENERATION
We analyzed the proposed solution with one of potential scenarios that we created based on a field study. The field study that we conducted was going to the Strip and observed pedestrians walking on the street and counting them. With an average of 5,000 visitors on the strip walking about 4.1 hours, at an average rate of 2,000 steps per hour; the resulting power output over the area of one mile is 74.83 GWH shown in Equation 1.

5,000* 2000* 4.1*5*1=74.83 GWH ------ (1)

That much energy is equivalent to approximately 14% off all power consumed by the strip (200.3/1,430 GWH). If you increase the area of the plates to encompass the entire length of the Strip, which is approximately 4.2 miles, you get 314.27 GWH, as shown in equation (2).

5,000* 2000* 4.1*5*4.2=314.27 GWH ----- (2)

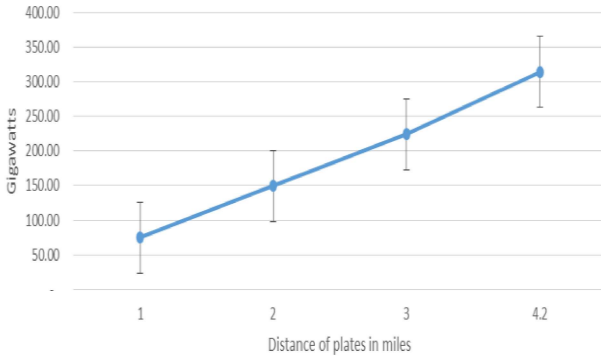


Figure 2. Pressure plate design

Figure 2 shows the amount of expected electricity when installing the pressure plates per distance in miles on the Strip. The vertical lines in the graph represents the level of variations of electricity that can be very based on the number of pedestrians and size of the street.

IV. DISCUSSION AND CONCLUSION

This study explored how to utilize kinetic energy creating from pedestrian walking on the street as a city-based sustainable source in generating electricity. The Las Vegas Strip was used as a testbed which is one of the most visited and walked areas in the United States. A load cell based pressure plate was proposed that generates high efficiency natural electricity. It is our conjecture that generating electricity from the Las Vegas pedestrian walkways with the proposed pressure plates will contribute to the power consumption of 22% for the strip, which is equivalent to 314.27 GWH.

In addition, this analytical research introduces a solution to any energy consumption. In terms of the Las Vegas Strip, it lowers the dependency these structures have and increase self-sustainability. As a broad impact, this research is not exclusive to the Strip in Las Vegas, however and can branch out to other cities in the world such as London, Paris, and Hong Kong. These cities can adopt the concept to assist in the energy production efficiency as their city based sustainability. It can give countries, which have unfavorable or rely too heavily on fossil fuels and non-renewable sources like Brazil, Mexico, and Russia, the chance to establish their own sustainability through their daily commutes and activities.

From another perspective, the solution we proposed and analyzed analytically in this study will save and create a way to have a more self-sustaining method to powering such high cost structures. More importantly, this study and concept can be carried on throughout the entire world. It can join in contributing to the energy creation using such a small accommodation of just our own kinetic energy; expanding to places that aren't able to produce enough energy to even power their most basic needs.

An extension of the proposed approach is to collaborate with the facilities on the Las Vegas Strip in a way to install the sustainable plates inside the casinos and hotels.

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