Design And Development of Solar Powered Multi-Feature Street Food Cart

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Abstract — This study aimed to create a solar-powered food cart and assess the state of hygienic food preparation in the food cart businesses along Dipolog City Boulevard. The interpretation of the findings concludes that Dr. Garvin's Eight Dimensions collects data through questionnaires. A total of 55 people responded, comprising food cart sellers, educators, business managers, and a TESDA representative. The mean and average weighted values were applied to the data. Many researchers conducted creative experiments to enhance the street food vendors' quality of service, with a focus on sanitation and hygiene in food carts. According to Syuhaida Idha Abd Rahim's (2018) study, cleanliness and personal hygiene are essential components of our existence. There is an immediate need to increase the efficacy and efficiency of food systems. The complexity of this challenge is increased by several significant issues, including the more complicated food supply chains, environmental limitations, an aging population, and changing consumer tastes and food consumption habits (King, T. et al., 2017).
It is recommended that the administration or the local government of Dipolog strongly encourage allocating funds to mass-produce this project so that other vendors with street food carts, specifically in Dipolog City Boulevard, can avail themselves of its usefulness. Enhancing the solar-powered food cart's features and design may improve its durability and quality.

Keywords — Food Cart, Solar Power, Vendors, Street Food Cart, Multi-Featured Food Cart

I. Introduction

The increasing number of people and the growing demand for food have become a global phenomenon. As a result, entrepreneurs found an opportunity to make food a primary source of their income. Making different varieties of traditional foods, selling them at restaurants, and making the food available to households through food mobilization, also known as food carts, became a hit both locally and internationally. According to the recent study of the Website Vantage Market Research in 2021, "the Global Food Truck Market or Food carts is valued at USD 3.94 Billion in the year 2021 and is projected to reach a value of USD 5.78 Billion by 2028".

Here in the Philippines, food carts began during their heyday in the 1980s and 1990s, and these traditional food carts saved many a stomach. It usually comes with wooden carts installed with wheels for easy towing or attached to a bicycle. Food carts' favorite locations include plazas, outside churches and schools, transportation terminals, and busy neighborhoods. Here in Dipolog City, the city Boulevard has been the hotspot for commercialization for small businesses, vendors, and food carts in recent years. According to Mr. Reggie La Victoria, manager of the Boulevard

Complex of the City government of Dipolog, an estimated 95 food carts are selling various street foods and the like.

A solar-powered food cart was designed to enhance the food carts. It is a proven fact that Filipino businesspeople are starting to prefer the food cart industry because it is simple to manage and construct. Food serving carts, which offer easy accessibility to ready-to-eat foods, significantly impact our community's economic development (De Asis et al. 2017). The features of this designed food cart set it apart from other carts because it uses solar power as the source to generate electricity for the lighting system during the entire operation. We have encountered various food carts in the streets, parks, and other places in this modern era. Unlike the common food cart that is electrically powered, which is not transportable, a suitable source of light is needed.

Designing and developing a solar-powered food cart with multi-hygiene features is significant in promoting sustainable and safe food practices, enhancing food accessibility, and reducing environmental impact in the food industry, as there would be a reduced reliance on non-renewable energy sources. The multi-feature hygienic food cart ensures the maintenance of high food safety standards, reduces the risk of foodborne illness, and promotes a healthier food option for consumers.

II. Methodology

This study presents the method used, research environment, Respondents of the Study, Research Instrument, Data Gathering Procedure, Statistical Treatment, and Ethical Considerations.

Method Used

The research used the developmental type.

Research Environment

This research study focused on developing the street food carts used in Dipolog City Boulevard.

Respondents of the Study

The study's respondents were chosen according to their qualifications and expertise on the subject of the study. To meet this study's objectives and goals, the researcher ensured that there were vendors, Technical Education and Skills Development Authority (TESDA) experts, industry managers, and faculty from the University where the researchers are explicitly situated, the College of Industrial Technology.

Research Instrument

The researcher utilized a survey questionnaire distributed to the food cart vendors on Dipolog City Boulevard, Consumers, and the JRMSU Faculty of Dipolog campus to determine the acceptability of the constructed solar-powered multi-featured hygienic street food cart**.**

Data Gathering

Before conducting the study, the researcher first obtained the endorsement to gather data, signed and approved by the Dean of the Graduate School. Afterward, the researchers, employed at JRMSU Dipolog Campus, asked permission from the Campus Administrator to conduct the study outside the university's premises. Additionally, the researcher asked permission from the city government to survey the area near Dipolog City Boulevard.

Statistical Treatment

$wx = \frac{\Sigma fw}{\Sigma f}$The ratings on the data gathering instruments were treated statistically using the average weighted mean to determine the average mean of the acceptability of the Hygienic street food cart with solar powered lighting system. The mathematical formula is written below:

Where:

wx = weighted mean

Σfw = Summation of the product of the frequency and weight

Σf = total frequency

Ethical Considerations

The ethical procedure was observed in the conduct of his study. The ethical principles are discussed below.

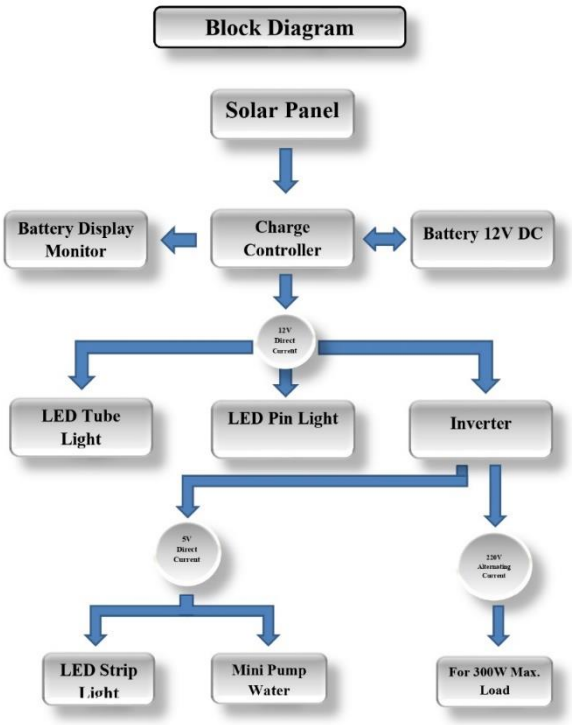
Social value. The purpose of this study was to address strategies for evaluating the extent of the food cart's acceptability, which was thoroughly discussed with the respondents based on its previous and current usage in Dipolog City Boulevard.

Informed consent. The researcher requested authorization to carry out a survey through a formal letter addressed to Dipolog City Mayor Daryl T. Uy.

Vulnerability of research respondents. The researcher made sure that the respondents were active vendors of Dipolog City Boulevard, TESDA, industry managers, and faculty of CIT, in order to obtain the needed data to complete the study.

III. Results and Discussion

This chapter presents the study's results in detailed textual and tabular form. Discussions of data analysis and interpretation are presented in specific headings based on the study's problems. Related studies are also presented to support and validate the findings or to distinguish them from the current study.



The figure above portrays the block diagram of the solar-powered multi-featured hygienic street food cart in Dipolog City. As drawn, the design has lines representing the importance of each function of the food cart. There were four caster wheels at the bottom part so that the cart can move to one place to other, on the second corner after the bottom was the glass enclosure to protect the foods that are to be sold, while on the opposite side was a sink where the dealer would use to clean the needed paraphernalias in the operation of the cart.

Solar Powered Lighting System

The performance of the 100 W Solar Panel for three (3) days of monitoring depicts that it produces an average of 12.8 Volts, 3.25 Amperes Current, and 40.3 watts of power. The data recorded using a DC multi-meter implies that solar-powered food carts are more advantageous than solar energy.

Charging

The battery takes an average of six (6) hours to charge fully using the 100 W Solar Panel. This is based on the recorded data using the DC voltmeter.

Battery Consumption

The battery takes an average of eight (8) hours to discharge with all loads running. This is based on the recorded data using the Battery Analyzer. At 30%, the battery would not be able to run all loads.

The food cart industry has steadily grown 9.9% since 2018. Known for their readily available, ready-to-eat foods and cost-effectiveness, the food carts are becoming solar-powered to fulfill their business power needs. (NCC)

The findings implied that the solar-powered, multi-featured, hygienic street food cart is helpful to those who engage in the business because its features are acceptable to the clientele.

A solar-powered street food cart sells quick delicacy meals to customers on the streets and during events. It's an excellent match for entrepreneurs who wish to start a restaurant but have no capital for a brick-and-mortar establishment (Asialink finance.com April 17, 2023)

A solar-powered street food cart business is considered the most successful business in the Philippines. It is a fact that the solar-powered food cart business is becoming more popular among entrepreneurs in the market because it is easily manageable, requires small capital, is easy to set up, and has a low risk of business failure (RJ Subong Espina 2021)

The rest of the items were rated as somewhat acceptable, with the average weighted value of 3.46 and 3.57, respectively. This means that the solar-powered street food cart has much adaptable food that is adequately covered from bugs, with waste and trash bins. These are observed in businesses like street food carts since it is a requirement of the city, like Dipolog, to maintain a clean and sanitized environment free from harm to customers.

The Food Safety and Standards Authority is mandated with disseminating evidence-based standards in conformance with the wholesome food for human consumption and matters connected to the food industry. Hence, this study was conducted to ascertain the conformance of the street food cart vendors in the city (RJ Subong Espina 2021)

This implies that developing street food carts must consider their standards to make the food cart vendors ' lives hassle-free. The strengths for a small food cart business might include a unique product offering, strong customer loyalty and a durable street food cart with well-established brand reputation (RJ Subong-Espina 2021) further, unlike traditional restaurants that are limited to a specific location, food carts have the advantage of able to move to different areas and events. This allows them to reach a broader customer base and exploit new opportunities.

It was found that the computed mean of 3.47 belonged to the most adaptable category. This means a solar-powered street food cart is easy to repair, and materials are available locally. It is implied that the newly developed solar-powered street food cart is very serviceable.

Serviceability can be seen in the durability with which the product can be put into service when it breaks down, as well as the competence and behavior of the service person. Besides, a product that is considered serviceable is of good quality and able to provide good service. It is a fact that the new solar-powered street food cart is usable. (RJ Subong Espino 2021)

The newly developed solar-powered street food cart is well-painted with a harmonious color combination. As a whole, the food cart is attractive and can attract many customers.

Aesthetics is a love design principle that defines the pleasing qualities of a design. In visual terms, aesthetics include balance, color movement, pattern scale, shape, and visual weight. Designers use aesthetics to complement their designs' usability, and so enhance functionality with attractive layouts (RJ Subong Espina 2021)

Perceived quality is the quality of a product or service according to the customer's perception. It is a subjective criterion and does not have to coincide with actual or objective quality, which is based on tangible data such as raw materials, manufacturing process, warranty, or after-sales service. Further, the perceived quality of a product or service is based on individual experiences and expectations. It is a critical product development aspect and essential to the competitive products industry. Overall, it is a subjective evaluation that plays a crucial role in product design success and customer satisfaction. This can vary among individuals and is influenced by factors such as durability designs, materials, and new technologies.

Garces (2016) pointed out that evaluating and improving product acceptability is crucial to minimize the risks of a new product not being accepted. Existing approaches do not integrate some features of acceptability, as the proposed method is based on evaluating the users' concept perceptions, such as performance, features, reliability, conformance, durability, aesthetics, and serviceability of the projects.

Summary table on the Extent of Acceptability of solar-powered multi-featured hygienic street food cart

Indicators	Mean	D
Performance	3.33	MA
Features	3.47	MA
Reliability	3.45	MA
Conformance	3.42	MA
Durability	3.46	MA
Serviceability	3.47	MA
Aesthetic	3.50	MA
Perceived Quality	3.52	MA
Gen. Mean	**3.45**	**MA**

Restatement of the Problem

This study aimed to fabricate a Solar-Powered food cart and determine the existing hygienic food preparation situation in the food cart industries along Dipolog City Boulevard.

Specifically, it sought to answer the following questions dealing (1) the requirements in developing the Food cart in terms of design and materials, (2) the attributes of the solar powered lighting system in terms of Voltage, Current and Battery Consumption, (3) the extent of acceptability of the Solar powered multi featured hygienic street food cart as to: performance, features, reliability, conformance, durability, serviceability, aesthetic and perceived quality, (4) the production cost of the solar powered food cart. The data is obtained through questionnaires utilized by Dr. Garvin's Eight Dimensions. There were 55 food cart vendors, faculty, industry managers, and a TESDA representative. The data was treated using the Average Weighted Value and the mean.

Summary of Findings:

The findings of this study are enumerated below:

1. The requirements for developing the solar-powered food cart in terms of:

   1.1 Design. The design consists of the necessary requirements for fabricating the project, such as the supplies and materials used, a working drawing, a schematic diagram, and a block diagram.

   1.2 Materials. The materials used for food cart fabrication are Angle Bars 2'x2"x1/8, Plywood 4'x4'x3/4, Floor Tiles white (60x60cm), Sink stainless (16x24cm), Bolts and nuts, Wood Sticks (2'x2'x6"), Faucet (chargeable electric water pump), Solar Panel, Solar Charge controller, LED Light Bulb (7 watts), LED Tube light (12 inches 7 watts), Strip light (5m LED light RGB remote control), Battery NS40

2. The development of the solar-powered food cart comprises four construction assemblies: the features and the design are responsible for the cart's functions and display. The preparation table is made of concrete and tile to ensure that the cart lasts. The other parts are made of light materials to make it lighter to carry.

3. Dr. Garvin's Eight Dimensions of Quality are needed to attain the acceptability of the solar-powered food cart. Overall weighted mean is 3.45 with a verbal description of "Most Acceptable". Quality dimensions are: *Performance, Features, Reliability, Conformance, Durability, Serviceability, Aesthetics, and Perceived Quality.*

The total amount spent on the construction of the solar-powered food cart is Php 27,060, with a labor cost (20% of the total cost of supplies and materials) amounting to Php 5,412.

Miscellaneous expenses (5% of the cost of materials and supplies was also computed, which amounted to Php 1,353). The total Fabrication cost of the solar-powered food cart is **Php 33,825.**

IV. Conclusion

Based on the findings, the following conclusions were drawn:

Through its features and designs, a project has been innovated and improved from the existing street food carts in Dipolog City Boulevard. Based on the requirements for developing the solar-powered food cart, it was concluded that its features have specific functions and demonstrate full functionality. It is well equipped in terms of the materials needed. It provides a safe and effective method of establishing the operating principles. The solar-powered food cart can be developed by assembling all the materials needed and following the required construction procedure. All Dr. Garvin's Eight Dimensions of Quality shown in the findings are present in the solar-powered food cart and are most acceptable in performance, features, reliability, conformance, durability, serviceability, aesthetic, and perceived quality as an innovation project. The production cost of a solar-powered food cart is higher than that of ordinary food carts selling a variety of foods, but it would last longer because of the materials used to make it durable.

V. Recommendations

The following recommendations were made based on the results of the study:

1. The administration or the Local Government of Dipolog is strongly encouraged to allocate funds to mass-produce this project so that other street food cart vendors, specifically in Dipolog City Boulevard, can benefit from its usefulness.

2. The solar-powered food cart may be improved by enhancing its features and design to attain durability and better quality.

3. To attain its acceptability, it is strongly recommended that the Eight Dimensions of Quality by Dr. Garvin be strictly followed when using the solar-powered multi-featured hygienic street food cart.

4. Call a meeting with the existing and potential vendors to discuss the availability of the solar-powered food cart.

5. The mechanism for the availability of food carts shall be discussed with potential vendors.

6. The Formica can be used as walling and aluminum molding at the edge of the project for additional durability and aesthetics. Tiling may be applied to the surface of the washing area for neatness and aesthetics.

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