

Sustainable development and Ethic aspects of the fruit powered Arduino for outreach

1. Description

Scientific experiments can be as fun as games, and experimental props can be as fancy as toys. This is the original intention of the team to design the product. To raise the interest of children in science and train the manipulative ability of children through playing, fruit batteries came into mind. Fruit can also be made into batteries to supply the circuit. The boring electrical, optical, and acoustic principles in textbooks will be displayed vividly in one product, opening a mysterious electronic world. Therefore, the product is dedicated to visualizing the voltage generated by a fruit battery. Through exploring the principle of battery power generation, the educational significance will be achieved. As an electronic device, this product uses these materials: Breadboard, Slice of copper, zinc, aluminum and other metals, Ultrasonic distance sensor, LCD screen, RGB light, Wires, Acrylic, Fresh acid fruits.

Section 1: Regulatory Consideration

All the components are under the control level of certain hazardous substances. The team will evaluate each product's manufactory regulations and apply UKCA and CE marks to cater to the restriction of RoHS [1]. Due to the target persons of this product being children and it can be defined as a toy to some extent, therefore, the product will be manufactured to the standard of children's toys. According to Toys (Safety) Regulations 2011 [2], detailed instructions will accompany the product to the customer. Therefore, the related instructions will include the following warnings: 1. Prevent the juice splashed into eyes 2. Prevent electric shock by proper operation 3. Prevent metal cuts 4. Prevent children from eating experimental fruits by mistake 5. Declare the maximum voltage. Because it is mainly used for children's education, the design of the product fully considers safety issues, so the acrylic shell is offered to prevent children from accidentally touching the wires during play and hurting themselves, and the shell also plays a role in protecting the circuit. As electronic equipment, when the voltage is too high, the indicator light will be on with noise and the screen will also show a warning.

Through experiment, the voltage supply of this product is 3-5 volts, which fulfill the requirements of Electrical Equipment (Safety) Regulations 2016 [3]. Furthermore, the range of voltage(<5V) will not harm the human body if accidentally touched. WEEE regulations are also taken into account when the user intends to throw away the used fruits. [4] Although this product does not contain arsenic, cadmium, lead and mercury, and certain flame retardants, it may generate zinc ions during the experiment and zinc ion recycling should be considered. The treatment method for zinc ions is to recycle the fruits containing zinc ions back to the company, and the company will process the contaminated lemons in batches.

Section 2: SD/Ethical Implications of large-scale manufacture & sale

The product has significance for children's education and electronic development. The principle of the product is not complicated, and the cost of production is also relatively cheap. Because the target users are vulnerable children, the process of manufacture will use safe, non-toxic materials. Therefore, the company should replace suppliers in time if they provide substandard raw materials. A transparent acrylic shell is also designed, which means the internal structure is visible and the children won't touch or damage the electronics inside. After the product is eliminated, the company is responsible to provide a waste recycling service and dispose of the damaged electronic components in a pollution-free manner. [5] The recycling of fruits containing zinc ions also complies with the provisions of WEEE. [4] At the same time, the acrylic shell can also be recycled and reused for sustainable purposes.

The educational significance brought by the product is profound when children use it to study and play. The product combines complex science, electronics, and engineering problems into simple

experiments of making fruit batteries. Children will learn how to make fruit batteries and how to connect simple circuits with electronic components. For customers, since this product is designed including sharp objects, which means young children (children less than 7 years old) should use this product under guidance. The sustainable development of the product is analyzed from three aspects:

Techno-centric: The team designed features including lights and sound to make the experiment more interesting, ensuring technology better serves education, which accord with the core values of Techno-centric. The team can also add more interesting features in the future, covering mechanics, biology, etc.

Eco-centric: The product uses environmentally friendly fruit batteries instead of zinc-manganese batteries, and the company provides recycling services to minimize negative environmental impact. Although the product does not play a role in environmental protection, the profound significance overweighs this inefficiency.

Socio-centric: This product aims to educate children by arousing their interest in electronic technology, enhancing their hands-on skills, developing their imagination and curiosity. Children are the future of society, so the significance of this product to society is far-reaching and significant.

After comprehensive consideration, the large-scale manufacture & sale of this product also meets the ethical meaning of sustainable development in the narrow and broad senses.

Section 3: SD/Ethical Implications of follow-on products/markets

Parents are more willing to invest in their children's education. [6] At the same time, people's demand for education is long-term, therefore, the benefits of this product will also increase. More importantly, this product is in line with the development concept of "green energy", which means the market will be optimistic about the prospects of the product. With a better design and more investment, the team can create a more popular product and capture more market share. For example, fruit-powered electric cars or drones. As a kind of clean energy, the energy generated by fruit batteries can be widely used in many aspects of life with the deepening of research, replacing some limited energy sources, and achieving environmental sustainability. The development of this project will also offer innovative ideas to the green market, so the follow-up prospect of it is worth the market expectation and can create greater benefits to the company.

For the risk of this product, timely recycling is a problem that the company needs to solve. Once it is not recycled in time, the contaminated fruit may cause pollution to the environment. Additionally, the following product guidance also needs to be considered after-sales. If customers are not satisfied with products and lead to an increase in the complaint rate, which may cause social and ethical issues.

References:

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