Finger Actuated Rotary Fed Soldering Apparatus

Rene A. Salmingo, Dimark B. Hermosada, John Jonathan Guanzon, Joseph T. Aguarin,
Andrew T. Masmila and Ariel V. Bulgado

***Abstract*—Soldering iron is one of the common tools used in electronics laboratory to join electronics components, wirings and terminals in the printed circuit board (PCB). The present study is a pencil type soldering iron which provides one handed operation by means of index finger required to manipulate the solder wire through the device. A gun type soldering iron was conceptualized by the researchers in designing and constructing a solder feed device for one handed operation. Instead of using index finger manipulate the solder wire, the researchers used thumb. In realization of the design, several steps were considered to test the functionality of the device in terms of: the diameter of the solder wire and the diagonal distance of aluminum metal tube from the soldering iron tip respectively. Based on the experiment conducted using (0.6, 1.0, 1.2) mm diameters of the solder wire, the result shows that the device can solder using 1mm wire diameter. Further, the product life cycle assessment (LCA) areas results revealed high level of sustainability, low environmental impact and very high LCA.**

***Keywords*— Life Cycle Assessment, One handed soldering operation, Solder wire, Soldering iron.**

I. Introduction

Every hobby has its special assortment of tools and supplies, and electronics is no exception. From the ordinary screwdriver to the high-speed drill, you enjoy playing with electronics much more if you have the right tools and assortment of supplies, organized and stored without cluttering the work area [5].

Soldering is the method use to make semi-permanent connections between components a circuit. Instead of using glue to hold things together you use small globs of molten metal [1].

In common practice, an electronics hobbyist utilizes soldering iron tool while soldering lead simultaneously with the other hand. The researchers could design soldering iron gun with solder feed by enhancing its handling capability using one hand while doing the soldering process especially in electronics laboratory activities and basic electronics projects.

The researchers sought to design and construct a solder feed to manually feed soldering lead to the tip of the soldering iron.

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Rene A. Salmingo is with the Task Force on Greening Projects as Engineering and Technology Specialist.

Dimark B. Hermosada was with Fukuda Electronics, Sta. Rosa, Laguna Appliance as Production Technician graduated Bachelor of Science in Industrial Technology – Electronics Technology from Carlos Hilado Memorial State College last 2015.

A. Objectives

The main objective of the study was to design and construct Finger Actuated Rotary Fed Apparatus. More specifically the study aims to test the functionality of the apparatus in terms of: diameter of the solder wire, distance of aluminum tube from the soldering iron tip; and solder basic electronics components, integrated circuits, electrical wiring and terminals.; and assess the apparatus in terms of Life Cycle Assessment.

B. Scope and Limitation

The study focuses on the design and construction and test of functionality of Finger Actuated Rotary Fed Soldering Apparatus made from recyclable materials. The soldering iron tip distance from the solder feed and the sizes of the soldering lead were considered in the testing. Finally, the device can solder basic electronics components, integrated circuit (IC) chips, wires and terminals on the printed circuit board (PCB).

C. Conceptual Framework of the Apparatus

The conceptual framework was based on input-process-output model in the operation of the apparatus. See Fig. 1.

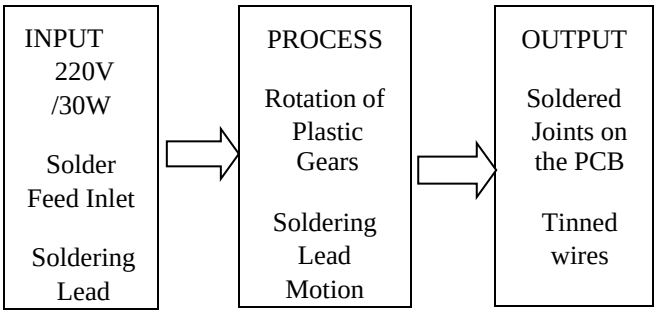

Fig. 1. Input-Process-Output Model of the Apparatus

The apparatus has an input voltage of 220V and 30W soldering iron having Solder Feed Inlet for the solder wire. The movement of plastic gears allows the soldering lead to reach the soldering iron tip to aid in soldering electronic components in the PCB.

II. Related Literature

Several solder dispensing devices have been used in soldering basic electronics components, integrated circuits (ICs), electrical wiring and terminals. The present apparatus aimed to improve solder feed attachment shown in US Patent 4,793,541 [2], which was issued December 27, 1988 and in US Patent 4,507,545 [3], which was issued on March 26, 1985, having a spool of solder wire at the top end and rear end, respectively produces handling difficulties and inconvenience during soldering.

The idea of having a one-handed soldering tool incorporating a heated tip configured with one or more solder

retains inside the handle. Adjacent to this heated tip is an end region of a solder supply conduit through which a solid wire solder passes. During operation, as the heated tip is heated, the adjacent end region of the solder supply conduit is likewise heated. The heating process will melt the wire solder therein thereby causing it to flow out of the conduit and into the recesses in the heated tip. This collection of melted solder can then be used to attach a workpiece in place as desired. Consequently, the user can support this workpiece during such operation since the step of continuously biasing the solid solder against the heated tip has been eliminated due to the collection of the solder stored in the solder retaining recesses of the heated tip [6].

III. Experimental Section

A. Materials

The present apparatus relates to Finger Actuated Rotary Fed Soldering Apparatus comprising a main housing, a solder wire inlet, soldering iron and aluminum metal tube. The main housing is made of polyvinyl chloride (PVC) having a plastic tube inclined inside the housing and projecting to hold the solder wire inlet, a pair of engaged plastic gears were secured in the main housing, one of the engaged gear has a manipulating portion extending outside of the main housing. The main housing is connected to soldering iron and an inclined aluminum metal tube holds the solder wire to reach the soldering iron tip for the soldering process.

B. Procedures

Upon the completion of the apparatus, three (3) experiments were done to test the functionality of the Finger Actuated Rotary Fed Soldering Apparatus using the following steps:

1. Determine the suitability of the diameter of the solder wire to the solder feed.
2. Determine the distance of aluminum metal tube from the tip of soldering iron.
3. Test the functionality of the device in soldering basic electronics components, integrated circuits (ICs), electrical wiring and terminal.
4. Assess the product life cycle assessment utilizing Green Research Product Life Cycle Assessment Survey [4].

TABLE I: SUITABLE DIAMETER OF THE SOLDER TO THE SOLDER FEED

Experiment	Activity	Observation
1.	Test the suitability of the solder feed using a 0.6mm diameter solder wire.	The solder wire can loosely pass through the solder feed inlet but it is immovable in the external gear.
2.	Test the suitability of the solder feed with the use of 1.0mm diameter solder wire.	The solder wire fits the solder feed inlet and reached the output feed.
3.	Test the suitability of the solder feed with the use of 1.2mm diameter solder wire.	The solder wire is too big that it cannot pass through the solder feed inlet.

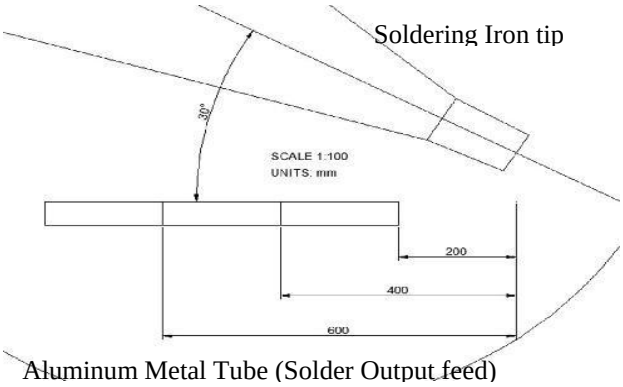

Fig. 2. Distance of aluminum metal tube from the tip of soldering iron.

The first experiment conducted using 2mm distance from the aluminum metal tube as shown in Fig. 2 will melt the solder wire. In addition, the second experiment having appropriate distance of 4mm is considered enough for the solder wire to reach the iron tip. During the third experiment using 6mm distance, solder could not reach the tip of the soldering iron.

TABLE II: SOLDERING VARIOUS ELECTRONICS COMPONENTS

Experiment	Activity	Observation
1.	Test the functionality in soldering basic electronics components	The soldered joints have low resistance.
2.	Test the functionality in soldering integrated circuit (IC) or chip.	The soldered joints have low resistance.
3.	Test the functionality in soldering electrical wiring and terminals.	The soldered joints have low resistance.

TABLE III: RESULTS OF GREEN RESEARCH PRODUCT LIFE CYCLE ASSESSMENT (LCA)

Area	Numerical Rating	Descriptive Interpretation
Sustainability	4.08	High
Environmental Impact	2.25	Low
LCA Phase	4.25	Very High

IV. Results and Discussion

This section describes the results as shown in the preceding evaluation procedures.

Table I, shows the suitable size of the solder wire was 1.0mm in the solder feed for desired soldering process.

Fig. 2, indicate the appropriate distance of aluminum metal tube from the tip of soldering iron is 4 mm for desired soldering process.

Table II, shows that the Finger Actuated Rotary Fed Soldering Apparatus is well-designed to solder basic electronics components, ICs, electrical wiring and terminal. As observed, they have low resistances approximately zero ohms on soldered joints in the PCB.

Table III further reveal that the apparatus has a High sustainability level, Low environmental impact and Very High life cycle assessment phase assessment when subjected to life cycle assessment.

The findings in the study imply that soldering lead diameter of 1.0mm is the right size that fits the solder feed. The distance of the aluminum tube to the soldering lead from the soldering iron tip was 4.0mm to prevent melting and soldering problems. Further, the device was well-designed to solder basic electronics components, ICs, electrical wiring and terminals.

V. Conclusion

The Soldering Iron Gun with Solder Feed can be made from locally available and recyclable materials in terms of its design and construction. The diameter of solder wire and diagonal distance of aluminum metal tube from the soldering iron tip affects the soldering process. Hence, the device can be utilized in electronics laboratory for repair, servicing and troubleshooting.

In view of the findings of the study, the following conclusions are drawn.

1. The research project has high sustainability level which will provide insights to further strengthen the environmental awareness of the college and encourage students' research to focus on recycling and material reuse in designing and developing a product.
2. The research project has low level of environmental impact as evidenced in the findings of the study.
3. The research project has higher level of life cycle phase assessment which is considered the best indicator that the college is ready for the next phase of ISO certifications especially on ISO 14001 Environmental Management System and ISO 14040 which represents Life Cycle Assessment.

VI. Recommendations

In view of the findings and conclusions derived from the study, the following recommendations are formulated:

1. The researchers strongly recommend that the device should undergo further evaluation among electronics experts, to test other components, and enhance its capability to allow different sizes of soldering lead.
2. It is important to monitor the sustainability areas of the research projects conducted through the implementation of CHMSC Green Product Seal and Award. Adoption of UNESCO's Education for Sustainable Development (EfSD) by recognizing the role of education in the development of societies toward becoming more equitable and sustainable.
3. Conduct comparative analysis along industrial products for Sustainability Research using GaBi Education.
4. Develop green energy technology research projects and electronics waste management system in the college to reduce carbon footprint.
5. Future researchers should conduct research collaboration with other universities to focus on greening campus and green research initiatives.

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About the Author

Engr. Rene A. Salmingo, MTM is a graduate of Master in Technology Management (MTM) last April 2017 at Carlos Hilado Memorial State College (CHMSC), Talisay City, Negros Occidental having affiliations with the Institute of Electrical and Electronics Engineers (IEEE) Life Sciences Community and the Institute of Electronics Engineers of the Philippines (IECEP) Negros Occidental Chapter. He graduated Bachelor of Science in Electronics and Communications Engineering (BSECE) at the University of St. La Salle Bacolod City, Negros Occidental last March 2008. He completed the Three (3) Years Bachelor of Science in Engineering Technology (BSET) Diploma in Electronics Engineering Technology last August 2005. He has necessary work experiences in academe and industry. He was also a Computer Instructor in PATTS College of Aeronautics, Parañaque City specializing in Avionics and Aeronautics Computer Aided Design (CAD) and have worked with Artesyn Embedded Technologies (formerly Emerson Network Power – Laguna and Cavite Plants) as Production Technician with specialization on Intelligent Switched Mode Power Supply and Power Electronics. He is currently conducting sustainable, energy and technology researches field of electronics engineering.

Dimark B. Hermosada, John Jonathan Guanzon, Joseph Aguarin, Andrew Masmila and Ariel Bulgado graduated Bachelor of Science in Industrial Technology Major in Electronics Technology, March 2016. They conducted the study on Soldering Iron with Solder Feed.