Development of Portable Electronic Angle Listing Finder

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DOI: https://doi.org/10.30880/ritvet.2024.04.01.019

Abstract

The welding industry in Malaysia is very extensive and this industry is very important in the field of manufacturing. This industry is categorized as a mechanical field that requires skills. The manufacture of fences and home iron grilles is mainly a welding service business that requires only skilled individuals. However, the tools used by them are not perfect and need a tool to improve the process of making and installing grills and furniture wood. However, this study was made based on the needs of welding workers from 5 companies. Researchers developed a tool to measure and support workpieces, the Portable Electronic Angle Index Finder. The materials used are mild steel and angle electronic magnets. Review from 5 experts, data analyzed using the SAW method for design selection and selection matrix method for product development requirements. In addition, this product has undergone experiments on the accuracy of the angle and timesaving of the product used to determine the effectiveness of the product. The results of the angle accuracy study show that 10º and 20º are less accurate but differ only slightly from 95% accuracy. Overall, all angles are accurate even though the materials are different. In terms of product usage savings, it is tested by taking the entire time before and after using the product. Experimental results show that making a grill can save time with an average of 3 hours and 15 minutes while the use of wood saves 1 hour. Therefore, this product has achieved all three objectives and can help the employees of the five companies to facilitate their work process.

1.   Introduction

Small and medium industries (SMI) are an important part of the Malaysian economy, accounting for 98% of total business and 65% of employment. In Malaysia, the number of SMI is lower, but they have the potential to make a significant contribution to the economy. (Abd Bachik, 2012, 1) The researcher focuses on manufacturing home iron grille construction and furniture assembly, which needs a product that can make things quickly. Without a qualified workforce, new staff can generate products through the improvement of angle tools. (Palanimally, 2016) However, the manufacturing process takes a long time. (Ciements et al., 2001, 27) So, making an iron grille and joining furniture wood using imperfect angle tools makes determining the angle difficult. The old method of measuring angles had defects that caused the manufacture of the iron grille and wooden joints to take a long time to complete. Therefore, this product was developed to save time by speeding up the process of

connecting angled workpieces by improving the tools used to provide angle accuracy electronic and support while assembling the workpiece. This product can facilitate connection work during the welding and carpentry process. The previous iron-iron grille manufacturing process was long due to using old methods, which had errors in angular accuracy. Today, there are many cheap and fast measuring tool technologies, and the old method was limited to 90º. (G. Zhang & R. Hocken, 2008) The installation of joining the grating parts by workers is done by first marking the parts that need to be joined, and the process appears to be repeated over and over to ensure angular accuracy. Additionally, the angle support devices sold today are expensive and bulky, and the manufacturing tools are not user-friendly. (Crompton, 2013) These problems cause the old process to be long. In Europe, they are just used for support, and they do not combine each measurement product.

The limitations of old tools can complicate product manufacturing in terms of the time taken for the product to reach the customer, and the quality is unsatisfactory. The angle section join is not accurate because it only uses a normal protractor, and long-time workers use approximations to determine the accuracy of angles. (Protractors | National Museum of American History, 2022) This matter cannot be continued, as if there is a mistake it can lead to the waste of grille material. Buying new iron is more expensive than selling all the excess iron, so the SMI iron welding company needs to do the work to avoid making mistakes that can cost the company and its waste. The researcher cannot determine one suitable technique for making an iron grille, as each person's skill is different. This process will be difficult when a new employee has to replace an old employee, and the time taken to prepare the iron grille will be long. (Hussin, 2021) To ensure accuracy, the researcher developed an electronic tool to improve the accuracy of finding the angle during the process of welding and joining furniture wood.

The objective of this project is to develop a Portable Electronic Angle Listing Finder. Among the development objectives of this project is to design product support during the process of joining the angled for metal and furniture. Next, to develop a product that can improve the angular accuracy during the support process of joining the parts for metal and furniture. Lastly, is to test the functionality of the Portable Electronic Angle Listing Finder from a time-saving aspect. To achieve this objective several research procedures have been taken to ensure that the development process of this product can run in an orderly and systematic manner.

2. Methodology

Through this methodology, projects implemented by developers can be implemented efficiently and systematically to ensure that existing criteria can be used in development. Several methods explain how the research method is implemented until the data analysis method is identified to get the decision to the developer about how the project is designed based on the EDP model. The content contained in this chapter is product development according to the phases of the methodology according to the chosen model. In addition, research instruments and product development process flow charts are useful. Otherwise, data has been collected from several procedures to ensure the effectiveness of the product. The location of this study is observation and interviews in five companies. This product provides corner stability and support in the connection of workpiece parts to connect iron and wooden furniture. This product is manufactured at company A in Perak and FPTV's general machining workshop. The manufacturing material of this product uses mild steel because the product is cheap and easily available. This product needs to use a lathe to produce new parts and needs to go through the process of threading, groove, and facing. The use of a grinding machine also helps the finish of this product to be smoother to provide comfort to the user. Reviews from experts reviewing the first store is company B, this store says the idea of this product is useful and used every day to do work. In addition, the employees of company C expressed the product idea of making it easier to see corners with digital numbers. Next, company D employees stated not to use clamps for magnets using steel. An employee of Company A gave an idea about a product that was very useful but put the indicator gimbal level. Finally, company E was very interested in the idea of this product, and has been used for the use of furniture to clamp wood.

2.1 Research Design

In product design, there are three sketches made by the researcher, each drawing has different characteristics. There were sketches 1, 2, and 3. The researcher has decided to use the Simple Additive Weighting (SAW) method to determine the best sketch before developing the product. According to Fishburn (Venkata, 2007) this method is the simplest method to find the solutions to design problems. So, using a few characteristics such as costing, functional, limited angle use, and the outlook of design. The function is based on how the accessories use functions and the outlook is based on the material use and whether is it suitable for the cost also. The matrix has given researchers an easy to compare the good design to move the development process. (Venkata, 2007) This method is used for easily choosing the design that looks the same and is difficult to choose.

Table 1 *Final step of analysis design*

Sketch/Characteristics	Cost (RM)	Functional	Limited Angle º	Outlook	Score	Rank
w	0.3333	0.2667	0.2333	0.1667		
A	0.5400	0.6250	0.5000	0.5000	0.5467	3
B	1.1111	0.7500	1.0000	0.8750	0.9495	2
C	1.0000	1.0000	1.000	1.0000	4.0000	1

Based on Table 1 shows the analysis we can see that sketch C is the best choice because sketch C from the costing is much cheaper than another sketch. After all, the costing includes the price of the part. Sketch A and B have many parts to put but Sketch C uses the balance from mild steel. From the functional of the product sketch C has more functions to use the electronic angle better than another sketch. From the characters of design, we know that Sketch A is limited to 90º, and it is better than Sketch B and C which can be open until 180º. So, sketch C has been chosen to develop the product because the design also is very easy, suitable, and not as complicated as others.
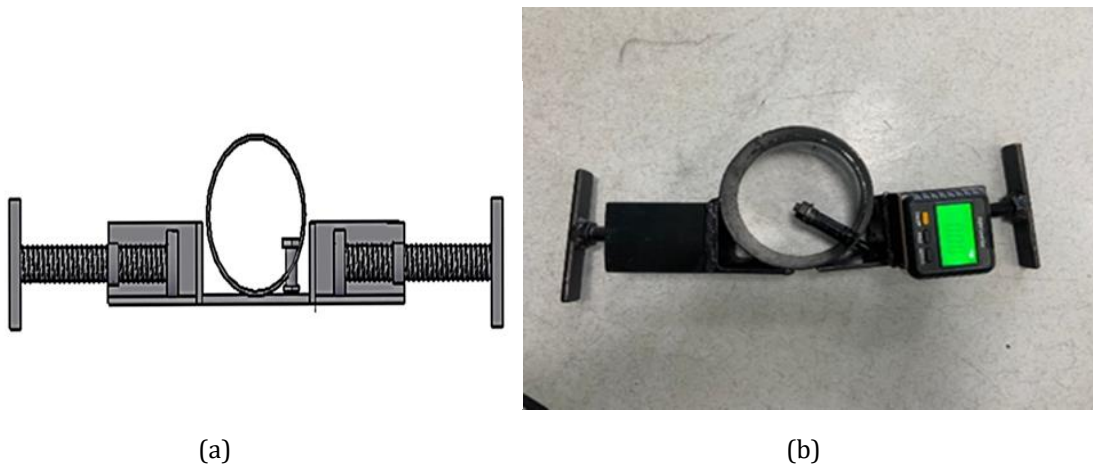

(a)　　　　　　　　　　　　　　　　　　(b)

Fig. 1 *Development of Portable Electronic Angle Listing Finder (a) Drawing design (b) The Portable Electronic Angle Listing Finder*

Fig. 1 shows the difference between the two figures. The left is a product done with AutoCAD and the right figure researcher has developed the product, inserting an electronic angle from the expert comment. Figure 2 shows the product used on the iron grille. The iron grille needs to be welded on the 90º.

Fig. 2 *Portable Electronic Angle List Finder used on iron grilles*

2.2   Research Procedure

Each procedure begins by using the EDP model that guides the researcher in developing the product. Start by analyzing the problem for this study then progress to the results of this product. Each step involved requires careful observation to ensure product development can be produced well. Therefore, the procedure made can reflect the implementation during the production of the product. In this product procedure, observations have been made in terms of design and making a product frame to be proposed to 4 steel companies that provide welding services and a furniture manufacturing company, that found their difficulty in making the welding of the customer's home grill difficult and delaying the production process. This research was done to determine the time to complete 1 of their products and to find the accuracy of the electronic angle. In the procedure to determine the accuracy of the electronic angle some data is recorded. Electronic angles and protractors were purchased to determine the reliability of the data taken. In the testing process, this electronic test procedure is repeated by taking readings 3 times. An electronic angle is purchased and attached to the iron and the angle reading is determined. There are several correct procedures to prevent reading errors from occurring, among them in terms of the position of the points that need to be perpendicular to the work material and accuracy in product assembly.

2.3   Research Instrument

Observation is the first instrument; the researcher can find the problem and evaluate for himself how the process has been made. Researchers need to go to the workplace to make observations. There are five companies, the researcher needs to observe mainly in terms of the design and function of each design. A comparison has been made. In the testing part, some experiments have been conducted to get results from the data. The conclusion from this observation becomes a full reference in the development of this product.

Expert interviews at five companies were the second instrument used to obtain more information and data. The instrument is necessary so that the expert can keep in touch with the researcher to develop the product. Information from experts is recorded then this information is used as data to analyze the design especially. Information from experts covers various aspects of project problems, the preparation of materials, and the manufacturing process. Once the product is ready, the product has been used by experts to determine the effectiveness of the product.

3.   Results and Discussion

The product has been tested by experts and users by using before and after the development of this product. After that, the product has been evaluated in terms of the process of evaluating the product produced with appropriate and safe use. Product evaluation is carried out by experts to determine the product according to the set standards and to repair several defects in the products and the design. Testing was done to compare the before and after the product's development to see how it is fulfilling the objectives. The expert has looked at the problem to inform the defect, so the development has redesigned the product to meet the customer's need.
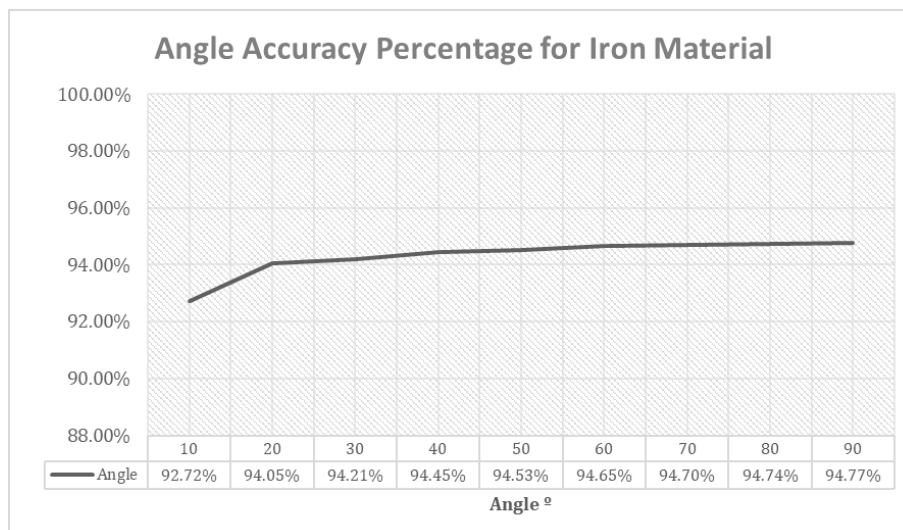
3.1 Results accuracy angle

Angle Accuracy Percentage for Iron Material

Angle º	10	20	30	40	50	60	70	80	90
Angle	92.72%	94.05%	94.21%	94.45%	94.53%	94.65%	94.70%	94.74%	94.77%

Fig. 3 *Graph of Angle Accuracy Percentage Using Iron Material*

Based on Fig. 3 the accuracy of the electronic angle using iron material is very accurate based on experiments. The graph shows that the 10º angle is 92.72% accurate and the angles of 20º, 30º, 40º, 50º, 60º, 70º, 80º, and 90º show an accuracy percentage of 94% - 95%. This shows that this portable electronic angle listing finder can be used and has an accurate angle.
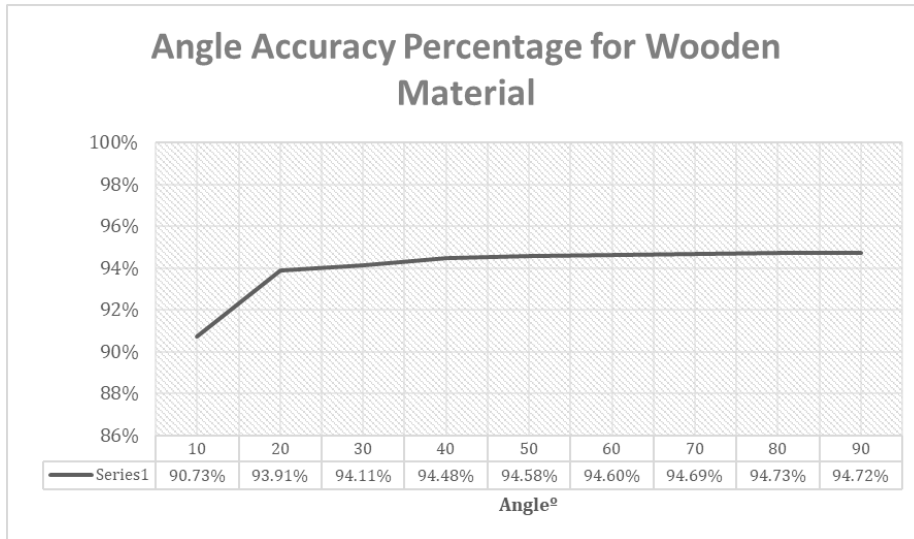

Fig. 4 *Graph of Angle Accuracy Percentage Using Wooden Material*

Based on Fig. 4, the graph of angle accuracy percentage using the wooden material is based on the experiments made. The percentage value on the graph shows that the exact value is 95%, the average data value obtained on the iron material is subtracted by 0.2 so that the angle is more accurate. The graph shows that the 10º angle is 90.73% and is close to 95% accurate. At 20º percent angle, the accuracy is 93.91%. In addition, angles of 30º, 40º, 50º, 60º, 70º, 80º, and 90º show an accuracy percentage of 94% - 95%. Based on the two graphs in Figures 3 and 4 show that the use of iron material is more accurate because the percentage difference of 95% is small compared to the use of wooden material. However, both are correct.

3.2 Product Efficiency Analysis

The analysis is made by distinguishing the period of use of the product before and after. Using the same company, 4 iron and welding companies A, B, and C, and 1 furniture company E. Observations are carried out within a month to obtain data and cooperate with each company to conduct this experiment. Therefore, the difference in data usage period is used to make an accurate conclusion.

Table 2 *Product Efficiency Analysis*

Company / Observation	Period Taken Before Product Use (hour)	Period Taken After Product Use (hour)	Inferences of timesaving (hour)	Average
Company A	9	6	3	3-hour 15 minute
Company C	11	6	5	
Company B	7	6	1	
Company D	8	6	2	
Company E	4-hour 16 minute	3-hour 55 minute	1 hour 1 minute	1 hour

Based on the Table 2 inference made from the observation, it proves that the product that has been developed can save the manufacturing time of grill and furniture product assembly. When this product is used, the actual time to prepare an iron grille door is 6 hours only, not including the rest period. On average, this product can complete grill manufacturing and furniture assembly in an hour. In conclusion, this product is efficient in speeding up the manufacture of iron grille and furniture assembly.

4.   Conclusion

In conclusion, every product has advantages and disadvantages. This product is an idea to help SMI companies improve their economic status in line with the increase in housing development. Although this product focuses on SMI companies, it helps in various aspects. Experts are the closest people to making this product a success. Their comments, suggestions, and advice are very helpful, and they can also use the product in the future. The difficult part in the development of this Portable Electronic Angle is in the manufacturing part. The sketched measurements are not suitable for actual material measurements because there are cutting parts that need to be shortened and lengthened for the product to achieve its function. Some materials must be removed and replaced to cut them all to get the right size. This metal material needs to be careful if it is mistakenly cut and the product is not perfect. Safety is the main factor that needs to be emphasized during this manufacturing. Starting from the material-cutting process to testing. This product is more of a welding hazard that easily injures the builder. Therefore, complete wear before entering the workshop is highly emphasized so that no unwanted incidents occur. In conclusion, the manufacturing process is a complicated matter in all existing processes.

Acknowledgement

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