Faculty of Manufacturing Engineering

CONCEPTUAL DESIGN OF REVERSE AND JAW DETECTOR JIG

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CONCEPTUAL DESIGN OF REVERSE AND JAW DETECTOR JIG

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DEDICATION

I would like to give a very special appreciation to my beloved friends and family for always been there in the time of need. Thanks for giving me continuous support in order for me to fulfill the needs of my Master Project. To my beloved mother, father, family and friends, thank you all for this.

ABSTRACT

Essentra Component is a company located in Ipoh, Perak which produce seals. There are two types of seal available in the company which are metal and plastic seals. The production plant still employs fully manual operation for most of the production line, but some operations are semi – automated. Due to manual assembly, human operator tends to get fatigue for doing repetitive task in one long shift. When this occurs, minor error such as misplace or wrong orientation of jaw will occur. Customers complain that the seal, especially those plastic seals are not functioning well. The quality problem sometimes not purposely done by the operator during placing the jaw in reverse orientation and moreover the jaw sometimes can be missing during transportation of work – in – progress to the ultrasonic welding station. This jig is designed to have the ability to detect reverse jaw or missing jaw and so that the finish product which has the quality problem will be prevented from being shipped to customers. The jig must also have a flexibility to be used for other plastic seal product. Under chapter 2, jig definition is known, the method of designing, suitable type of sensors, sample jig which used and research on decision making tool. As for methodology, a project schedules being developed in the form of Gantt chart to have time restriction in producing the concept design of reverse and missing jaw jig. Each and every stage was explained in detail in the methodology chapter. In result and discussion, House of Quality (HOQ) have been used to determine the highest weightage criteria. The important criteria which will be carried forward to Analytical Hierarchy Process (AHP) are 15.9% on flexibility and ease of maintenance, 15.4% on both ease of use and longevity of jig usage, lastly 15.2% for accuracy checking. The result obtain after AHP computation are Design 1 with 20.7%, Design 2 with 13.7%, Design 3 with 22%, Design 4 with 27.1% and Design 5 with 16.5%. Design 4 is selected due to the highest weightage after computation. Last chapter consists of a conclusion that has been drawn out from overall research project where final design is justified its properties and why should it be fabricate. Some suggestions are mentioned for future work in order to obtain better reading to make a better judgement.

ABSTRAK

Essentra Component ialah sebuah syarikat terletak di Ipoh, Perak di mana menghasilkan "seals". Terdapat dua jenis "seal" iaitu jenis besi dan plastic. Kilang ini menjalankan operasi keseluruhannya melalui cara manual dan sebahagian merupakan separuh automatik. Disebabkan kerana pemasangan manual, operator akan cepat penat kerana melakukan pekerjaan yang sama dalam satu jangka tempoh yang panjang. Ketika ini berlaku, kesilapan kecil bakal terjadi seperti tidak letak atau tersilap letak "jaw". Masalah kualiti ini sebenarnya tidak disengajakan oleh operator kerana "kehilangan jaw atau tersalah kedudukan boleh terjadi ketika pemindahan produk yang belum siap sebelum ke mesin kimpalan ultrasonic. Jig ini dicipta supaya mempunyai kebolehan untuk mengesan kehilangan atau terbalik kedudukan "jaw" supaya produk yang mempunyai masalah tidak akan dihantar kepada pelanggan. Jig ini juga perlu mempunyai tahap fleksibel yang tinggi supaya semua jenis "seal" lain jenis plastic boleh digunakan. Dibawah proses pengimbasan sastera, maksud jig dikenalpasti, cara untuk mereka, jenis sensor yang tepat, sampel jig yang pernah digunakan dan mengkaji alat digunakan untuk melakukan sesuatu keputusan. Bagi metodologi pula, jadual projek dibuat dalam bentuk Carta Gantt untuk mengawal masa ketika menghasilkan konsep rekabentuk jig bagi mengesan terbalik dan tidak diletakkan "jaw". Setiap peringkat diterangkan lebih lanjut dalam bab ini. Di dalam Bab 4 pula, "House of Quality" (HOQ) digunakan untuk memilih 5 kriteria paling tinggi pemberatnya. Kriteria yang telah dipilih dan digunakan di Analytical Hierarchy Process" (AHP) adalah 15.9% pada daya fleksibel dan mudah untuk menyelenggara, 15.4% pada dua kriteria iaitu mudah digunakan dan tahan lama serta 15.2% terhadap kriteria ketepatan memeriksa. Hasil daripada AHP pula menunjukkan Reka Bentuk 1 sebanyak 20.7%, Reka Bentuk 2 sebanyak 13.7%, Reka Bentuk 3 sebanyak 22%, Reka Bentuk 4 sebanyak 27.1% dan Reka Bentuk 5 sebanyak 16.5%. Reka Bentuk 4 dipilih kerana mempunyai pemberat yang tinggi. Di hujung bab ini, sebuah rekabentuk akan dipilih untuk dibina. Topik terakhir merupakan kesimpulan terhadap keseluruhan projek. Sedikit cadangan ditambah pada bab ini juga supaya boleh meletakkan skala dengan lebih bagus jester memperoleh keputusan yang lebih tepat.

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CAD	-	Computer Aided Design
GT	-	Group Technology
CBR	-	Case Base Reasoning
CAFD	-	Computer Aided Fixture Design
AI	-	Artificial Intelligence
RBR	-	Rule Base Reasoning
KUKA	-	Keller Und Knappich Augsburg
MP1	-	Master Project 1
MP2	-	Master Project 2
AHP	-	Analytic Hierarchy Process
HOQ	-	House of Quality
LED	-	Light Emitting Diode
SOP	-	Standard of Procedure
λmax	-	Max Eigenvalue
∑	-	Sum of Priority Value
CI	-	Consistency Index
CR	-	Consistency Ratio
RI	-	Random Consistency Index
UTeM	-	University Technical Malaysia

CHAPTER 1

INTRODUCTION

This chapter is about introducing the beginning of the proposed research. The title of this research is "Conceptual Design of Reverse and Jaw Detector Jig". This jaw will make the seal to be effective enough in locking. The content which will be discussed in this chapter is the background of study, problem statement, objectives and scope.

1.1 Background of Study

Industrial people have found a way to create new type of seal whereby it reduces cost and can be customized. Essentra is a company based in United Kingdom which has brought over the company Abric recently. Even though, the top management has changed, the objective and main product still have not changed. This company produces two types of seal which are plastic seals and metal seals. Jaw is a component present in the plastic seal. The function of this jaw is to prevent the pull back of insertion and make sure a strong lock between the seal and the product that needs locking. The jaw is a metal part which being inserted in the plastic seal before being covered with plastic cap. Figure 1.1 is sample image of jaw which gives higher strength for the seal when locking.

Figure 1.1: Jaw used for Mini Jawlock.

Figure 1.1, the jaw is being placed in a slot and being covered by a plastic cap through the process of ultrasonic welding. Figure 1.2 shows the assembly of jaw and cap in the product of Mini Jawlock.

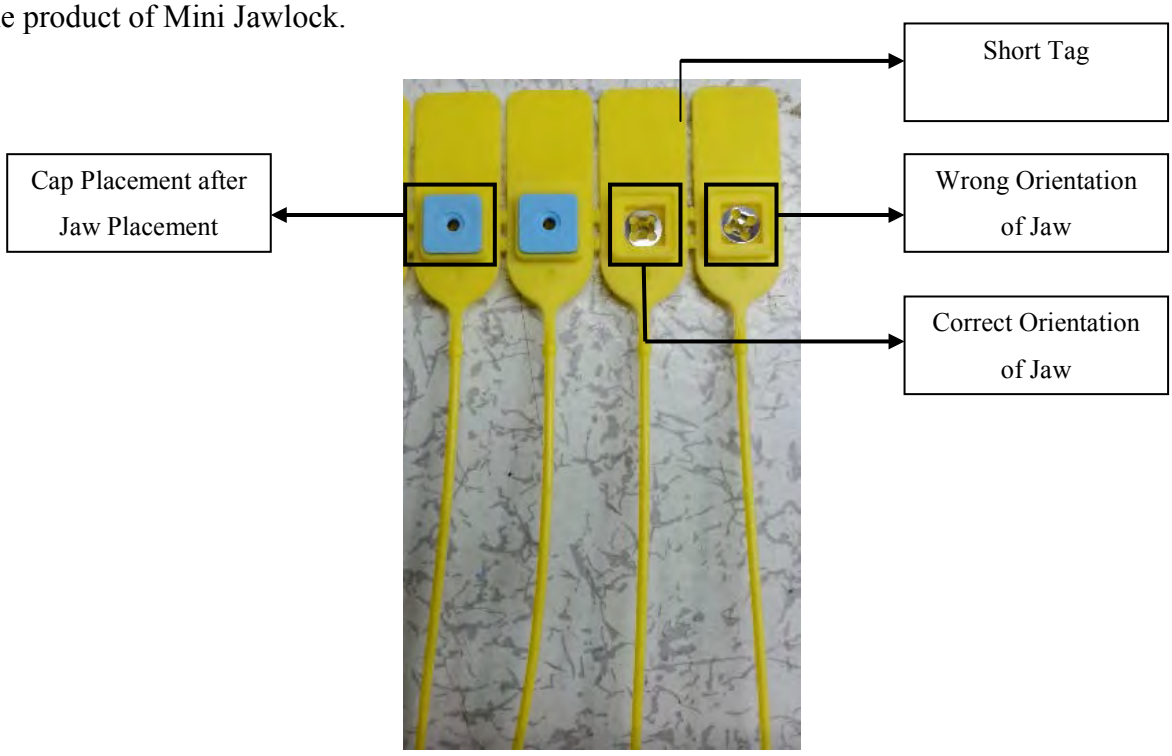

Figure 1.2: Image of placing jaw and cap in Mini Jawlock.

In this company, some of the seals are being assemble manually and some are assemble by using single manned machine basically with the used of automation table. The concept of creating this seal is based on the concept of cable tight. Different designs and colours are designed based on customization of customers. The specifications are altered according to how much strength needed for each type of seal for locking.

However, the company receives lot of complaints regarding the reverse jaw assembly problem, making the product to be sealed through a wrong orientation. The impacts of wrong assemble will caused customers to have hard time to use the seal. Some issues occur where during the assembly of jaw and cap after ultrasonic welding, few cavities are losing the jaw, hence making the locking impossible to be done. Figure 1.3 shows the locking condition in correct orientation of jaw placement, while Figure 1.4 shows the locking when the jaw is in wrong orientation.

Figure 1.3: Locking of seal with correct orientation of jaw.

Figure 1.4: Locking of seal with wrong orientation of jaw.

As can be seen in Figure 1.4, some cavities in the mat need to be sealed by inserting in opposite way. This is the problem that always occurred and need to be solved immediately. This is due to the fact that when a defect in any one cavity, the whole mat will be rejected.

1.2 Problem Statement

To overcome this problem of hard in detecting the reverse and absence of jaw, several studies and research have been carried out. Several problems encountered during the implementation of suggestion to design a new jig. One of the most crucial problems is the human fatigue. As mentioned, fatigue can lead to error while performing assembly process. In Figure 1.2, the jaw is being place in the mat can sometimes being placed inversely. When this problem occur, the seal will not functioning well. Next problem is that a mat consists of ten cavities. When one cavity is faulty, the whole mat will be rejected. The purpose of having the whole mat reject because some cavity can be located in the middle of the mat therefore amendments hard to be done. This will result as making the whole mat send for rework or send for crushing to make a new set of mat. The biggest problem that the company faces is that the possibility of shipping this rejects pieces to the customers. Since the failure to detect reverse or missing jaw in a particular cavity, the mat will be labelled as good part and ship to the customers. Some other problem which will probably occur is to identify the method of identifying tool to detect this defects. The final benefit that will be gain is that there will be zero defects product which will be shipped towards the customers. These are the few problems that need to be solved.

1.3 Research Questions

Some question rise when this research study starts such as:

i. How to detect the jaw is present or in correct orientation?
ii. Out from many criterions, which criterions is more important for design selection?
iii. Which design of jig should be selected at the end of this research study?
iv. How to make a jig that can be used to a variety of products?