UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AN ANALYSIS OF THE APPLICATION OF SOCCER LEAGUE COMPETITION (SLC) IN SOLVING ROUTE PLANNING PROBLEM IN HOLES DRILLING PROCESS OF THE PRINTED CIRCUIT BOARD (PCB)

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

by

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DEDICATION

I dedicated this thesis to my beloved parents who have always been my nearest and educated me to reach this level. I am also wanted to say a thank you to my Supervisor, Co-supervisor, and all my housemates who have encouraged, guided, motivate me to complete this research.

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ABSTRACT

The research on the path planning in PCB holes for the drilling process is to minimize the time taken in drilling a group of holes in the PCB. Most of the manufacturing industries, especially for those producing electronics products will make use of the CNC machines for drilling process in PCB. These CNC machines will make sure each hole is drilled by following a profile sequence. However, this profile sequence is rarely optimized. Hence, an optimization on the drilling sequence can reduce the overall production time and production cost. Based on the past literatures, the algorithms proposed that solves the routing path problem are Tabu search algorithm and PSO. Meanwhile, specifically in the CNC machine are 2-Opt Heuristic Evolutionary algorithm, GA and AA. This paper main objective is to propose an analysis on the SLC algorithm in solving this routing problem for the drilling holes process in the PCB.

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ABSTRAK

Penyelidikan mengenai perancangan laluan dalam lubang PCB untuk proses penggerudian adalah untuk meminimumkan masa yang diambil dalam penggerudian sekumpulan lubang dalam PCB. Kebanyakan industri pembuatan, terutamanya bagi mereka yang menghasilkan produk elektronik akan menggunakan mesin CNC untuk proses penggerudian di PCB. Mesin CNC ini akan memastikan setiap lubang digerudi dengan mengikuti urutan profil. Walau bagaimanapun, urutan profil ini jarang dioptimumkan. Oleh itu, pengoptimuman pada urutan penggerudian dapat mengurangkan masa pengeluaran keseluruhan dan kos pengeluaran. Berdasarkan literatur masa lalu, algoritma yang dicadangkan yang menyelesaikan masalah laluan-laluan adalah algoritma carian Tabu dan PSO. Sementara itu, khususnya dalam mesin CNC adalah algoritma 2-Opt Heuristic Evolutionary, GA dan AA. Objektif utama kertas ini adalah untuk mencadangkan satu analisis mengenai algoritma SLC dalam menyelesaikan masalah penghalaan ini untuk proses lubang penggerudian dalam PCB.

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LIST OF SYMBOLS

C_{ij}	-	Distance from first hole to second hole
C_{total}	-	Total distance of the path
$d_{Euclidean}$	-	Euclidean distance
M	-	Assume as a number of team
M_{total}	-	Minimum tool path length between holes
n	-	Number of holes needed
P_{ij}	-	Drill bit movement from hole i to hole j
x_i	-	Coordinates of hole i in X-axis
x_j	-	Coordinates of hole j in X-axis
y_i	-	Coordinates of hole i in Y-axis
y_j	-	Coordinates of hole j in Y-axis

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LIST OF ABBREVIATIONS

ACS	-	An Ant Colony System
BMOA	-	Binary Magnetic Optimization Algorithm
BPSO	-	Binary Particle Swarm Optimization
CNC	-	Computer Numerical Control
CS	-	Cuckoo Search
EA	-	Efficient Algorithm
EU	-	European Country
FA	-	Firefly Algorithm
GA	-	Genetic Algorithm
GPSO	-	Global Particle Swarm Optimization
GSA	-	Gravitational Search Algorithm
HTGA	-	Hybrid type of Taguchi Genetic Algorithm
KF	-	Kalman Filter
MOA	-	Magnetic Optimization Algorithm
NN	-	Nearest Neghbour
PCB	-	Printed Circuit Board
PSO	-	Particle Swarm Optimization
SKF	-	Simulated Kalman Filter
SLC	-	Soccer League Competition

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TCP	-	Travelling Cut Problem
TSP	-	Travelling Salesman Problem

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter purpose on proposed a new algorithm which is SLC algorithm, brief the concept of this algorithm. It focused on the overview of this research, detailing the objectives, briefly the problem statement, scope and provide the outcome of the research. Hence, the structure of the research can be visualized clearly by using application of the algorithm. This research aim was to analyse the application of the SLC algorithm in solving route planning problem in PCB holes drilling process.

1.2 Background of Study

A PCB was a board that is made up of special materials that less conductivity. The electronics components were designed to conduct electricity on the boards with copper tracks between them. The electronic components were fixed in their positions by drilling holes on the board, placing them and soldered. Many manufacturing industries, particularly in electronic manufacturing, use a CNC machine rather than a robot to make a group of holes in the PCB board.

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The CNC milling machine's movement, the machine table is moving in the (X-Y) direction so that each hole is drilling in its initial position. The time required to move the drill bit from one point to another is generally considerable. Therefore, an optimization of the hole in the PCB board production operations has been proposed that can reduce the machining time, which directly improves the manufacturer's mass production.

The concept of the SLC algorithm was based on the football system in an EU country. The countries are Australia, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom. Each league on this soccer game has each team where the teams are sorted based on the team's strength such as Strongest, Regular, and Weakest.

1.3 Problem Statement

A PCB or it can be called as 'Printed Wiring Boards' or 'Printing Wiring Cards'. The PCB has mechanically supported electronics components which were soldered onto this board electrically. The machine uses to drill the holes in PCB was a computer controlled. The drilling process was a slow process since each hole has to be individually drilled. The new invention of industry technology was introduced the PCB Robotic Drill to speed up the process and minimize the time taken to find the shortest drilling holes path. Thus, this paper approach SLC algorithm to analysed in solving route planning problem in holes drilling process of PCB.

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1.4 Objectives

The main goals of this research are:

1. To determine the route planning problem in holes drilling process of the PCB.
2. To identify and analyse the characteristics of the SLC algorithm.
3. To study the relationship between the number of teams and the number of seasons.
4. To identify the best soluton fitness by applying the SLC algorithm in solving the routing problem.

1.5 Scope of Project Research

There are three scopes that need to be done in order to achieve the objectives of this research. Firstly, to calculate the total path of the 14-holes on the PCB by using the mathematical equation. There is a condition where the initial position from the top left corner of the PCB workpiece to the first hole and the last hole to the initial position are neglected. Secondly, the determination of the SLC algorithm based on the idea of the football system in a league and the characteristics that this algorithm need to explore in this case study. Lastly, by initialize and declared some parameters and variables that suitable with the coding.

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