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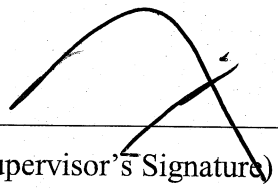

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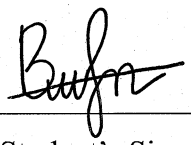

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DEVELOPMENT O] [RE DEVICE FOR AUTOMOTIVE [NSPECTION

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Thesis submitted in fulfillment of the requirements
for the award of the degree of
Master of Science

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

APRIL 2017

ACKNOWLEDGEMENTS

Alhamdulillah, first and foremost, I thank Allah S.W.T. for endowing me with Taufik and Hidayat, patience and knowledge to complete this research work.

I am also grateful and would like to express my sincere gratitude to my supervisor, Ir. Dr. Hj. Nik Mohd Zuki Bin Nik Mohamed for his germinal ideas, invaluable guidance, continuous encouragement and constant support in doing this research. I am truly grateful for his progressive vision about my training in science, his tolerance of my innocent mistakes, and his commitment to my future career.

My sincere thanks go to all my members of the Human Engineering Group (HEG) Lab UMP, for their excellent guidance, support, and enthusiasm in all phases of this work.

Lastly, I thank my parents, wife, brothers, sisters and friends for their constant encouragement and support in completing this research work through various stages.

ABSTRAK

Kualiti pada bahagian badan kereta adalah sangat penting, terutamanya dalam industri automotif, di mana dapat mengurangkan penggunaan masa untuk pembangunan kitaran produk dan ini menjadi faktor pembeza yang penting untuk menunjukkan perbezaan antara syarikat berprestasi baik dengan industri automotif yang lain. Proses pemeriksa kualiti pada bahagian badan kereta bertujuan untuk menghasilkan komponen kereta yang berkualiti tinggi, mengurangkan kos, dan menghasilkan produktiviti yang lebih tinggi. Pemeriksaan ketepatan rekabentuk alatan sangat diperlukan dalam pengeluaran bahagian automotif khususnya untuk memeriksa ketepatan bahagian automotif agar mengikut rekabentuk piawai yang ditetapkan dan untuk mengurangkan kesilapan manusia dengan menggabungkan pengaturcaraan komputer. Objektif utama penyelidikan ini adalah untuk membangunkan satu unit Peranti Pemeriksaan Ketepatan Mudah Alih (PCFD) untuk memeriksa ketepatan permukaan komponen automotif, menganalisis ketepatan permukaan komponen automotif pada bahagian *stamping* dan mengesahkan keberkesanan sistem pada PCFD. Pembangunan PCFD bermula dari rekabentuk sistem gantri, bahagian perkakasan dan perisian sehingga pengesahan data pada PCFD. Sistem gantri daripada rekabentuk 4 dipilih dan proses merekabentuk dilakukan mengikut rekabentuk ini. Aluminium dipilih sebagai bahan utama yang digunakan untuk mereka bentuk struktur gantri pada PCFD. *Arduino Mega* sebagai mikropengawal dan bertanggungjawab untuk memproses arahan pergerakan, mengawal motor *stepper* dan mengawal bacaan alat pengesan. Pengesan jarak ultrasonik digunakan untuk mengukur kualiti permukaan komponen, dan data yang diperolehi dikaji menggunakan perisian komputer untuk memastikan sama ada data tersebut mengikut data *CAD* yang sebenar. Perisian *Visual Studio* digunakan untuk mencipta ruangan untuk membolehkan pengguna membandingkan antara data sebenar komponen dengan data bacaan yang diperolehi daripada PCFD. Selepas itu, data akan dipindahkan ke komputer untuk dianalisis dan dibincangkan dengan lebih terperinci. Pengumpulan data diambil dari tiga sampel daripada komponen automotif yang sama iaitu sampel A, B, dan C dengan tiga bacaan berulang. Daripada analisis data sampel A, 73.33% daripada titik pemeriksaaan diterima dan 26.67 % ditolak dan bagi sampel C kira-kira 70.00% daripada titik pemeriksaan diterima dan 30.00 % ditolak. Penemuan ini menunjukkan sampel A dan C mempunyai kualiti permukaan yang lebih tinggi kerana jumlah peratusan pemeriksaan yang diterima lebih daripada 70%. Daripada data sampel B, 63,33% daripada titik pemeriksaan diterima dan 36.67% ditolak. Hal ini menjelaskan bahawa, sampel B mempunyai kualiti permukaan yang lebih rendah kerana jumlah peratusan titik pemeriksaan yang diterima lebih rendah daripada 70%. Melalui pengiraan masa yang dibuat pada setiap titik pemeriksaan pada PCFD menunjukkan bahawa masa yang diambil oleh PCFD adalah lebih baik daripada Mesin Pemeriksaan Kordinat (CMM) yang digunakan di industri automotif iaitu selama 6.67 saat. Di samping itu, daripada kajian Mengukur Pengulangan dan Penghasilan (GR&R) menunjukkan sistem pengukuran bagi PCFD boleh diterima kerana bilangan kategori yang berbeza adalah lebih daripada lima dan perubahan sistem pengukuran adalah di bawah 10%. Kesimpulannya, PCFD menghasilkan sebuah analisis untuk mengesahkan kualiti ketepatan permukaan komponen automotif yang menjadi penanda aras untuk operasi pemeriksaan dan pembangunan PCFD boleh digunakan sebagai rujukan dan garis panduan bagi jurutera untuk membuat pembangunan dalam menghasilkan peranti pengesahan dan pemeriksaan kualiti.

ABSTRACT

Automotive body panel quality is imperative, particularly in the automotive industry where radically shortened product development cycle time remains a crucial differentiating factor between the best performing companies and the rest of the industry. Automotive body panel checking processes aim to produce higher quality parts, reduce cost, and achieve higher productivity. Checking fixtures design is required in the automotive parts manufacturing, specifically to check the accuracy of the produced part according to the standard design and reduce the human error by incorporating computer programming. The primary objectives of this thesis were to develop a Portable Checking Fixture Device (PCFD) in order to check the surface accuracy for automotive stamping parts, analyse the surface accuracy of the automotive stamping parts and validate the system of PCFD. The development of a PCFD starts from the design of the gantry system, hardware and software part until the validation of the data. Gantry system Design Four is selected and fabricated according to this design. Aluminium is selected as the primary material used to fabricate the structural gantry of PCFD. Arduino Mega as microcontroller was responsible for processing movement instructions, controlling stepper motors and controlling the reading of the sensor. Ultrasonic distance sensor is used to calibrate the quality surface of the sample panel, and data are examined using computer software to ensure whether it follows the actual Computer Aided Design (CAD) data. Visual Studio software is used to create the user interface and compare the actual value and setting value for the checking point of sample panel in the quality checking process. Then, the data transferred to the computer to be analysed and discussed. Data from three samples are collected, namely sample A, B, and C with three repeated readings. From the data analysis of sample A, 73.33% of the points are accepted and the remaining 26.67% are rejected and for sample C, about 70.00% of the points are accepted and 30.00% are rejected. This finding shows that sample A and C have higher surface quality because the total percentage of the checking point has accepted more than 70%. From the data of sample B, 63.33% of the points are accepted and the remaining 36.67% are rejected. It can be seen that sample B has a lower surface quality because the total percentage of checking point accepted is lower than 70%. Checking time per point produced when checking the surface of sample panel by using PCFD is better than Coordinate Measuring Machine (CMM) used in the automotive industries which are 6.67 seconds. Also, from the Gage Repeatability and Reproducibility (GR&R) study of the measurement system of a PCFD, it is found that the measurement system is acceptable because the number of distinct categories is more than five and the measurement system variation is under 10%. As a conclusion, the PCFD generates the quality analysis of the surface accuracy for an automotive body part that guides the operation of inspection, and the development of a PCFD can be used as are references and guidelines for the engineers to make the development of CFs.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

C	Ultrasonic spreading velocity
dx	Diameter of *X*-axis shaft
dy	Diameter of *Y*-axis shaft
Fx	Force at *X*-axis
Fy	Force at *Y*-axis
L	Measured distance
Lx	Length of *X*-axis shaft
Ly	Length of *Y*-axis shaft
Mx	Maximum bending moment of *X*-axis
My	Maximum bending moment of *Y*-axis
N	Number of safety factor
p	Number of pole pairs
R	Weight of sensor device
s	Distance
t	Timer record
T	Time
°C	Degree Celsius
σ'	Design stress
σ_d	Design effort

LIST OF ABBREVIATIONS

ABS	Acrylonitrile Butadiene Styrene
ADC	Analogue to Digital Converter
AIAG	Automotive Industry Action Group
AISI	American Iron and Steel Institute
BIM	Building Information Modelling
CAD	Computer Aided Design
CF	Checking Fixture
CMM	Coordinate Measuring Machine
CNC	Computer Numerical Control
DAQ	Data Acquisition
DC Motor	Direct Current Motor
DTR	Data Terminal Ready
EEPROM	Electrically Erasable Programmable Read-Only Memory
FEA	Finite Element Analysis
FEM	Finite Element Method
FTDI	Future Technology Devices International
GR&R	Gage Repeatability and Reproducibility
GUI	Graphical User Interface
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
MOS Transistors	Metal-Oxide-Semiconductor Transistor
NEMA	National Electrical Manufacturer Association
OICA	International Organization of Motor Vehicle Manufacturers
PCFD	Portable Checking Fixture Device
PWM	Pulse-Width Modulation
QA	Quality Assurance
RAM	Random Access Memory
RAMPS	RepRap Arduino Mega Polulu Shield
RX LED	Receive Light-Emitting Diode
SWOT	Strengths, Weaknesses, Opportunities and Threats
TTL	Transistor Transistor Logic
TX LED	Transmit Light-Emitting Diode
UART	Universal Asynchronous Receiver/Transmitter
USART	Universal Synchronous/Asynchronous Receiver/Transmitter
USB	Universal Serial Bus

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