CLEANROOM ATTIRE MANAGEMENT SYSTEM WITH CLOSE LOOP CONTROL, TRACEABILITY, AUTOMATED EMAIL REPORTING, AND GOVERNANCE

MUHAMMAD 'AMMAR BIN MUHAMMAD SANI
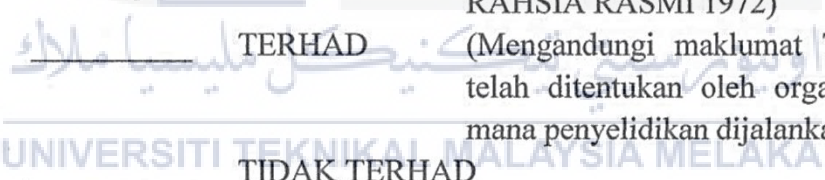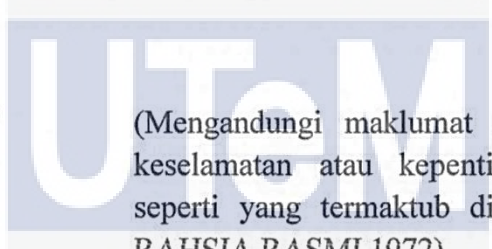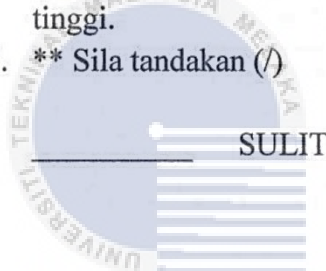
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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CLEANROOM ATTIRE MANAGEMENT SYSTEM WITH CLOSE LOOP
CONTROL, TRACEABILITY, AUTOMATED EMAIL REPORTING, AND
GOVERNANCE

MUHAMMAD 'AMMAR BIN MUHAMMAD SANI

This report is submitted in partial fulfilment of the requirements for the
Bachelor of Computer Science (Database Management)

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2017

DECLARATION

I hereby declare that this project report entitled

CLEANROOM ATTIRE MANAGEMENT SYSTEM WITH CLOSE LOOP CONTROL, TRACEABILITY, AUTOMATED EMAIL REPORTING, AND GOVERNANCE

is written by me and is my own effort and that no part

has been plagiarized without citations.

STUDENT: _____   Date: 25/8/17

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I hereby declare that I have read this project report and found this project report is

sufficient in term of the scope and quality for the award of

Bachelor of Computer Science (Database Management) With Honours.

SUPERVISOR: _____   Date: 25/8/2017

(YAHYA BIN IBRAHIM)

DEDICATION

To my beloved parents, my siblings, lecturers and everyone that keep supporting me till now. Thanks, and may Allah bless you and grant you with Jannah.

ACKNOWLEDGEMENTS

I would like to thank to my supervisor, Sir Yahya Ibrahim since he always guides and supervise me since diploma until know. Thanks sir.

I would like to thanks to my parents and my family members for every support, motivation, understanding especially during developing this project. Thanks, and I love all of you.

ABSTRACT

Nowadays, Industry 4.0 is the target for all industries all over the world. The "smart factory" concept is the output from this emerging trend. By applying this concept, they need to consider automation and data exchange in manufacturing technologies and develop the cyber-physical systems, the Internet of things and cloud computing. The cyber-physical systems monitor overall physical factory process done in their factory. Employees whom are working inside cleanroom production area must ensure they were provided and wear dress code correctly as mentions by the standards. The employees were assigned with their own dedicated attire for being used by them inside production area in the factory anytime anywhere. To ensure the attire still met the specifications working inside the cleanroom, which is it must clean and maintained the electrostatic discharge (ESD) protective, the attire must be send for washing at least once in a fortnight. The attire washing handled by the Attire Team inside the Attire Room. There are several flows for manages the attire currently happened in the segment accordingly. Currently, the segments (department) have/managed their respective cleanroom attire management systematics based on their "Best Can Do" approaches with no proper/clear close loop control for attire management, no automated reporting for certain attire cycles, no governance for attire usage cycles, and different operations flow for each segment. This application will ensure all flows happened currently in attire room are recorded and captured inside the system. Then, the application will provide auto emailing trigger for reporting. The application was developed by using phased-development methodology and object-oriented approach for documentation and system implementation. The result of this project is a web with mobile-first design and windows-based (client-server) application.

ABSTRAK

Dunia industri kini sedang merebut takhta siapakah yang akan mendahului dalam mengimplimentasi konsep-konsep yang ditekankan dalam Industri 4.0. Istilah "Kilang Pintar" seringkali digunakan sebagai hasil kepada kemunculan ideologi ini. Untuk melaksanakannya, industri perlu tampil dalam dan mewujudkan makanisma pengkilanan dengan mengutamakan automasi, penrkongsian data masa nyata, mencipta sistem siber-fizikal, peranti berhubung (IoT) dan pengkomputeran awan. Sistem siber fizikal yang dibangunkan akan memantau setiap proses fizikal yang berlaku di kilang dan dilaporkan terus ke sistem ini secara masa nyata. Selain itu, para pekerja yang bekerja dalam kawasan yang ditetapkan juga perlu mematuhi standard yang telah ditetapkan, seperti pemakaian yang khusus ketika melakukan tugas. Untuk tujuan itu, setiap pekerja kebiasaannya akan diberikan pakaian untuk digunapakai sepanjang waktu kerja pada setiap masa dan lokasi seperti yang ditugaskan. Pakaian kerja ini diguakan ketika mereka berada di kawasan yang dilabel sebagai "bilik bersih" atau *cleanroom*. Pakaian kerja yang diberi mestilah sentiasa bersih dan mampu mencegah daripada pembebasan arus elektrik statik. Untuk memastikan pakaian-pakaian yang telah diberikan kekal mematuhi standard tersebut, pakaian biasanya perlu dihantar untuk semakan dan cucian setiap dua minggu sekali. Kutipan pakaian ini akan dilakukan oleh petugas yang ditugaskan oleh bahagian-bahagian pengkilangan di lokasi yang telah ditetapkan. Oleh kerana saiz sesebuah kilang kebiasaannya terlalu besar, lokasi bilik kutipan ini ditempatkan di beberapa loaksi yang berbeza dan berasingan mengikut ketetapan yang dibuat oleh bahagian-bahagian pengkilangan. Kutipan diuruskan oleh seorang atau beberapa individu di lokasi-lokasi tadi. Disebabkan lokasi dan bahagian yang berbeza, setiap bilik mempunya tatacara pengurusan yang berlainan. Tatacara yang digunakan ini ditetapkan oleh pentadbir bagi setiap bahagian. Setakat ini, bilik-bilik ini diurusakan mengikut pendekatan sebaik mungkin mengikut kemampuan yang dimiliki, tanpa ada pemantauan secara menyuluruh/jelas bagi setiap proses yang berlaku, tiada laporan yang dijana secara automatik dan tiada pengurusan yang rapi bagi setiap proses. Implementasi aplikasi yang dibangunkan ini mampu mengatasi masalah-masalah seperti yang disebutkan tadi. Ia akan memastikan setiap transaksi dapat dikesan dan dikenalpasti untuk pelbagai tujuan. Aplikasi juga menawarkan penjanaan laporan secara automatik melalui aplikasi ataupun penghataran menggunakan emel. Aplikasi ini telah dibangunkan menggunakan metodologi pembangunan-berfasa dan pengaturcaraan serta dokumen menggunakan kaedah pembangunan berorientasikan objek. Hasil daripada tesis ini akan menghasilkan penyelesaian menggunakan dua jenis teknologi iaitu berasaskan *web* dan *desktop*.

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CHAPTER I

INTRODUCTION

1.1 Introduction

Nowadays, Industry 4.0 is the target for all industries all over the world. The "smart factory" concept is the output from this emerging trend. By applying this concept, they need to consider automation and data exchange in manufacturing technologies and develop the cyber-physical systems, the Internet of things and cloud computing. The cyber-physical systems monitor overall physical factory process done in their factory.

Traversing deep into this trend, one of the thing the industry need to take care is: - the standards applied to the employees whom were working inside their factory. At this era, most of manufacturing industries implements the cleanroom standard as a best practice for their environment in every production area. There is one point the cleanroom need is to ensure a low level of environmental pollutants such as dust, airborne microbes, aerosol particles, and chemical vapours.

In addition, Electrostatic discharge (ESD) is a highly potential risk for the employees who were working inside production area of the factory. ESD is the sudden flow of electricity between two electrically charged objects caused by dielectric breakdown, electrical short and direct contact between the employee and the device itself.

From here, the manufacturer need to ensure the clean and safety environment for the cleanroom every time the production is running. The environment must be set up according to the standards set by the expertise. The room must always clean and the workers are always protected against ESD. This requires them to wear a special attire prescribed by the industry. The attire must always in a very clean condition and it able to protect the wearer from ESD.

To ensure the attire still met the specifications of the cleanroom, the attire must be sent for washing at least once in a fortnight. The attire will be collected by the person in-charged (PIC) in attire room or sometimes the employee may send it directly to the bins located nearby from their production area. The attire room PIC will manage all further processes such as sending those attires to the Laundry Vendor, collect and check the returning attire from the vendor and returning the attire to the owner.

Besides that, the attire team are responsible to manage attire assignment for trainee, new employee, and guest. They are also managing any new attires ordering for new employee and attire replacement. When the attire is ready for collection, the attire team must ensure the owner collects it from them. All such works currently being done manually without a standard systematic approach.

1.2 Problem Statements

Currently, the segments/department have/managed their respective cleanroom attire management systematics based on their "Best Can Do" approaches with no proper/clear close loop control for attire management, [1] no automated reporting for certain attire cycles, no governance for attire usage cycles and each segment is operating their attire room with a different flow from others.
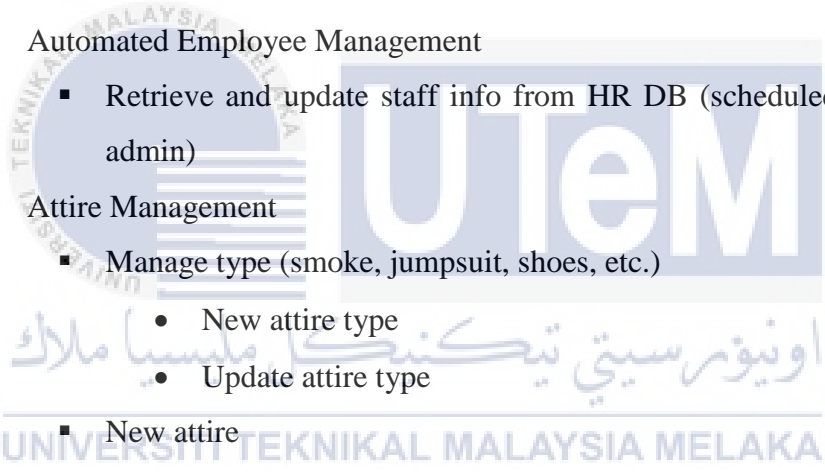
1.3 Objectives

This project aims to fulfil the target which are:

- an effective/automated cleanroom attire management system,
- systematics database management with close loop control, attire traceability,
- automated reporting/triggering, [1]
- and offers a standard automated operation flow for each segment.

1.4 Scopes

1.4.1 General tasks

- ✓ Automated Employee Management
  - ▪ Retrieve and update staff info from HR DB (scheduled / manual by admin)
- ✓ Attire Management
  - ▪ Manage type (smoke, jumpsuit, shoes, etc.)
    - • New attire type
    - • Update attire type
  - ▪ New attire
  - ▪ Update attire
- ✓ Attire Assignment
  - ▪ New trainee
  - ▪ Certified trainee
  - ▪ Existing employee (new attire caused by lost, torn, expired - old item remarks as scrap)
- ✓ Laundry Cycle – Each process through manual bar code scanning.
  - ▪ Laundry In (sent to the attire/put inside smart bin)
  - ▪ Laundry Sent (sent to the vendor)
  - ▪ Laundry Returned (washed and returned by the vendor)
  - ▪ Laundry Out (give back to the employee)
- ✓ Laundry Tracking (available to collect, still with the laundry vendor, etc.)
  - ▪ Check attire laundry status (for user enquiries)

- ✓ Attire Tracking (using Attire No. / Staff No. / RFID)
    - ▪ Display attire information and status
- ✓ Employee resigns
    - ▪ Release the attire assigned

1.4.2 Reporting tasks

- ✓ Automated Attire Room Reporting (Laundry, Storage, Escalation)
    - ▪ Send email for any attire that didn't sent for washing more certain periods
    - ▪ Send email if the employee did not collect more that certain periods
- ✓ Attire Expiry Management and Reporting
    - ▪ A dashboard to view overall expiry status for the attires
    - ▪ Get a list for attire need to change
    - ▪ Get a list by range of cycle usage availability

1.4.3 Modules to be developed

- i.   Employees Dashboard, Details and Attire Management
- ii. Guests Review, Details Management and Attire Loans
- iii. Attire Details, Expiry, Status, Assignment and Return to owner.
- iv. Review and Manage Laundries by segments with batches.
- v.   Monitoring based on produced reports and charts.

1.4.4 Target Users

- i.   General Employees
- ii. Room Members,
- iii. Room Admins,
- iv. Application Admins,
- v.   Application Owner

1.5 Project Significance

Any manufacturer with cleanroom practices at their factory might need this application. Systematic approach is one the target in any size of manufacturing company. With limited headcount to develop such this application, a ready-made application as this will help them since it just requires a very minimum effort to adept it into their factory site.

1.6 Expected Output

❖ Web-based Application – Monitoring solution

❖ Desktop-based (Windows) Application – Attire Room Management solution

Both with ability to use multiple login authentication including access grant for multiple type of user and data ownership capabilities.

1.7 Conclusion

To conclude this chapter, it briefs us the overall idea about the target implementation needed for completion of the entire application. Until here, explanations made consist of a brief introduce of the project, problem statements, objectives, scopes, project significance and expected output. The next chapter will tell the methodology decided to be used and the planning steps for completing the application development.

CHAPTER II

PROJECT METHODOLOGY AND PLANNING

2.1 Introduction

This chapter consist of descriptions of methodology used for completing the cycle of application development. Also in this chapter, there are project planning, schedule and milestone as a guide and goal to achieve.

2.2 Project Methodology

This project is utilising the Phased-Development Methodology. This methodology had been chosen due to the fast development and multiple phase features requirement from the user. So, to ensure the application can deploy within limited time frame given, the requirements asked by the user will be break into certain phases. The 1st phase must be useful to user even though, not all functionalities offered to them. During the running of the 1st phase, the priorities for next phase might be different. The developer can be decided what functionalities must be added next. [2]

Overall development process for this project is based on Object Oriented Approach. For analysis and design, Object Oriented Analysis and Design (OOAD) will be used for diagramming and describing them. During development, the

application will be using Object Oriented Programming (OOP) for easier synchronising between diagram and implementation.

2.3 Project Schedule and Milestones

Table 1 - Weekly Project Schedule and Milestones

Week	Activity	Deliverables
1	Project proposal and approval.	Proposal / Software Development Planning (SDP) Document
2	Project analysis and design. Requirement gathering and by off Initial prototype	Software Requirement Analysis (SRA) Document
3	Project analysis and design. Database design Project Use Case Use Case description	Software Requirement Specification (SRS) Document
4	Project analysis and design. High-level classes Functionalities details descriptions	Software Design Description (SDD) Document
5	Project development Database Implementation	
6		
7		
8	Project development Application Implementation	
9		
10		
11		
12	Project test planning and development	
13		
14		
15		
16	Project testing, and approval	Software Test Description (STD)
17		
18		
19		

Week	Activity	Deliverables
20		
21	Demonstration preparation	Application Demo's Slides
22		
23		

Table 2 - Gantt Chart of Project Activities

Activity \ Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	23
Project Planning																						
Project Design																						
Project Implementation																						
Project Testing																		█	█	█		
Project Feedback																			█	█		
Project Maintenance																			█	█	█	█
Project Documentation																				█	█	█

2.4 Conclusion

This chapter provides the methods plan to ensure the project could be develop as user requires fast and quick development. The phase development methodology had been the chosen one since it able to target certain features to be developed at certain level and it makes the application could be deliver faster before the overall application completely developed. At the same time, the chapter also provides the target timeframe to get everything done on time. This time frame might be used as a guide to the project from time to time.

CHAPTER III

ANALYSIS

3.1 Introduction

This chapter will explain the existence application and current flow of the operation best on their current practice. We might understand the overall picture of the entire cleanroom attire management flow. Then, this chapter will introduce the initial idea came after analysed the current application and practise intentionally for improving and enhancing the current job.

3.2 Problem Analysis

One of the study had been made to the industry which they had develop a system named Attire Online System. [1] The demonstration of the system had been given by the developer of the application from Operation Excellence (OE) Department in one of the industry in Batam, Indonesia. According to her explanation, this system will handle a request for attire changes made by the employees themselves. They need to request it through the system and go to the attire room the following day. The attire team will review all requests made and prepare for those inside Attire Spot Centre. The attire stocks stored inside another room and quite far from the centre. To resolve each request, that's why the employee needed to request a day before the attire is ready for collection. Inside the system, it also consists some rules defined and implement