



Faculty of Computer Science and Information Technology

Perodua Manufacturing Training System: Visual Manual

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Bachelor of Computer Science with Honours (Multimedia Computing)

2019

Perodua Manufacturing Training System: Visual Manual

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This project is submitted in partial fulfilment of the
requirements for the degree of
Bachelor of Computer Science with Honours

Faculty of Computer Science and Information Technology

UNIVERSITI MALAYSIA SARAWAK

2019

UNIVERSITI MALAYSIA SARAWAK

THESIS STATUS ENDORSEMENT FORM

TITLE PERODUA MANUFACTURING TRAINING SYSTEM: VISUAL MANUAL

ACADEMIC SESSION: 2019/2020

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ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the Most Merciful. First and foremost, I would like to take this opportunity to express my gratitude to Ms. Emmy Dahliana bt. Hossain, my Final Year Project supervisor for her assistance and supervision throughout the process of completing this project. I also would like to thank her in regard of the guide she had provided, and the time she had taken to go through my project. I would also like to thank Professor Dr Wang Yin Chai, the Final Year Project subject coordinator for countless guidance and coordination.

My deepest appreciation to Developmental and Dojo Education, Perodua Manufacturing Sdn. Bhd staffs, especially Mr. Sabarudin bin Norman in providing me the chance to improvise my internship project and for his supervision throughout previous internship regarding this project, aside of offering me a deeper understanding of the Visual Manual and production line processes.

I am also thankful for my parents, especially my father who has been there for me, supporting me to go through this project emotionally and having faith in what I would do and what I am doing. Not to forget, thank you to my mother who had also supported me especially financially and mentally.

I would like to share my gratitude, too, to my friends especially for their help, support, discussions and struggles in accomplishing this project. Thanks to each of them for not giving up on me and keep on encouraging each other, although I myself was at my lowest. Lastly, I would like to thank those who had indirectly and directly assisted me in completing this project.

ABSTRACT

The use of teaching aids in learning and teaching is important in ensuring an engaging, interactive and also effective environment. With the development of technologies these days, modern ways of teaching such as implementation of e-learning, courseware, slideshows and visual aid are being used widely in various field including industrial. This project introduced a teaching courseware namely Visual Manual that is used by trainers of various Shops from Developmental and Dojo Education Perodua Manufacturing Sdn. Bhd. during training sessions. The content in Visual Manual consists of the basic processes, safety, awareness and standards required in manufacturing processes. However, as time passes by along with the growth of new technologies, Visual Manual has a downside as it is outdated and obsolete. Due to this issue, a demand to present a Visual Manual that is updatable, operable and stable is required by the trainers in order to ease their teaching processes. The features that is implemented in this project consists of managing courses, display training progress, generate training session report and translation option for the training courses. The project makes use web-based programming language including HTML, JavaScript and PHP by the application of Rapid Prototyping for ISD Model as its methodology. Visual Manual is expected to have improvements that is beneficial to the users and also will affect the learning and teaching process efficiently, and in order to ensure the objective is achieved, development process is being done, followed by testing that received mixed reaction from its users such as intrigued, confused and also glad.

ABSTRAK

Penggunaan alat bantu pengajaran dalam pembelajaran dan pengajaran adalah penting dalam memastikan persekitaran yang menarik, interaktif dan berkesan. Dengan perkembangan teknologi hari ini, cara pengajaran moden seperti pelaksanaan e-learning, courseware, persembahan slaid dan bantuan visual digunakan secara meluas dalam pelbagai bidang termasuk industri. Projek ini akan memperkenalkan satu perisian pengajaran iaitu Visual Manual yang digunakan oleh pelatih pelbagai Kedai dari Pembangunan dan Dojo Education Perodua Manufacturing Sdn. Bhd yang digunakan semasa sesi latihan. Kandungan dalam Manual Visual terdiri daripada proses asas, keselamatan, dan piawaian yang diperlukan dalam proses pembuatan. Walau bagaimanapun, seiring dengan pertumbuhan teknologi baru, Visual Manual mempunyai kelemahan kerana ia telah lapuk dan tidak beroperasi dengan baik. Disebabkan isu ini, permintaan untuk membentangkan Visual Manual yang boleh dikemas kini, dikendalikan dan stabil diperlukan oleh jurulatih untuk memudahkan proses pengajaran mereka. Projek ini akan menggunakan bahasa pengaturcaraan berasaskan web termasuk HTML, JavaScript dan PHP. Visual Manual dijangka mempunyai peningkatan yang memberi manfaat kepada para pengguna dan juga akan mempengaruhi pembelajaran dan proses pengajaran dengan cekap, dan untuk memastikan ini berjaya, proses membangunkan aplikasi dijalankan, diikuti oleh fasa percubaan yang mana telah membuahkan hasil yang pelbagai daripada pengguna contohnya kagum, keliru dan juga teruja.

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CHAPTER 1 INTRODUCTION

1.1 Introduction

Perodua Manufacturing Sdn Bhd (PMSB) is one of the groups in Perodua Sdn Bhd, that focuses on the car manufacturing processes. Several departments under PMSB consists of Press Shop, Body Shop, Paint Shop, Assembly Shop, Quality Control, Casting Shop, Machining Shop, Engine Shop, Unit Quality Control and also Developmental & Dojo Education (DDE).

DDE is a department that provides training sessions for new and current employees, where the training mainly focuses on car manufacturing processes, basic skills development and also insights on rules and regulation in the manufacturing plant. Shops will send two most skilled employees as trainers in DDE. Two categories of trainers are Shop Dojo and Mechanism Dojo.

The use of manufacturing courseware nowadays is considered vital as it guides the trainees through introduction of types of equipment, tools, machineries they will use in production line. (Hsieh & Hsieh, 2001). In PMSB, the use of learning material is implemented through the usage of Visual Manual. It is used daily by the DDE trainers during training sessions.

Training sessions will be held almost daily and as aforementioned, it is divided into two categories: Shop and Mechanism. Mechanism Dojo focuses more on the introduction and basic of parts, machineries that will be used in line, safety precautions for each Shop and other theoretical fundamentals in production line. Plus, Visual Manual is being used more in Mechanism Dojo compared to Shop Dojo.

Shop Dojo on the other hand, focuses on the process in production line. Visual Manual is less used here since trainers would take the students to tour around the Shop. The learning session would also be engrossed on practical sessions rather than explanatory. However, this does not describe Visual Manual as not crucial since the content of the Visual Manual will assist the training session efficiently.

Both training session would be initiated with a pre-training test. The pre-test contains the syllabus that the trainee will learn later. Trainers then collect the paper once the test finished, and the training session begins. Towards the end, the trainees will be distributed with post-training test papers. This test contains the exact questions of pre-test, but the questions are

arranged in a random manner compared to previous test. The results of the tests will determine whether the trainees are competent or comprehend the syllabus well enough.

Visual Manual is an important fundamental guide in understanding the progress in production line as it provides basic knowledge and skills required in car manufacturing processes. Poberezhskaya as cited in Vassilyev, et al., 2009, state the benefit of learning management system is its ability in assisting factories to associate training ideas with tactical strategies along with developing effective knowledge supervision procedures according to factory's size.

1.2 Problem Statement

Based on previous industrial training experience in Perodua, DDE is looking forward in providing a training environment that is on par not only in regard with technological developments in the manufacturing, but also in the IT field. Training sessions and skill enhancement classes for production processes were held daily, and the use of a courseware used by trainers namely Visual Manual, is meant to make the training session easier and in a more detailed yet interactive manner.

Visual Manual is made in CD form distributed for each shop, where trainers will select the syllabus they wanted through a list of chapters. The chapters later were divided into categories that contain the topics that trainer will decide to teach. Multimedia components such as videos, images, graphics and Flash files were used as an interactive guide to accompany the explanation provided. Unfortunately, due to restrictions and demands, Visual Manual requires major improvements to adapt through technological upgrades.

The issues recorded include:

- The structure of menu, several contents and components are not neatly arranged and inconvenient for the users to browse through.
- The hardware and software requirements are obsolete and incompatible.
- The current version of Visual Manual is not in-line with the progress and changes in the production line. Trainers had issues in catching up with the updates and desired to have an updatable system, so that they can easily take charge of the syllabus.

Thus, in response to this problem, this study proposes to improve the current situation and ensuring that Visual Manual to be beneficial for both trainers and trainees who attended the class.

1.3 Objectives

- To design an interactive and simpler interface of Visual Manual for better users' understanding.
- To develop an interoperable, updatable and interactive Visual Manual.
- To evaluate the usability of the Visual Manual for current and future uses.

1.4 Methodology

The method selected in order to complete this project is through the implementation of Rapid Prototyping. Rapid Prototyping Model includes these stages:

- Assess needs and analyse content
- Set objectives
- Construct prototype (Design)
- Utilize Prototype (Research)
- Install and Maintain System.

Figure 1.1 shows the brief overview of phases in the Rapid Prototyping Model that will be explained in detail in Chapter 3.

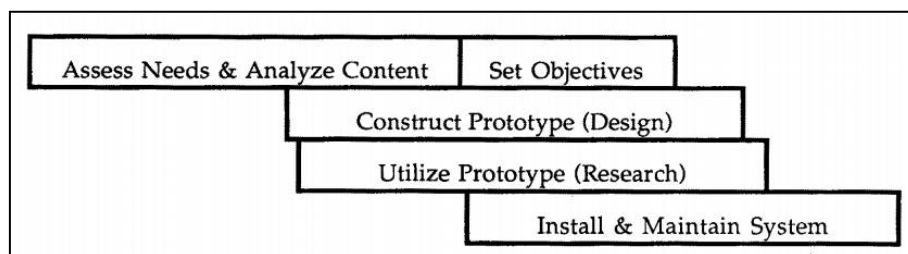


Figure 1.1 Rapid Prototyping Approach in Industrial Design

Gutierrez (2015) states that the strength of rapid prototyping approach in industrial is “it encourages instructional designers to think out-of-the box, it enhances communication between different stakeholders, it is flexible and efficient, it establishes expectations early on in the project, and a resource-efficient process”.

Gutierrez (2015) also promotes rapid prototyping as an ideal solution when the course's interactivity is crucial, asides of complexity and excessive usage of media issues may arise. This methodology is also well-related and an improvement to the well-used ADDIE Instructional Design Model. A detailed explanation on the methodology will be explained in Chapter 3.

1.5 Scope

Visual Manual is expected to be beneficial for trainers during training session, trainees who attend training and also the management board. Trainers will make use of Visual Manual during theoretical and practical class, making revision on syllabus and also in training evaluation.

Trainees consists of employers from Perodua company itself, suppliers, vendors and visitors from other companies – including international companies, mainly from Japan. Trainees will gain benefit from Visual Manual through the simplicity, interactivity and interesting interface. Trainees, however, have limited access to the Visual Manual as it is for internal and administrative uses only.

However, there are few limitations that will affect the progress of this project. This includes the outdated programming language used in previous Visual Manual, which leads to obsolete hardware and software requirements. Some other issues also consist of trainers and trainees' level of IT literacy and the absence of database to update training sessions as data is stored manually in Excel spreadsheet form.

1.6 Significance of Project

Visual Manual, as aforementioned is a crucial software as it is used daily for training, aside of acting as an essential introduction to manufacturing processes happening in-line. Demands from trainers in having a Visual Manual that is updatable and also acts as a steppingstone to upgrade the state of Visual Manual to a more efficient system.

The lack of important features can cause inconvenience during training sessions. It is also important in ensuring that the learning and teaching process ongoing is on par with the upgrades in production line. The improvements proposed will benefits both parties which are trainers and trainees through the aforementioned features upgrade. Asides that, it is also crucial to implement the upgrades as it is getting obsolete which causes the need to have a sustainable system.

1.7 Project Outcome

The expected result of Visual Manual training system will benefit the trainer through improvisation; where the previous version restricted the crucial feature of updating Visual Manual in regard to any changes that occurred in plant. It is also expected to be operable through various OS versions and also adaptable to not only software updates, but also hardware requirements as it is upgraded into web-based system.

Trainers will have a Visual Manual that enables the trainers to update any required information and also having the feature of displaying syllabus in a better appearance. This includes adding new information and depleting outdated or unnecessary details.

Trainers will also be able to go through the syllabus in a more refined way through the partitioning of category, chapter and subtopic upon the main menu, instead of through a table of content as in previous version of Visual Manual. It will also assist the trainers in managing the records of pre-training and post-training conducted during the training session.

Visual Manual will be used to display syllabuses from different Shops through a selection of chapters and will implement the use of medias such as video, images, Flash files and quizzes along with meaningful yet simple and interesting explanation. Trainees will be benefited through the simple and informative interface to interact with, while listening to the trainers' lectures.

1.8 Project Schedule

The progress of project throughout the beginning date until the end followed by the detailed explanation of each activity's duration and date is attached as Appendix A.

1.9 Thesis Outline

For the project outline, the project will begin with Chapter 1 that describes the objectives, methodology proposed, significances of project, scope, expected outcomes and the project schedule followed by Chapter 2 that consists of analysis of current application and related works, comparison of features of each systems or application, and discussion over the findings.

Chapter 3 on the other hand will present the methodology used to develop the project through a detailed explanation for each methodology phased, followed by the proposed work. This chapter also will discuss the findings that is collected from the users and thorough

explanation of features in requirement analysis, which is later followed by the design of components including database, flow of navigation and the wireframes, and lastly the design for the testing phase.

Chapter 4 which is Implementation will discuss the implementation process where the configuration components, software and hardware to make up the application is being described, along with the modules' implementations. The next chapter, which is testing, explained the tests that are being done and the findings of the tests from unit and system and also usability testing is being discussed. The final chapter will conclude on whether the objectives are being achieved, constraints on the project and also the plan for the project in the future.

1.10 Summary

Previous version of Visual Manual is programmed inefficiently and have out-of-date hardware and software requirements, hence making it unable to adapt with technology advancement. Other issues related to the growth of technology include the changes of machineries in the production line. Although the plant had been using new version of machines, the current restricted Visual Manual may cause issues during training session as it will not be resourceful.

Furthermore, additional improvements and features that will assist towards the Industry 4.0 includes the changes from manual and traditional method of updating training progress besides of having traditional meet up can be replaced with an automated, time-worthy results and presentation. Since Visual Manual is a vital component in being a guidance for manufacturing processes, improvement is critical and in order to achieve this, the Rapid Prototyping approach in Industrial Design is being used.

This chapter generally describes the improvement that is required to establish a training management system for Developmental and Dojo Education (DDE) trainers from Perodua Manufacturing Sdn Bhd (PMSB) namely Visual Manual. The following chapters for this report are Chapter 2: Literature Review and Chapter 3: Methodology, Chapter 4: Implementation, Chapter 5: Testing, Chapter 6: Conclusion and Future Works.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

A prior step before proceeding to development phase includes a thorough background study and reviews on existing systems to make sure the project's objective is achieved. This chapter will review and provide an analysis of existing systems through their usability, features, capabilities, functionalities and several other aspects. This chapter will also describe several attributes regarding the needs, usages and development of courseware and learning management system in various field, especially manufacturing.

2.2 Current Scenario Analysis

Limitation such as restricted laboratory access and equipment, along with the insufficient resources to aid students outside of the platform caused a drawback in providing the students with exposure on tools and equipment that they will use for the industry (Hsieh & Hsieh, 2001). However, a developing progression of computer technology implementation in manufacturing education is noticed nowadays and even though they are unable to take the place of the feel of using the equipment hands on, this can introduce the students on information required on the equipment.

A computer-based instructional system known as intelligent tutoring system (ITS) is a system that describe the wisdom required in teaching about a subject through the application of artificial intelligence techniques. (Hsieh & Hsieh, 2001)

An example of ITS includes the electronic assembly technology (EAT) that is arranged based on the required growth of China's higher vocational education. EAT is aimed to ensure the students to understand the process of electronic products manufacturing, able to choose and use materials and components accurately, grasp the knowledge of electronic components processing and soldering skill, and able to assess and assemble machines. Since it is hard for students to comprehend precisely and able to gain required skills through traditional blackboard and lectures method, the use of modern teaching comes in handy. (Tian, Wu, & Zhu, 2018)

The same concept is applied on the current version of Visual Manual. Visual Manual is considered as an ITS and courseware for its features. This application is being used by DDE trainers to teach about fundamentals of manufacturing process, safety and health issues, quality control, etc. Those who attend training consists of employers from Perodua group, suppliers, vendors and sometimes local and international visitors, mainly from Japan.

Visual Manual was firstly distributed in CDs by Toyota (Japan) as training aids and delivered throughout the department, or Shops, where a department may receive one or more Visual Manual CD but this application, later, was adapted by Perodua in their training sessions.

This application embedded multimedia elements such as videos, texts, graphics, Flash files animation as teaching aid. Trainers select a course to teach from a menu presented in a list of topics by clicking “O” This may be inconvenient in future uses to search for specific topic, hence a Search option should be included in the proposed Visual Manual. This issue is as shown as in the given figure, Figure 2.1.

ショップ: エンジン加工

技能分類			コンテンツ名	コンテンツNo	VM
大分類	中分類	小分類			
共通	基本知識	受入教育	安全の基本	FGUK1-v0001	<input type="checkbox"/>
			品質に対する考え方	FGUQ1-v0001	<input type="checkbox"/>
	基本技能	加工の基本	エンジンの仕組み	FGUQ1-v0008	<input type="checkbox"/>
			かんばんの役割	FGUK1-v0004	<input type="checkbox"/>
		測定・判定	表面あらさ(触覚)	FGUK2-v0510	<input type="checkbox"/>
			ノギスの測定技能	FGUK2-v0512	<input type="checkbox"/>
			マイクロメータの測定技能	FGUK2-v0513	<input type="checkbox"/>
		治工具	TLレンチでの締め付け	FGUK2-v0520	<input type="checkbox"/>
		ゲージ測定	当たりゲージ(軸物・GTゲージ)の測定技能	FGUK2-v1541	<input type="checkbox"/>
			幅ゲージの測定技能(L)	FGUK2-v1542	<input type="checkbox"/>
			外径ゲージの測定技能(O)	FGUK2-v1543	<input type="checkbox"/>
			栓ゲージの測定技能(P)	FGUK2-v0544	<input type="checkbox"/>
			ネジゲージ測定技能(SG)	FGUK2-v0545	<input type="checkbox"/>
			シリンダーゲージの測定技能(MP)	FGUK2-v0546	<input type="checkbox"/>
			ネジ深さゲージの測定技能(PS)	FGUK2-v1547	<input type="checkbox"/>
			テーパーネジゲージの測定技能	FGUK2-v1548	<input type="checkbox"/>
			電気マイクロゲージの測定技能(EP)	FGUK2-v0549	<input type="checkbox"/>
			電気マイクロゲージの測定技能(EC)	FGUK2-v0550	<input type="checkbox"/>
		深さゲージの測定技能(S)	FGUK2-v0551	<input type="checkbox"/>	
		基本技能応用	刃具交換	ドリル交換	FGUK2-v0570
	スローアウェイチップ交換作業			FGUK2-v0571	<input type="checkbox"/>
	フライスカッター交換(FMG)			FGUK2-v1572	<input type="checkbox"/>
	フライスカッター交換(FMGT)			FGUK2-v1573	<input type="checkbox"/>
	アーバーバイト交換1(マスター合わせ)			FGUK2-v1574	<input type="checkbox"/>
	アーバーバイト交換2(バイト高さ測定)			FGUK2-v1575	<input type="checkbox"/>
	アーバーバイト交換3(バイト高さ調整)		FGUK2-v1576	<input type="checkbox"/>	
	セッティング		タップセッティング	FGUK2-v1580	<input type="checkbox"/>
			ドリルセッティング	FGUK2-v1581	<input type="checkbox"/>
			リーマセッティング	FGUK2-v1582	<input type="checkbox"/>
			ステップドリルセッティング	FGUK2-v1583	<input type="checkbox"/>
底付きセッティング			FGUK1-v9001	<input type="checkbox"/>	

Figure 2.1 List of chapters in previous version of Visual Manual

The courses are classified into different skills/main topic, and each of them contains topics and subtopics, and explanation accompanied by multimedia elements. Even though it is meticulously arranged, the Visual Manual, however, is only accessible through Internet Explorer (ver. 11 and below) and runs best on Windows 7 and below. The structure of the codes, too, are not well-written. This is a limitation that is needed to be solved. The interface of this component is as shown as in Figure 2.2.

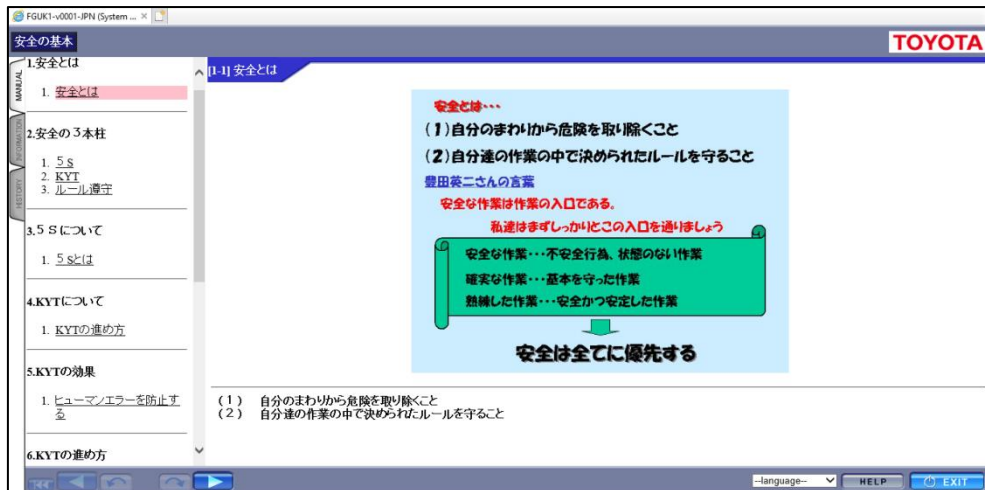


Figure 2.2 A snapshot of Visual Manual that is being used currently

The bottom navigation bar enables the trainer to click restart the topic, go to previous topic/subtopic, translate to different languages, access to Help and exit the application. However, the icons provided produces the same function, and Help is not accessible. Language that is available to be translated to is only in English. Other function available in this application includes the graphic enlargement feature, where once the user clicked on the graphics, a window will pop-up, containing a larger-sized graphic. This is as shown as in Figure 2.3 where it shows the use of bottom navigation bar.

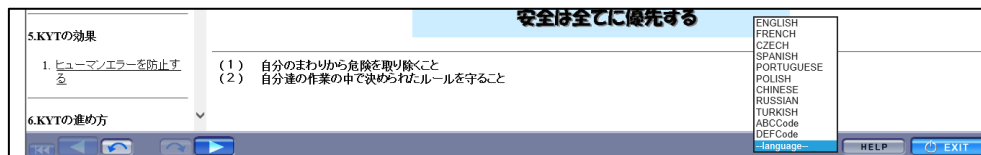


Figure 2.3 Bottom navigation bar in Visual Manual

Perodua demanded an updatable, robust and stable Visual Manual as the current version has a plethora of drawbacks, and due to this demand, the state of current Visual Manual as a courseware needs an upgrade to a training management system. Thus, the proposed project will include a feature that enable the user to update the course and provide authority on the Visual Manual. Changes in technologies including machineries used in production line caused the current Visual Manual to be outdated and not in par with the process in factory. This project is expected to solve and improve the weak points of this application for a better use in the future.

2.3 Reviews on Similar Existing Systems/Application

Courseware is broadly used in education field nowadays, thus, it is not shocking to see many types of courseware to be distributed everywhere. However, due to the advancement in technology in this era, the need of learning management system is as crucial as having a courseware and provide better features when it comes to authority of contents. The differences between courseware and learning management systems may depend on the functionality, features, interface designing and usability. This section will review the comparisons of the systems that existed and also regarding the proposed system.

2.3.1 IM-SmartSAFETY

Health and Safety Induction Course (HSIC) is an obligatory initial course for labourers and authorities before going into construction site. It is often being delivered by trainers in Malay as most of the trainers are not fluent in English, and this includes the presentation of English media to be described in Malay. This courseware is developed by applying learning theories consisting constructivism, social and minimalism using ADDIE methodology, and is intended to break the language barrier in explaining the contents of HSIC to foreign workers. (Salleh, Abdul Nifa, Zakaria, Mohd Nordin, & Abdul Rashid, 2017)

The language barrier is a serious issue to be brought up as a study shows that the accidents were caused by the inability of the foreign workers to comprehend safety instructions and procedures, unable to understand safety signage. Due to this issue, the application is designed and built as a way to present HSIC to the foreign workers. An example of this application's interface is as in Figure 2.4 below.



Figure 2.4 A snapshot of IM-SmartSAFETY