SECURING CAMPUS ACCESS CONTROL AND MANAGEMENT SYSTEM WITH ATTRIBUTE-BASED ACCESS CONTROL (ABAC)

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DECLARATION

I hereby declare that the material in this thesis is my own except for the questions, equations, summaries, and references, which have been duly acknowledged.

12 February 2022

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ABSTRACT

Campus Access Control and Management System of UMS Campus still relies on conventional manual registration and spreadsheet management, resulted in a time-consumed registration process, inconsistent data entries, and disclosure of visitor's privacy. The registration and access control becoming worst during the covid-19 pandemic. Malaysia's universities are using various systems and platforms to manage their campus access control. For example, the M-Pass ID system from Monash University, Smart Card system from Universiti Sains Malaysia and so more. However, the access control of these systems primarily constructed based on a conventional role-based access control policy that authenticated with a password, which subjected to password guessing attacks and granted permission is based on the user's role, not on data operations and objects. To address these gaps, this project aimed to propose a Campus Access Control and Management System with Attribute-Based Access Control (ABAC) which granted access to the user by attributes. The project aims to investigate lightweight Attribute-based Access Control from the perspective of computation speed of setup, verify and granting process by using systematic literature review and experimental approach, design and develop a web-based management system with attribute-based encryption on access control by using the waterfall approach, and evaluate the usability performance of the developed campus access control and management system by using System Usability Scale (SUS) approach. A large number of literature reviews from a different angle are expected, interviewing the security division also done for further analysis. Then the experiment on attribute-based encryption was undergoing and chose the best to implement into the project. The expected outcome of this project is a web-based campus access control and management system that eases the UMS security division in registering managing visitor entries.

ABSTRAK

Selamat Sistem Kawalan dan Pengurusan Akses Kampus dengan Kawalan Akses Berasaskan Atribut (ABAC)

Sistem Kawalan dan Pengurusan Akses Kampus Kampus UMS masih bergantung kepada pendaftaran manual konvensional dan pengurusan spreadsheet, ia telah menyebabkan proses pendaftaran yang memakan masa, kemasukan data yang tidak konsisten, dan pendedahan privasi pelawat. Pendaftaran dan kawalan akses menjadi semakin teruk semasa wabak covid-19. Universiti Malaysia lain telah menggunakan pelbagai sistem dan platform untuk menguruskan kawalan akses kampus mereka. Contohnya, sistem ID M-Pass dari Monash University, sistem Kad Pintar dari Universiti Sains Malaysia dan lain. Walau bagaimanapun, kawalan akses sistem ini dibina terutamanya berdasarkan polisi kawalan akses berasaskan peranan konvensional yang disahkan dengan kata laluan, yang senang dikenakan serangan meneka kata laluan dan izin yang diberikan berdasarkan peranan pengguna, bukan pada operasi data dan objek. Untuk mengatasi jurang ini, projek ini bertujuan untuk mengusulkan Sistem Kawalan dan Pengurusan Akses Kampus dengan Kawalan Akses Berasaskan Atribut (ABAC) yang memberikan akses kepada pengguna berdasarkan atribut. Projek ini bertujuan untuk menyiasat Kawalan Akses berasaskan Atribut ringan dari perspektif kelajuan pengiraan persediaan, mengesahkan dan memberikan proses dengan menggunakan tinjauan literatur sistematik dan pendekatan eksperimen, merancang dan mengembangkan sistem pengurusan berasaskan web dengan enkripsi berdasarkan atribut pada kawalan akses dengan menggunakan langkah air terjun, dan menilai prestasi kebolehgunaan sistem kawalan dan pengurusan akses kampus yang dikembangkan dengan menggunakan Skala Kebolehgunaan Sistem (SUS). Terdapat bilangan besar tinjauan literatur dari sudut yang berbeza diharapkan, wawancara bahagian keselamatan juga dilakukan untuk analisis lebih lanjut. Kemudian eksperimen pada enkripsi berasaskan atribut sedang dijalankan dan memilih yang terbaik untuk dilaksanakan ke dalam projek. Hasil yang diharapkan dari projek ini adalah sistem kawalan dan pengurusan akses kampus berasaskan web yang memudahkan bahagian keselamatan UMS dalam mendaftar menguruskan kemasukan pelawat.

TABLE OF CONTENTS

LIST OF TABLES

Pages

LIST OF FIGURES

Pages

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

In the year 2015, 2.3 million students started university in the United Kingdom, standing for 4% of the population are at greater risk of crime than other people in Britain. (Wootton *et al.*, 2015). Based on the figures from the Office of National Statistics, 19% of full-time students were victims of crime in 2014-15, compared to 16% of all adults in the general population. These situations can be reduced or against effectively as there was a proper or well-equipped campus access control and management system exist. With the system, the campus or administrator can fully control or checking the access of visitors or contractors within the areas easily.

Currently, there are several types of campus access control and management system used by universities. For example, ONEcard from the University of Alberta with the slogan "the one card you need on campus" and TigerCard from Princeton University that enables students to make the payment on campus and access the building. Besides foreign universities, there also have a Smart Card system from Universiti Sains Malaysia that has a similar function mention before. Although Universities Malaysia Sabah also has their own Matric Card system, there are limited functions related to access control that is used or lack of development on the card system.

On the other hands, it is making the situation severe as the Security division of Universiti Malaysia Sabah still relies on the traditional paperwork to register visitor and granting their access to entering campus. Universiti Malaysia Sabah has good coverage in the use of free campus WIFI which means there are enabled to connect to the internet from everywhere on the campus even at the gates of the campus, but they seem like they had given up on using a proper or advanced campus access control and management system.

This project aimed to produce a campus access control and management system with attribute-based access control (ABAC) that suitable in Universiti Malaysia Sabah. By using this system, Universiti Malaysia Sabah may walk forward on securing the campus.

1.2 Problem Background and Motivation

Based on the observation, the Security division of Universiti Malaysia Sabah relies on the traditional paperwork to register visitor and granting their access to entering campus. This causes the visitors or contractors need spending even more time on the formalities for only one pass using on campus. Once sightseeing has done, visitors also need to repeat for revocation of the pass. On-campus part, the security division UMS also needed to clean up or disposed of the detail of visitors or contractors periodically to prevent the overload.

This situation may cause the risk of spread out the pandemic Covid-19 which is the most dangerous virus nowadays. Due to the prevention of the pandemic, the processing time on the formalities become longer than usual and it causes the flows of the visitors to become longer which means easier to spread or affect the Covid-19 in these times. There also have data from the WHO state that universities or school may become one of the outbreaks of the pandemic.

On the other side, the visitors or outsiders also can easily sneak into UMS to do some illegal activities especially sexual harassment, stealing, and more. The campus may endure an amount of loss that the property destroyed or stolen by visitors.

With a Campus Access Control and Management system, the department can gather, compile, and analyse information more efficiently. The overall operations, strategies, decision-making by the department can be reform into a more powerful combination (David Weedmark, 2019). A web-based system is an excellent choice since there are free from updating issues, quick development cycles, better security, highly support in different platform, reliable performance in limited cost, etc (Jimi, 2019).

Apart from UMS, the Campus Access Control and Management system used by other campuses also have some limitation. For example, ONEcard from the University of Alberta is counting perfect for the students, lecturers, or other relators to campuses but it seems not very suitable to outsiders. It is impossible to produce a new ONEcard for only visiting campus once. Even on the campus if ONEcard from the student has a door access issue there also have no solution but replacement only. Moreover, the system they are using was role-based access control also have some limitation which will further discuss in the next following section.

1.3 Problem Statements

The problem statement can be summarized as follows:

i. **Inadequate Of Role-Based Access Control Policy In Existing Campus Access Control And Management System**

   Since there needs a lot of work and time on assigning the roles and the permissions. The role-based access control is not suitable for campus access control and management system that are not well prepared. There is a serious concern on RBAC which is the implementation of separation of duty controls (Vincent Hu *et al.,* 2006). For example, there is a student who has assigned

a role that has a restriction on access to a resource library. Then, he has assigned to another role that has no restriction to access that resource library. This conflict causes a loophole in the role structure (Vincent Hu *et al.,* 2006). The attribute-based access control will fulfil the inadequate access control policy that enables the developers to implement attributes easily at any time.

ii. Privacy Issues On Storing Visitor's Data

The Security Division of UMS still relies on traditional paperwork to register visitors and data visitors are storing at the spreadsheet that subjected to sabotage and risk of disclosure. According to kisi(2019), a management system can significantly increase the protection against the privacy of visitor information as there is privacy protection by encryption data. The presence of the campus access control and management system will enable turn out data visitor into a database with encrypted that may reduce the risk of leaking information.

iii. Lack Of Audit Tracing For Visitors And Contractors Access

The traditional paperwork to register visitors and data visitors are lacking audit tracing for visitors and contractors access. We also need to waste a lot of time searching and pairing the data that we need. For example, a web system called 'My Visitor' has provided visitor name search capability that increases the efficiency significantly compared to auditing the visitor from spreadsheet data on the logbook. A complete, suitable management system will minimize the issues of inadequate auditing on tracking visitors and contractors access.

1.4 Project Objectives

- To investigate lightweight Attribute-based Access Control from the perspective of computation speed of setup, verify and granting process by using systematic literature review and experimental approach.

- To design and develop a web-based management system with attribute-based encryption on access control by using the waterfall approach.

- To evaluate the usability performance of the developed campus access control and management system by using the System Usability Scale (SUS) approach.

1.5 Project Scope

The target users are the visitors of campus and the contractors which mean the unrelated people that come into UMS campus. The embedded research element is the attribute-based encrypted access control. Table. 1.1 shows the modules, description, and targeted user or roles in the campus access control and management system.

Table. 1.1: Modules of the Campus Access Control and Management System

Module	Description	Targeted Users /Roles
User registration and authentication	Used for registering the system user Used for granted/denied access permission. Used for keying visitor information.	Admin Manager Visitors Contractors
Visitor/manager profile management	Used for update/delete visitor information	Admin Manager
Attribute-based encryption	Implementation of ABE algorithm for enclosing/disclose data.	Visitors Contractors Admin Manager
Report generation	Generate a detail when searching for user Used for search visitor data by using attribute	Visitors Contractors Admin Manager
Real-time visitor status (Dashboard)	Used to view status of visitor	Visitors Contractors Admin Manager