

WABS: WEB ACCESSIBILITY BARRIER SEVERITY METRIC

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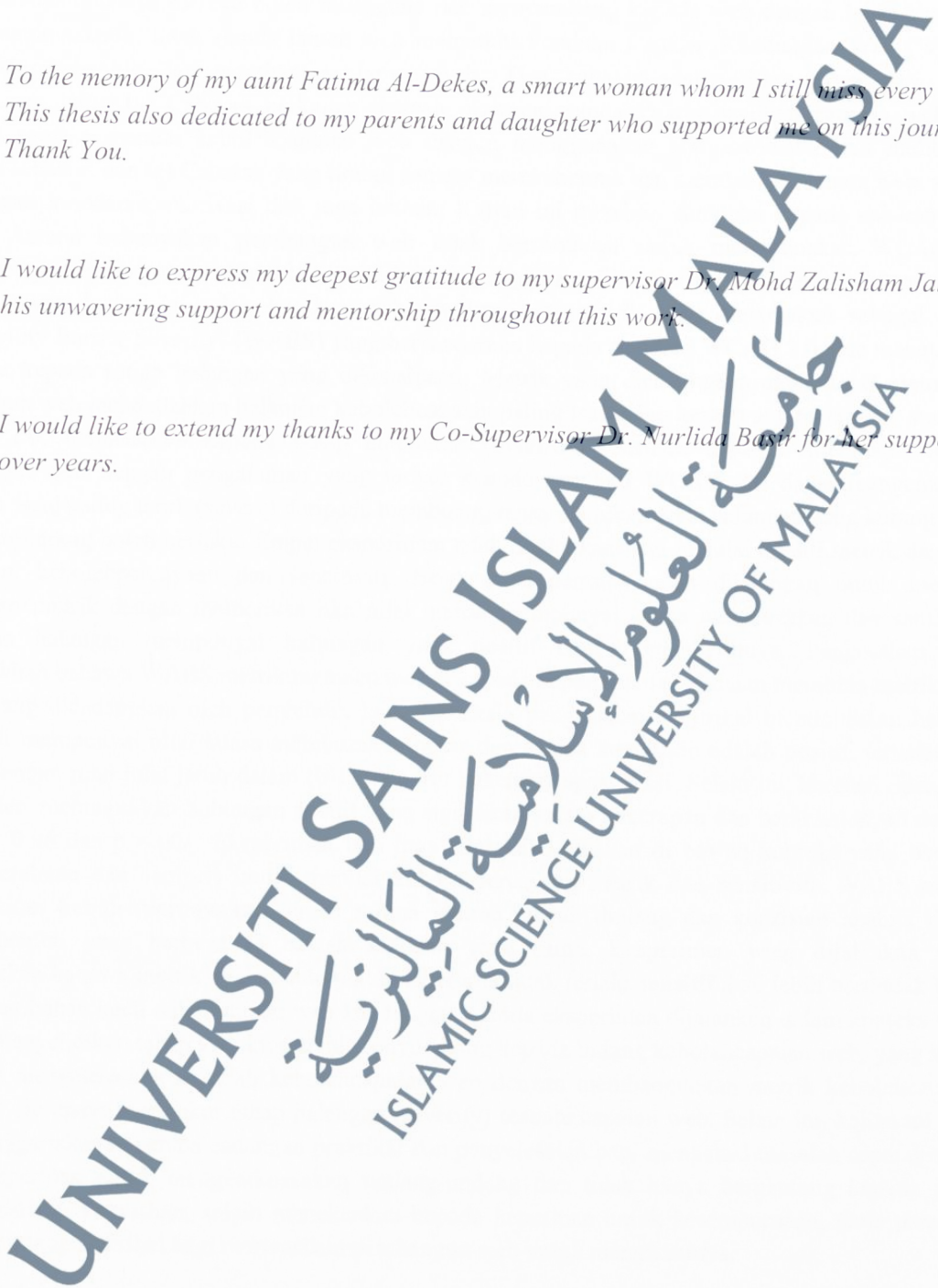


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To the memory of my aunt Fatima Al-Dekes, a smart woman whom I still miss every day. This thesis also dedicated to my parents and daughter who supported me on this journey. Thank You.

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ABSTRAK

Kebolehcapaian web adalah bertujuan untuk menyediakan orang kurang upaya dengan pengalaman bebas-halangan supaya mereka boleh mengguna dan menyumbang kepada web dengan lebih berkesan. Walaubagaimanapun, tidak semua laman web mematuhi Panduan Capaian Kandungan Web (WCAG) ketika merekabentuk dan membangun laman web. Tiga cabaran utama dikenalpasti dari kajian sebelumnya, iaitu: (a) Cabaran berkaitan dengan piawaian/standard/garis panduan capaian web; (B) Cabaran semasa menilai kebolehcapaian web dengan menggunakan alat automatik dan melibatkan pengguna sebenar; dan (c) Cabaran yang timbul semasa merekabentuk dan membangun laman web; seperti kekurangan kesedaran, motivasi dan juga latihan. Kajian ini memberi tumpuan kepada cabaran yang terakhir kerana kebanyakan pembangun web tidak bermotivasi untuk menggunakan WCAG 2.0 memandangkan garis panduan ini ada banyak kriteria yang perlu diikuti, dan juga memerlukan masa dan usaha. Tujuan kajian ini ialah untuk membangunkan satu metrik yang dinamakan sebagai 'Web Accessibility Barrier Severity' (WABS) yang bersandarkan kepada standard WCAG 2.0, dan menetapkan pemberat kepada setiap halangan yang dikenalpasti. Metrik yang dicadangkan akan dapat membantu pembangun web mendedahkan halangan kebolehcapaian paling lazim dan kerap yang melanggar standard WCAG 2.0, berdasarkan kepada tahap keterukan (severity) sesuatu capaian. Ini membolehkan pembangun web dengan pengalaman yang terhad kepada standard WCAG 2.0 dapat mengenalpasti halangan yang paling teruk (severe) daripada membuang masa mengkaji jenis halangan yang kurang teruk dan jarang-jarang boleh berlaku. Empat eksperimen telah dijalankan bagi menilai kualiti metrik dari segi kesahihan, kebolehpercayaan dan sensitiviti. Eksperimen pertama telah dijalankan untuk menguji **kesahihan** metrik dengan memeriksa jika nilai metrik mempunyai kuasa membezakan dan sama ada kekerapan halangan mempunyai hubungan yang positif dengan pemberatnya. Pengesahan teori mengesahkan bahawa WABS metrik memacu metrik kepada keperluan dan andaian membina metrik baik seperti yang dicadangkan oleh penyelidik lain, manakala pengesahan empirikal menunjukkan bahawa metrik ini mempunyai nilai kuasa membezakan besar dan semua keputusan adalah positif, terbatas dan normal dengan nilai julat jatuh dalam (0-1) menurut kehendak spesifikasi. Selain itu, korelasi Spearman 'rank-order' menunjukkan hubungan positif yang signifikan antara kekerapan dan berat halangan dengan $r_s(15) = 0.96$ dan $p < .001$. Eksperimen lain juga telah dilaksanakan di bawah konteks yang berbeza (masa, peralatan dan sampel) untuk menilai kebolehpercayaan metrik dan sensitiviti. WABS metrik menunjukkan **kebolehpercayaan**, kerana semua ukuran adalah diulang dan konsisten apabila dikira dengan penilai yang berbeza di bawah keadaan yang sama. Eksperimen yang dijalankan telah menunjukkan bahawa metrik adalah cukup kuat kerana ia tidak terlalu **sensitif** atau lebih bertindak balas kepada perubahan kecil dalam laman web kandungan apabila eksperimen dijalankan dalam konteks yang berbeza. Penyelidikan tahap kedoktoran ini menyumbang kepada bidang kebolehcapaian web, yang mana kajian ini menyelesaikan masalah kebolehcapaian web dengan membangunkan metrik kebolehcapaian web yang berupaya mengukur tahap halangan (severity) sesuatu capaian web. Selain itu, kajian ini juga telah menggariskan beberapa cadangan praktikal dan penyelesaian bagi mengatasi masalah capaian web; seperti keperluan untuk menguatkuasakan undang-undang dan tidak hanya bergantung kepada garis panduan sahaja. Tambahan, selain menekankan kepada keperluan untuk kesempurnaan, garis panduan juga perlu cukup fleksibel bagi memotivasikan pembangun web untuk mengikutinya.

ABSTRACT

Web accessibility aims at providing disabled users with a barrier-free user experience so they can use and contribute to the Web more effectively. However, not all websites comply with the Web Content Accessibility Guidelines (WCAG 2.0) due to challenges facing Web developers during the website's design and development. These challenges which lead to incorrect ways of coding produce barriers for assistive technologies. Thus, assistive technologies such as screen readers would not be able to interpret the presented contents on the monitor which will contribute to making websites inaccessible to disabled users. Therefore, these websites can suffer from barriers that make accessing their contents difficult for disabled people. The purpose of this work is to develop a Web Accessibility Barrier Severity (WABS) metric that adheres to WCAG 2.0 standards, and assign measurable weight to each identified barrier. The proposed metric will help Web evaluators to disclose the most prevalent and frequent accessibility barriers that violate WCAG 2.0, and then rank them based on their severities and impacts on the accessibility level. Once the barriers are ranked, Web developers can fix the highly ranked severe barriers instead of wasting time in studying and fixing less severe types of barriers that may rarely occur. Four experiments were conducted to check the metric quality in terms of validity, reliability and sensitivity. The first experiment was carried out to test the metric validity by checking if the metric values have discriminating power and whether the barrier frequency has a positive correlation with its weight. The theoretical validation confirms that WABS metric adheres to the requirements and assumptions of building a good metric suggested by eminent researchers, whereas the empirical validation of the metric shows that WABS values have large discriminating power and all the results are positive, finite and normalized with continuous range of values fell within the range (0-1) as intended by the specifications. Moreover, Spearman rank-order correlation shows a significant positive relationship between barriers' frequency and weights with $r_s(15) = .96$ and $p < .001$. The remaining experiments were conducted under different contexts (time span, tools and samples) to examine metric reliability and sensitivity. WABS metric shows reliability, because all the measurements are reproducible and consistent when calculated by different evaluators under similar circumstances. The conducted experiments have demonstrated that the metric is robust enough since it is not too sensitive or over reacting to small changes in websites contents when the experiments are conducted in different contexts. Following, the accessibility level for a dataset of websites that contain different types of barriers was measured. Then, WABS metric measured the severity of each barrier type found in the evaluated dataset and ranked them accordingly. After that, the top five severe types of barriers as identified by the metric were removed from the dataset, and then the accessibility level for the evaluated dataset was measured again. Paired samples t-test elicited statistically significant improvement of accessibility level after removing the five barriers ($t = 8.467$, $p \approx 0.001 < 0.05 = \alpha$). This doctoral research contributes to web accessibility area by developing a good quality web accessibility metric that identifies severe barriers in which fixing them will increase the accessibility level of websites significantly. Moreover, this work provides some practical recommendations and solutions to overcome accessibility challenges, such as: the need to issue enforcement legislations regarding web accessibility rather than depending on voluntary guidelines. Furthermore, instead of emphasizing the need for perfection, guidelines should be flexible enough to motivate Web developers to follow them.

ملخص الدراسة

تهدف خاصية تسهيل الوصول للمواقع الإلكترونية إلى تزويد ذوي الاحتياجات الخاصة بتجربة خالية من معوقات التصفح الإلكتروني؛ حيث يسهم ذلك في مشاركة ذوي الاحتياجات الخاصة بشكل فعال في تصفح الويب. بيد أن الكثير من المواقع الإلكترونية لا تتبّع المبادئ التوجيهية المتعلقة بمدى سهولة الوصول لمحتويات المواقع الإلكترونية (WCAG 2.0)، وربما يعود السبب في ذلك إلى وجود تحديات تواجه فريق تطوير المواقع الإلكترونية أثناء تصميمهم المواقع وتنفيذها. هذه التحديات تؤدي إلى أخطاء برمجية من شأنها إيجاد معوقات تحد من كفاءة عمل التكنولوجيا المساعدة لذوي الاحتياجات الخاصة و قدرتها على قراءة محتويات الصفحات الإلكترونية مما يعني حرمانهم من ميزه الوصول و التصفح. تهدف هذه الدراسة إلى تطوير مقياس جديد يسمى بـ (WABS) يخضع لمبادئ (WCAG 2.0). حيث يقوم بإسناد وزن قياسي لكل معوق تم اكتشافه ويساعد هذا المقياس الفاحصين بتحديد معوقات الوصول للويب الأكثر شيوعاً وانتشاراً والتي لم تكن بمبادئ (WCAG 2.0)، ومن ثم يقوم بترتيبها بناءً على مدى تأثيرها على قضية الوصول للويب. بعد ترتيب المعوقات، يصبح بإمكان مطوري الويب إصلاح المعوقات الأكثر شيوعاً وتأثيراً التي تم تحديدها أولاً من المقياس الجديد المقترح، عوضاً عن تضيق الوقت في دراسته و إصلاح أنواع من المعوقات نادره الحدوث و الغير مهمة. تم إجراء أربع تجارب للتأكد من صحة، ومصداقية، وحساسية المقياس الجديد المستخدم. وقد تم إجراء أول تجربه للتأكد من صحة اختبار قياس عن طريق فحص فيما إذا كان المقياس قادراً على إعطاء قيمة تميزه لكل معوق، و فحص فيما إذا كانت العلاقة بين تكرار كل معوق و وزنه علاقه إيجابيه. على صعيد الصحة النظرية للمقياس فلقد تم اثبات أن المقياس WABS يخضع للمتطلبات العلمية الواجب توفرها في المقياس العلمي الجيد. من ناحية أخرى فقد أظهرت صحة المقياس العمليه أن المقياس يعطي قيمة مميزة و موجبه لكل معوق يتم اكتشافه عدا عن أن هذه القيم محصوره في الفترة (0-1). أضافه إلى أن معامل سيرمان للإرتباط أكد على وجود علاقه إيجابيه بين وزن المعوق و تكراره $rs(15) = .96$ and $p < .001$. باقي التجارب تم إجراؤها في ظروف مختلفه من حيث (الفترة الزمنية، الأدوات المستخدمه و العينة) للتأكد من مصداقيه و حساسيه المقياس. لقد أظهر مقياس WABS مصداقيه حيث إن كل المعايير يمكن إعادته انتاجها من قبل فاحص آخر في حاله تطبيق تجربه بنفس الظروف. هذا و قد أظهرت التجارب أن المقياس يمكن الاعتماد عليه حيث إنه ليس حساساً بشكل مفرط للتغيرات الطفيفه عند اقامه التجارب تحت ظروف مختلفه. بالإضافة إلى ذلك تم قياس مدى سهوله الوصول لعينه من المواقع الإلكترونية و من ثم قياس خطوره المعوقات فيها و ترتيبها حسب التأثير باستخدام (WABS). علاوه على ذلك لقد تم اصلاح أعلى خمسة معوقات و من ثم إعادته قياس مدى سهوله الوصول للمواقع. لقد أثبت اختبار المجموعات المترابطه على وجود تحسن كبير بمدى سهوله الوصول للمواقع بعد اصلاح هذه المعوقات الخمسه $(\alpha = 0.05 < 0.001 < p = 8.467, t)$. لقد حاولت هذه الدراسة إثراء البحث العلمي من خلال تحديد مصاعب الوصول للمواقع الإلكترونية بالإضافة إلى تطوير مقياس جديد ذي جوده عاليه لقياس خطوره معوقات الويب التي من شأن اصلاحها تحسين مدى سهوله الوصول للويب. و لقد اقترحت هذه الدراسة حلول عملية للتغلب على مشاكل صعوبة الوصول للويب، مثل اقتراحها لحاجه فرض قوانين و تشريعات متعلقه بسهوله الوصول للويب، عوضاً عن الاعتماد على مبادئ توجيهيه تطوعيه، يضاف إلى ذلك حاجه المبادئ التوجيهية للمرونة من أجل تحفيز مطوري الويب لاتباعها.

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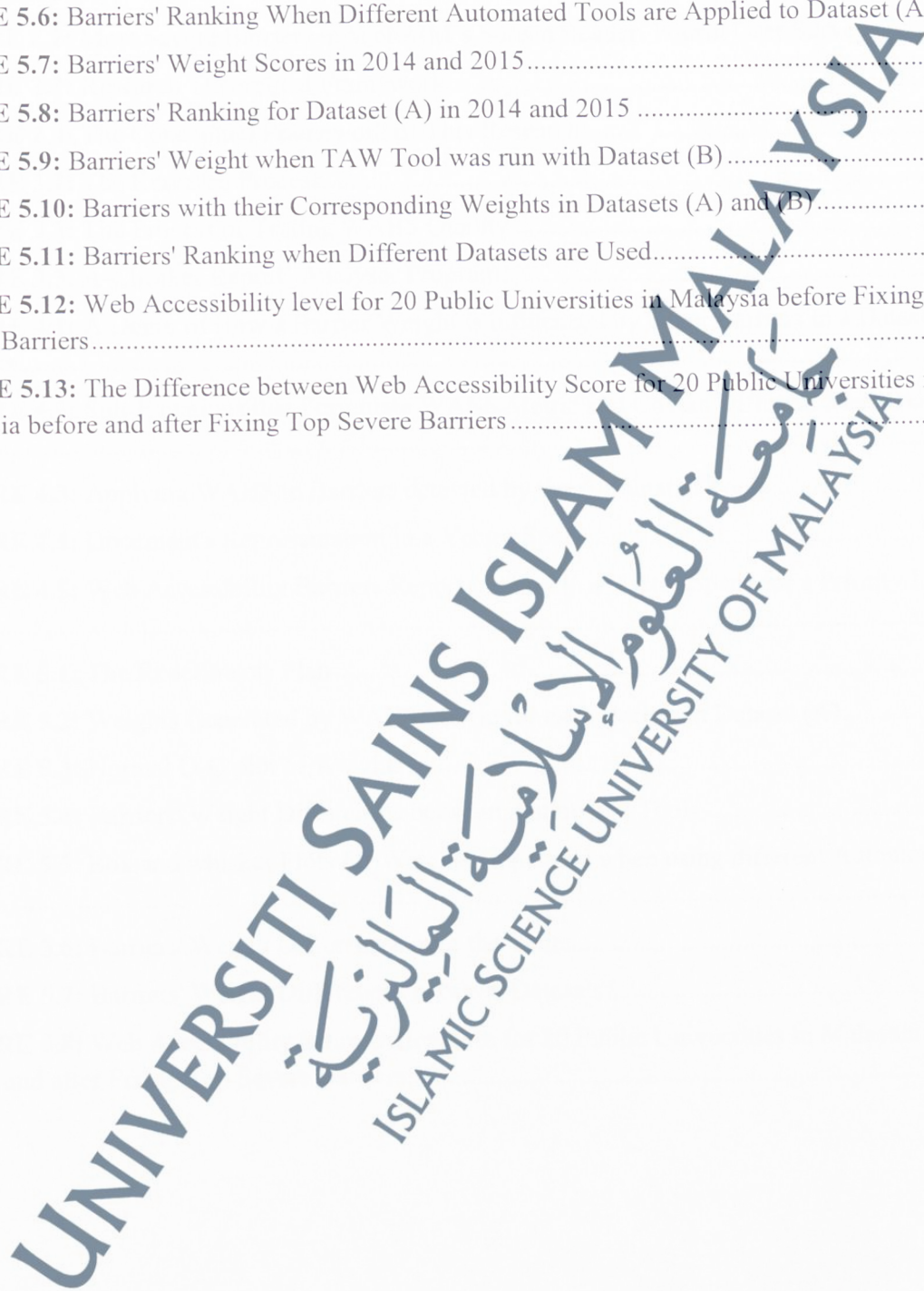
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ABBREVIATIONS

AEM	Accessibility Evaluation Method
ARIA	Accessible Rich Internet Applications
ATAG	Authoring Tool Accessibility Guidelines
BITV	Barrierefreie Informationstechnik-Verordnung
DOM	Document Object Model
EIT	Electronic and Information Technology
HCI	Human Computer Interaction
ICT	Information and Communication Technologies
MAB	Malaysian Association for the Blind
MWBP	Mobile Web Best Practices
PWDs	Persons with Disabilities
SC/ SCs	Success criterion/ Success Criteria
SMIL	Synchronized Multimedia Integration Language
UAAG	User Agent Accessibility Guidelines
W3C	World Wide Web Consortium
WAI	Web Accessibility Initiative
WCAG	Web Content Accessibility Guidelines

