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Project Know Your Area (KYA)

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EXECUTIVE SUMMARY ← *(Christian D)*

Contemporary HCI has turned to socially conscious efforts of altruism, reflecting a strong desire and belief in helping improve the lives of those disadvantaged through innovative technology solutions [1]. An example of such a vulnerable subset of the population is tourists, who in most cases lack the location-based knowledge to avoid dangerous areas, and expose themselves to “crimes of place”, i.e., crimes associated with criminal Hotspots [2]. Existing technology offers proactive measures to avoid these incidents, in the form of applications that either crowdsource events of interest or make use of historical records to present crime locations on maps (e.g. “SpotCrime Crime Map”) [3]. However, they require an increased cognitive load on the users, who are now tasked to research areas they might come across during their travels. Project “Know your Area” (KYA) proposes a reactive mechanism, making use of persuasive approaches to modify a tourist’s mobility pattern if and when he/she moves into zones of increased risk.

In addition to the obvious benefits on **tourists (users)** and **law enforcement entities**, KYA can help reduce the societal impact of crimes and its negative effects on the **tourism industry of affected countries** [4]. Gubernamental departments should invest in this project because the profitability of taxation directly associated to tourism (e.g. \$100 billion in 2013 for US market) is dependent on the country’s brand value [5]. A study on the economy of New Orleans concluded that the proactive involvement in safeguarding tourists can increase the country’s brand value, thus increasing profitability [4]. KYA offers a mechanism to do so, while keeping a competitive advantage in its reactive approach, that in comparison with existing applications in the market, requires no interaction from the user other than installing the app. It also offers our clients, **MIT Media Laboratory’s Fluid Interfaces group**, a platform to advance the field of persuasive and wearable technology.

The KYA team will define a meaningful metric to classify zones of interest. Then, using historical criminal records, the team will create geofences that delimit these areas and store them in a remote database. KYA will deliver the design and implementation of a remote service that will access this database when information requests are received from Android Clients. The team will implement a client for the Android wear platform that will notify when the location of the device transitions between geofences, allowing the tourist to make an informed decision on whether he wants or not to continue the current path. Additionally, the KYA system will include tools to collect telemetry data on user mobility for future subject studies that will be carried out by our customers.

The milestones for project KYA consist of the definition of a meaningful metric to classify areas of risk (21/09/15), the design of software modules (28/09/15), the implementation of the system (19/10/15), testing and refinement (26/10/15), module integration (4/11/15), and product delivery (11/11/15). The project will have an expected cost of \$20,501, which includes expenses of labor, fringe benefits, overhead (35.76%), third party services, materials, and travel expenses.

The team is composed of four Computer Engineering students. Christian Vazquez has previous experience acting as group leader in collaborations with MIT Lincoln Laboratory, and has conducted research in the areas of HCI and Ubiquitous computing in both MIT Media Lab and Google Research groups. Luis Escobar, has several internships in Microsoft acting as program manager, where he will be working full time for the Skype team. Joel Corporan, has experience in mobile application development for Android and iOS. Finally, Christian Montes has worked in several web, database, and Android applications in multidisciplinary contexts.

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PROBLEM STATEMENT

Research on 'crimes of place' suggest that visiting certain locations [5] can make individuals more susceptible to crime. "Wrong-place/wrong time" incidents like the murder of Stephanie Kuhlen [6], where a family unconsciously wandered into "the wrong neighbourhood", show how a wrong turn can have tragic consequences. Tourists represent a large subset of the population (3.2 million in Puerto Rico on 2013 alone[7]) that is particularly vulnerable to "crimes of place" given the lack of location-based insight that is usually acquired by being a local. Crimes on tourists not only endanger individuals, but also have a negative socioeconomic effect on the country associated with an impact on the tourism industry [8]. Therefore, **crime enforcement entities**, **tourism agencies**, and **tourists (users)**, could potentially benefit from immediate mechanisms to preemptively reduce incidents. Hot Spot theory suggests that knowledgeable tourists can avoid certain locations likely to be stalked by criminals [9], however, no mechanism exists to acquire the necessary knowledge to do so without proactively researching an area. We propose a mechanism that allows tourists to preemptively avoid exposing themselves to "crimes of place" through reactive measures, with no need of a priori knowledge.

Given no mechanism exists for tourists to reactively avoid areas of danger, we will develop a system that enables the correction of tourist mobility patterns by reactively informing when exposure to risk occurs. By collaborating with Fluid Interfaces (MIT Media Lab client) during the following four months of the Capstone project, a team of four Computer Engineering students will use entries of criminal activity obtained from local authorities databases, we will cluster geo zones and assign to them a computed risk factor defined through research. The purpose of this metric is not to predict crime, but to establish meaningful differences among zones. Additionally, this metric is constrained by the quality of the data regarding reported crimes. Given public records are not maintained nor generated by us, ensuring this quality is beyond the scope of the project. Through transition based geofencing [10], we will notify users when the condition of mobility in the direction of increasing danger is met. By combining these components with the affordances granted by wearable devices, such as an Android watch, we can both seamlessly notify the user and gain insight on how to influence tourist mobility patterns.

OBJECTIVES

- To design and deliver, in collaboration with Media Lab's Fluid Interfaces group, a Three-tiered computer system that enables the storage and generation of risk classified geo-zones. This system should notify Android wear devices that move between geo-zones in the direction of increasing risk. This system should be delivered by November 11, 2015.
- To define a meaningful metric that classifies generated areas of interest using a computed safety factor, i.e., how safe is an area based on previous criminal history. A relative percentage difference of around 10% should exist between classified ranks of adjacent zones (e.g. a zone classified with risk level 2 should show at minimum 10% increase in crime incidents from an adjacent zone classified with risk level 1)
- To define an methodology for transforming clustered areas of interest into storable, programmatically generated geo-fences.
- To design and implement a web admin interface that allows visualization of procedurally generated areas of interest on a map.
- To design and implement a remote cloud service that:
 - Generates areas of interest by fetching new criminal entries and feeding it to the geo-zone generator.
 - Serves HTTP requests inquiring about the current security zone occupied by a specific device.
- To design and implement a prototype, Android watch application that:
 - Shares user location with a remote cloud service.
 - Notifies user when a transition between a lower criminal incidence and a higher criminal incidence area occurs.
 - Sends telemetry data about user mobility in response to notification.
- To design and implement a database that stores:
 - Mobility related telemetry data
 - Areas of Interest

OUTCOMES

Project KYA ("know your area") will make available a reactive mechanism to notify tourists when they move into locations of increased risk. To do so, a three-tier application will be delivered with the following primary components: a remote cloud service, reliable storage, and an Android client app. By the end of the project, we will provide a meaningful metric to classify zones of risk generated through the clustering of historical crime data. This metric will provide a relative percentage difference of at least 10% between risk factor levels. Its purpose is not to predict crime but to define crime differentials between areas. A module will be delivered to extract data from a database containing criminal record history. A methodology for generating, classifying, storing, and geofencing these clustered zones will be made available. The Android client will be developed for smart watches.

Android clients will communicate with the remote service using HTTP, share user location, and notify changes in risk factor. In lieu of gathering information about the most effective way to influence tourist mobility, KYA will additionally deliver built-in features to check-in telemetry data regarding user mobility for future user studies.

METHODOLOGY AND TEAM ORGANIZATION

Technical and Managerial approaches

To ensure the quality of the product, the KYA team will be using the Scrum agile model. Considering the project size, and the short development time, using Scrum seems like a sensible strategy given it was designed to improve the development speed and align the team's and the client's objectives [11]. However, we will not employ a pure Scrum model, but a mixture of Scrum sprints with the Waterfall model. Although the waterfall model has its weaknesses, it emphasizes important stages of project development and is suitable for our project [12]. Under the role of Product Owner and Scrum Master are Luis Escobar and Christian Vázquez, respectively. Joel Corporan and Christian Montes will act as the Scrum Development Team.

Given our development time is limited to four months, each sprint shall have a duration of one week. A Sprint Review will be hosted at the end of each week to discuss the completed work. At the end of a Sprint Review, Sprint planning will be resumed, where the Product Owner will decide the Product Backlog tasks to be performed for the next Sprint. Given that our clients are abroad, weekly video meetings shall be hosted during the planning phase, and bi-weekly video meetings will be accommodated during the implementation phase.

Although Scrum suggests a 15-minute Daily Scrum Meeting, we will employ a different method. This new method has been dubbed "Daily Breakdown Meetings" and can be described as such:

- The duration of meeting is one hour.
- Prior to the meeting, each person must upload any work he/she has committed to for the meeting.
- The work will be discussed and iterated upon during the meeting.
- Each team member must commit to a new set of tasks by the end of the meeting.

The sprint review and the sprint planning meeting will be held every Sunday up until the project's completion. Each session will have a 30-minute duration.

Team Qualifications

Christian Vázquez: An experienced full-stack Android developer. He has done research in the area of HCI, and worked with several wearable devices such as Google Glass and Android smartwatches. He's lead teams in successful collaborations with MIT Lincoln Laboratory, and published work with MIT Media Lab.

Luis Escobar: A Project Manager with vast experience in agile development models such as Scrum. He has knowledge in the areas of Database Design, as well as Web Server Implementation. His previous experiences working in Microsoft have earned him a full-time position in the Skype team.

Christian O. Montes: Application Designer for Web environments and Object-Oriented Systems, experienced in programming languages such as HTML5, CSS, Java and Javascript. He has designed a number of high quality prototypes in the past as well, including Android mobile applications for micro-controller management.

Joel Corporan: An experienced application developer in the areas of Network Security and Design. His research focuses on applications to identify information leakage in multimedia data transmissions and security performance algorithms, which he has been working on in conjunction with the Communication Assurance for Performance Group at Georgia Tech. He has developed several iOS and Android applications and implemented services for cross-platform web applications.

For more information on past experiences and qualifications for this project, refer to Appendix B.

Testing and quality control procedures

The KYA project roadmap is composed of five phases: planning, design, implementation, integration, and product delivery. For the implementation and integration phases, different test cases will be conducted to achieve high quality standards. White-box testing, Unit testing, and Integration testing will be the testing methods used during KYA's development [13]. White-box testing is testing that takes into account the internal mechanism of a system or component, while Unit testing is testing of individual hardware or software units or groups of related units. Finally, Integration testing is testing in which software components are combined and tested as a group to evaluate the interaction between them [13].

The project's tasks have been assigned to the team members according to their respective skills. At the end of the implementation phase, each task will culminate with the creation of at least one module that will be tested independently. Each member is responsible of designing, implementing, and testing their modules. After all modules have been completed and thoroughly, independently tested, the integration testing phase begins. In the integration testing phase, all modules will be integrated following a Bottom Up Testing approach and Regression Testing will be performed to verify that new modifications do not break existing functionality [13]. All code developed by the team will be maintained in a Git repository (GitHub) [14] and will follow Version Control best practices, such as Snapshot-Oriented History and Code reviews [15]. The team will use branches for Production and Development, with each team member owning a development branch.

Work Breakdown Structure

In order to work more efficiently KYA's work has been divided into five main components or areas of work. These areas are **Server**, **Database**, **Android**, **Administrator Dashboard**, and **Risk Factor**. Each area represents a main component of the application that is required for the project to be considered successful, and they are subdivided into features or modules; each one of those modules contains tasks and work items to be executed. The **Server** area includes all the web server modules responsible for the

processing of the information received, the generation of geo-zones, location analysis, and telemetry collection. The **Database** area includes the design and implementation of the local databases where all the generated zones and telemetry data will be stored. The **Android** area contains the design and implementation of the GUI and Notification System for the Android Wear application. The **Administrator Dashboard** covers the design and implementation of the administrator dashboard web application to see the data collected and an interactive map with the zones generated. And finally the **Risk Factor** area includes the research on metrics, and experimentation to prove the accuracy of the risk factor calculated in the zones generated.

To access the Work Breakdown Structure, please follow this link, <http://www.goo.gl/Y62vrQ>

Team Organization

In the figure below, the Organizational Breakdown Structure is presented. Christian D. Vázquez will be the project manager, responsible of ensuring that the deliverables are completed on time and with high quality standards.

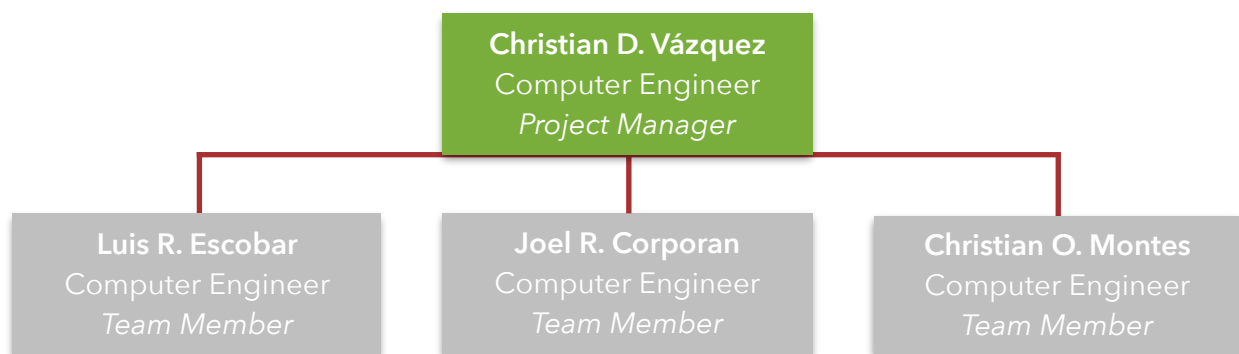


FIGURE 1: Organizational Breakdown Structure

Work Distribution

Task Title		Christian D. Vázquez Project Manager	Luis R. Escobar Team Member	Joel R. Corporan Team Member	Christian O. Montes Team Member	MIT Media Lab Customer	
Server							
	Data Serialization	RAS	CA	I	S	IC	
	Data Handling	RAS	S	S	CA	IC	
	Location Handling	AS	R	CA	S	IC	
	Geo-zone Generation	AS	SA	R	S	IC	
	Request Handling	AS	CA	S	R	IC	
	Telemetry Collection	AS	R	CA	S	IC	
Database							
	Geolocations Storage	AS	S	R	CA	IC	
	Telemetry Storage	AS	R	S	CA	IC	
Android							
	Wear Application	RAS	S	CA	I	IC	
LEGEND		Web Administrator Dashboard					
R	Responsible	Scripts	AS	I	S	R	IC
A	Aprove	Graphical User Interface	AS	C	SA	R	IC
S	Support	Risk Factor					
I	Inform	Metric Research	RAS	RA	R	R	IC
C	Consult	Experimentation	AS	S	I	R	IC

TABLE 1: Responsibility Assignment Matrix

BUDGET AND FINANCIAL ASPECTS

The budget required for the successful completion of KYA is divided into 4 major categories. The **Human resources** category includes labor costs, considering that the scope of the project is research oriented. The **Equipment** category includes both hardware components necessary for the development and testing of the project such as Android wear and mobile devices. This also include third party services (e.g. storage) , web hosting and Android developer licensing. The **Facilities** cost is composed of a monthly rent for offices and basic services such as water, electricity and internet service provider. The **Miscellaneous** category includes travel expenses to meet with stakeholders, and several other expenses. A summary of the costs is presented in the following table.

Category	Cost
Human Resources	\$ 14,128.96
Equipment	\$ 972.99
Facilities	\$ 2,940.00
Miscellaneous	\$ 2,460.00
Total estimated cost	\$ 20,501.95

TABLE 2: Summary of the Costs

Considering the direct and indirect costs an overhead cost of 35.76% was estimated for the project. Appendix C contains a more detailed explanation of the project budget.

$$\text{Overhead} = \frac{5,400}{15,101.95} = 35.76\%$$

Equation 1: Calculation of overhead cost

PROJECT SCHEDULE

Milestones

Milestones	Dates
Definition of research metric	September 21, 2015
Finish design documentation	September 28, 2015
Implementation of software modules	October 19, 2015
Testing and Refinement of modules	October 26, 2015
Full Integration of software modules	November 4, 2015
Product delivery	November 11, 2015

TABLE 3: Milestones

Gantt Chart

As the KYA team will be using the Scrum agile model, the Gantt Chart for the project is divided into ten sprints that will last one week each, beginning on September 7th, 2015. From those ten sprints the first three, the team will be working on the design of all the components, the fourth sprint will be spent writing the progress report, after that, the next three sprints will be spent implementing all the components, in the ninth sprint all the modules will be tested and integrated, and finally in the tenth and last sprint the team will be preparing the final report and poster. Each sprint contains several work items associated directly with the work breakdown structure.

To access the Gantt Chart, please follow this link, <http://www.goo.gl/M2up0q>

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GLOSSARY

1. **Affordance:** Relation between an object and a subject that affords a specific kind of interaction (e.g. doors afford opening and closing) [24].
2. **Amazon Web Services (AWS):** Amazon Web Services, a collection of remote computing services, also called web services, make up a cloud-computing platform offered by [amazon.com](https://www.amazon.com) [25].
3. **Android:** Mobile operating system, open-sourced by Google Inc [26].
4. **Android Wear:** Version of Google's Android operating system designed specifically for smartwatches and other wearable devices [27].
5. **Client:** A piece of computer hardware or software that accesses a service made available by a server [28].
6. **Clustering:** Task of grouping a set of objects in such a way that objects in the same group (cluster) are more similar to each other than to those in other clusters [29].
7. **Cognitive Load:** Total amount of effort in working memory [30].
8. **Crime of Place:** A crime whose occurrence is tightly coupled with its location. This term is interchangeable with Hot spot theory.
9. **Daily Breakdown Meetings:** A one hour meeting, whose purpose is to refine and iterate over individual work. Before a breakdown meeting, members commit to specific tasks. An initial draft must be delivered by the time of the meeting.
10. **Daily Scrum Meetings:** A fifteen minute standup meeting to discuss progress on task assignment [31].
11. **Data Serialization:** Process of translating data structures or object state into a format that can be stored and reconstructed later in the same or another computer environment [32].
12. **Database normalization:** is the process of organizing the attributes and tables of a relational database to minimize data redundancy [33].
13. **ER diagram:** An entity-relationship diagram is a graphical representation of an information system that shows relationships between people, objects, places, concepts, or events within the system [33].

14. **Geozone:** The digital representation of a real-world geographical area.
15. **Geolocation:** The identification of the real-world geographical location of an object [34].
16. **Geofencing:** Using GPS coordinates to define a geographical boundary and perform meaningful actions when a device enters or leaves these boundaries [35].
17. **Git repository:** A Git enabled storage that tracks the history of the work stored [15].
18. **Github:** Web-based Git repository hosting service that offers distributed revision control and source code management [36].
19. **HCI:** Stands for Human-Computer interaction. It is the field that researches the design and use of computers focusing primarily on interfaces between people and computers [37].
20. **Hot Spot Theory:** Theory in criminology that states crime is not random, and follows spatio-temporal patterns. As such, certain zones, denominated as "hot spots", can be predicted prone to have more criminal activity based on previous historical data [38].
21. **Integration Testing:** Phase in software testing in which individual modules are combined and tested as a group [39].
22. **Location-based services:** query based service that provide useful information to end-users based on information of specific geographical area [40].
23. **Module:** A set of standardized parts or independent units that can be used to construct a more complex structure [41].
24. **Moving window:** calculation to analyze data by creating a series of averages of different subsets of the full data set [42].
25. **Overhead Cost:** All costs other than direct labour, expenses, or materials [43].
26. **Persuasive technology:** Technology that is designed to change attitudes or behaviors through persuasion and social influence [44].
27. **Product owner:** Key stakeholder in the scrum methodology. He or she is responsible for a project's success. Product owners lead the development effort by conveying his or her vision, outlining work and prioritizing it based on value [45].
28. **Restful Service:** Software architecture style for building scalable web services. A restful service must follow the following architectural constraints [46]:
 - a. Consumers are decoupled from producers
 - b. Service must be stateless
 - c. It must be able to leverage a cache
 - d. It must leverage a layered system
 - e. Must have a uniform interface

29. **Risk factor:** Computed metric that meaningfully describes how safe or dangerous is a place. A geozone denoted with a high risk factor shows a higher probability of crime than a geozone denoted with a lower risk factor.
30. **Scrum:** An agile methodology to manage software development projects. It is characterized by adopting an empirical approach—accepting that the problem cannot be fully understood or defined, focusing instead on maximizing the team's ability to deliver quickly and respond to emerging requirements [47].

"The Scrum model suggests that projects progress via a series of sprints... sprints are timeboxed to no more than a month long, most commonly two weeks. Scrum methodology advocates for a planning meeting at the start of the sprint, where team members figure out how many items they can commit to, and then create a sprint backlog - a list of the tasks to perform during the sprint. During an agile Scrum sprint, the Scrum team takes a small set of features from idea to coded and tested functionality. At the end, these features are done, meaning coded, tested and integrated into the evolving product or system. [48]"

31. **Scrum Master:** The facilitator for a product development team that employs the scrum methodology. His purpose is to manage the process on how information is exchanged [49].
32. **Server:** A running instance of software capable of accepting requests from clients [50].
33. **Smartwatch:** Mobile device with a touchscreen display, designed to be worn on the wrist [51].
34. **Sprint:** A Scrum sprint is a n-day long repeatable work cycle during which a specific set of features are focused on for the development of a product [52].
35. **Telemetry:** Highly automated communication process by which measurements are made and data is collected from a remote location [53].
36. **Three-tier architecture:** Client-server software architecture pattern in which the user interface, functional process logic, and storage are developed and maintained as independent modules on separate platforms [54].
37. **Transition based geofencing:** A subset of geofencing where meaningful actions (e.g. notifications) are delivered when a device moves between to different fences that meet a specific relationship.
38. **Unit Testing:** Software testing method by which individual units of code within modules are tested to determine in isolation to determine they are fit for use [55].
39. **Version control:** System that records changes to a file or set of files over time so that earlier versions of it can be reviewed or recovered later [56].
40. **Wearable devices:** Clothing or accessories incorporating computers and/or advanced electronic technologies [57].
41. **White box testing:** Testing methodology that tests internal software structures or modules of an application, as opposed to its functionality [58].

APPENDICES

Appendix A: Resumes of the Team Members

Christian D. Vázquez

P.O. Box 41 Barceloneta PR, 00617
787-613-1066 | christian.vazquez7@upr.edu

OBJECTIVE

Looking for internship or full time opportunity related to human-computer interaction, mobile application development, and interface design.

EDUCATION

University of Puerto Rico Mayaguez

Bachelor of Science in Computer Engineering
Graduation date: December 2015

Major GPA: 4.00/4.00
Overall GPA: 4.00/4.00

EXPERIENCE

Google Summer Internship

May 2015 – August 2015

Google Research IoT Group – Mountain View

Bill Schilit

Designing a new communication protocol using Android devices.

- Contributed to design and implementation of new communication protocol specification.
- Created extendable App Engine Service with Cloud SQL storage.
- Built extendable Android app to measure timings and energy consumption of end-to-end BLE communication with peripheral devices using the newly designed protocol.

MIT Media Lab Research

May 2014 – May 2015

MIT Media Lab – Fluid Interfaces Group

Dr. Pattie Maes

Development of apps to facilitate just-in-time learning through Google Glass.

- Full-stack, lead developer for two Google Glass applications with Android's GDK.
- Published work for CHI WIP 2015.
- Contributed to *Wearscript* (open source JavaScript platform for Google Glass).
- Developed Zeus wearable device to control Olympus Air camera.

Startup Software Developer

July 2014 – October 2014

DataCrowd – Android Shelfie Team

Developing native Android application for sponsored startup company. Developed a library with OpenCV that detects and scans barcodes for automatic out-of-stock detection through crowdsourcing.

Mobile I-Vector Research

August 2013– May 2014

MIT Lincoln Laboratory – Human Language Technology

Ported I-Vector's speaker, language, and gender recognition functionality to the Android platform.

- Led team in the development of a fully operational Android application.
- Integrated extensive C++ codebase on the Android platform through Android's NDK.
- Best presentation award of IAP Conference 2014.

MIT Lincoln Laboratory Summer Intern

May 2013 – August 2013

MIT Lincoln Laboratory – Human Language Technology

Developed graphical interfaces for speaker, language, and gender recognition.

- Developed two stand-alone graphical Java applications with Swing.
- Shipped summer project as a product to interested sponsor.

SKILLS

- Fluent in English and Spanish
- Java, C, C++, Python, JavaScript, and SQL
- SVN and Git Repositories
- Basic OpenCv
- Android Programming
- Node.js
- Development in Google Glass
- Basic HTML, CSS, and JQuery

Luis R Escobar

PO Box 918, Barceloneta PR, 00617 | 787-963-2402 | luis.escobar@upr.edu

Objective

- To find a job in the Program Management or Project Management areas where I can contribute my knowledge and in the meanwhile obtain valuable experience that will help me grow in my professional career

Education

IN PROCESS- BACHELOR'S DEGREE | DEC 2015 | UNIVERSITY OF PUERTO RICO IN MAYAGUEZ

- Major: Computer Engineering
- Finished 5 years of study with a 3.70/4.00GPA
- Related coursework: Advanced Programming, Data Structures (Java), Database Systems, Microprocessors Interfacing, Operating Systems.

Experience

PROGRAM MANAGER INTERN | MICROSOFT CORP | MAY – AUG 2014

- Performed the Program Manager role in the Skype team for the next version of Windows OS.
- Designed from scratch a performance plan to identify flaws in our Skype App and set targets for those scenarios. Also, I was the product owner of two features, which gave me the opportunity to talk to our stakeholders, gather information from our customers and define specifications for those features.
- The project required a lot of communication with different teams inside Microsoft to identify dependencies and stakeholders. This gave me the opportunity to interact with people that had completely different priorities from ours and helped me work on my communication and persuasion skills.

PROGRAM MANAGER INTERN | MICROSOFT CORP | MAY – AUG 2013

- Performed the Program Manager role in the Lync Modern team under the Skype division.
- Worked in multiple tasks contributing to the shipment on time of the following version on Lync for Windows Store App. I was the product owner for multiple features that shipped, which gave me the experience of working with real product that will affect millions of people around the world.
- Learned the SCRUM process and worked with two different SCRUM teams which gave me different perspectives of the process of creating software and helped me acquire more experience making teamwork.

ROTATIONAL INTERN | MICROSOFT CORP | MAY – AUG 2012

- Experienced the roles of Program Manager, Software Development Engineer and Software Development Engineer in Test for the Lync Client team.
- Worked in a project in the MSFT Office Division with two other Explore interns. As part of the project, wrote design specs for the features to be implemented and programmed in C# language.
- Acquired the experience of working with real projects and learning how is the process of creating software, from the idea until the final product.

Skills & Abilities

- Fully Bilingual (English and Spanish). One year in French language.
- **Programming Languages:** C# (intermediate), Java (intermediate), C and C++ (intermediate), HTML and CSS (Basic).
- **Technologies:** JQuery Mobile, Node.js, MySQL, Windows 8 App Development, JIRA Agile, Confluence.
- Leadership, experience working under pressure and good making teamwork



Joel R Corporan

(787) 630-9640 joel.corporangomez@upr.edu P.O. Box 1215 Saint Just, PR 00978-1215

Creative professional and highly motivated who had demonstrated success in applications developments and project management . Effective leader with the ability to cultivate teamwork and an innate skill in coaching and motivating others to perform at optimal levels. Possesses confidence and patience to effectively communicate with colleagues.

Education

**University of Puerto Rico,
Mayaguez Campus**
Bachelor of Science in Computer
Engineering, December 2015

Achievements | Awards

iOS Foundation | Paradise
Fellowship for Development of Mobile
Applications - 2015

**The Professional Engineers &
Surveyors Association of Puerto
Rico - CIAPR**
Outstanding Computer Engineering
Scholarship recipient - 2015

ECE-UPRM Software Exhibition
Top 3 Database design award for
Campus Security Application - 2014

**Luis A. Ferre Foundation | Banco
Popular Inc.**
Distinction Scholarship recipient - 2013

Berklee College of Music
Prestigious Scholarship for Full-Time
Studies - 2012

Puerto Rico Heineken Jazz Fest
Young Prospects Musicians selected
Pianist - 2011

**Puerto Rico Heineken Jazz Fest, 25
Anniversary**
Young Prospects Musicians selected
Pianist - 2010

Berklee College of Music
Prestigious Scholarship for Full-Time
Studies - 2010

Trujillo Alto City, Puerto Rico
Outstanding Music Performance Award
Fine Arts - 2007

Professional Experience

TEACHING ASSISTANT, UNIVERSITY OF PUERTO RICO; MAYAGUEZ, PUERTO RICO – 2015-PRESENT

By professor recommendation, taught a laboratory for the Operating Systems class in the ECE department. The laboratory will be given to around 15 students over the entire semester.

SOFTWARE DEVELOPER & LEADER, UNIVERSITY OF PUERTO RICO; MAYAGUEZ, PUERTO RICO – 2015-PRESENT

Led a team of three computer engineers in the development and deployment of a unique mobile application (iOS and Android) that allows students, professors and other members of the university community to communicate and report emergencies in real-time.

WEB DEVELOPER, ECELED-UNIVERSITY OF PUERTO RICO; MAYAGUEZ, PUERTO RICO – 2015-PRESENT

Developed a dynamic and responsive website focused on strategic information for future customers of alternative lighting systems for energy efficiency and renewable energy.

RESEARCHER, INDUSTRIAL AFFILIATES PROGRAM (IAP) AND VERIZON WIRELESS; MAYAGUEZ, PUERTO RICO – 2015

Led and developed an exclusive mobile application to track Electronic Remittance Advice Delivery System (ERADs) from Verizon devices and integrate on existing programs, especially legacy systems. Also, included UX concepts which increased user satisfaction levels.

SYSTEM ADMINISTRATOR ASSISTANT, LABORATORY OF APPLIED REMOTE SENSING AND IMAGE PROCESSING; MAYAGUEZ, PUERTO RICO – 2014-PRESENT

Managed high-performance computers, servers, network routers and switches at the Laboratory of Applied Remote Sensing and Image Processing and adjacent laboratories that improved access to cyber tools for users (students & faculty).

RESEARCHER, GEORGIA INSTITUTE OF TECHNOLOGY; ATLANTA, GEORGIA – 2014

Developed a scalable software algorithm to auto-answer multiple video calls from users on Skype. This software helped to quantify the amount of information leakage transmitted over the Internet. Participated in the development of a network detection system capable of analyzing motion over network traffic. Designed and managed a dynamic database able to collect user information in real-time, such as location, devices, timestamps.

RESEARCHER, INDUSTRIAL AFFILIATES PROGRAM AND VERIZON WIRELESS; MAYAGUEZ, PUERTO RICO – 2014

Developed the capability to identify the required bandwidth for In-Home Wi-Fi routers for FiOS subscribers. This included the creation of a software algorithm to determine the scalability of the system in terms of network stress and interference.

RESEARCH MENTOR, STUDENT RESEARCH DEVELOPMENT CENTER; SAN JUAN, PUERTO RICO – 2012-2013

Mentored and encouraged approximately thirty pre-college and undergraduate students to develop a research topic in their area of interest. Also, worked as a research collaborator on the students' projects and as a judge at the annual symposium for oral and poster presentations.

Additional Work Experience

MUSIC DIRECTOR, ASSEMBLY OF CHRISTIAN CHURCHES, INC.	–	2007 - 2012
COMPUTER PROGRAMMER, ALL ELECTRONICS REPAIR, INC.	–	2009 - 2010
LINE INSTALLER ASSISTANT, PUERTO RICO TELEPHONE COMPANY, INC.	–	2005 - 2007

Skills

- Fully Bilingual; English & Spanish.
- Knowledge in Algorithms Technics, Programming Languages (C, C++, Objective-C, Swift, Java, JavaScript, Python, Assembly), and Web Programming Languages (HTML, HTML5, PHP, CSS, CSS2). *Complementary languages that I used are Ruby, MatLab*
- Knowledge in SQL, Database design methods (Database Normalization, Entity-Relationship Diagram, etc.). Experience in MySQL, PostgreSQL, MariaDB, and MongoDB.
- Knowledge in Digital Electronics & Embedded Systems Design (Texas Instruments MSP430 & TIVA Families).
- Knowledge in Internet Protocols, Network Routing Methods [LAN, WAN, MAN], and Routing Protocols [RIP, RIPv2, OSPF, IGRP, EIGRP].

Extracurricular Activities

- **Etta Kappa Nu (HKN) Lambda Chapter, IEEE Honor Engineering Society Member** - 2014
- **Tau Beta Pi PRA, Computer Engineering Representative & Community Advisor** - 2014-2015
- **Band & Orchestra of UPRM, Assistant Director of the Popular Music Ensemble** - 2013-Present
- **Tau Beta Pi PRA, Engineering Honor Society Member** - 2013
- **Student Research Development Center, Judge for Math, Science and Engineering** - 2012-Present

CHRISTIAN O. MONTES TIRADO

Urb. Río Canas Amazonas Street #2824
Ponce, PR 00728

Phone: (787) 231-5270
e-mail: christian.montes@upr.edu

EDUCATION

- **University of Puerto Rico, Mayagüez Campus** **2009-Present**
Bachelor of Science in **Computer Engineering**
GPA: 3.55/4.00
Expected graduation date: **December 2015**
 - **Relevant Courses:** Foundations of Computing, Advance Programming (Java), Data Structures, Database Systems, Programming Languages, Software Engineering, Microprocessors, Computer Architecture, Electrical System Analysis I-II, Electronics, Logic Circuits and Fundamentals of Web Design.

EXPERIENCE

- **WebSphere MQ L2 Customer Support Intern at IBM** **Summer 2015**
 - Developed samples for the WebSphere MQ Application in C and Java. Worked in the design of a SSL Tester Connection application for MQ customer to test an SSL connection with the MQ product. Wrote a technical document on how to develop samples for MQ using Eclipse.s
- **Research Assistant at University of Wisconsin-Madison (SURE Program)**
Project: **Developing a matrix management solution through Redis, an in-memory database** **Summer 2014**
 - Many machine-learning algorithms are trained via interactive human feedback. This interaction requires fast data management. We worked to design our algorithms to take advantage of Redis, allowing the data that need to be fast and quickly accessible be in the Redis database; increasing the performance of our applications.
- **Research Assistant at University of Puerto Rico at Mayaguez**
Project: **Smartphone-based User Interface for Supporting Physicians Tasks at the Point of Care** **Fall 2014**
 - Nursing and physicians tasks remain mostly documented via rudimentary, inefficient, and time-consuming pen and paper methods. Worked in a team to develop user interfaces following the principles of Human Computer Interaction to support physicians and nurses in clinical areas.
- Project: **Biomedical Imaging Acceleration Testbed (BIAT)** **Fall 2013**
 - Worked in the development of a Hyperspectral Image Detection library to be used for cancerous cell detection. We used C language in conjunction with CUDA library for implementing different mathematical functions on parallel computing.
- **Mathematics Tutor**, University of Puerto Rico, Ponce Campus **Summer-Spring 2011**

UNIVERSITY PROJECTS

- **Embedded System (Fall 2014):** Worked in the design and assembly of an embedded system to automate various actions performed in the Unit Operations Lab II from Chemical Engineering.
- **Mobile App (Fall 2013):** Designed and implemented a mobile app for an e-commerce style site. It was implemented using database, web and mobile apps technologies.
- **Python Scanner (Spring 2013):** Designed and implemented a lexical analyzer for Python using Java to compare it with a lexical analyzer implemented in Flex.
- **Algebra and Calculus with Polynomials (Fall 2012):** Implemented general math operations using linked lists. (Java)
- **Number Puzzle Game (Spring 2012):** Worked in pair to design and implement a game similar to the sliding puzzle. (Java)

SKILLS

- **Languages:**
 - Proficient in: Java
 - Familiar with: Python, C, Javascript and HTML/CSS.
- **Software:** Linux, Mac OS X, Windows XP/7/8, MS Office Suite, Eclipse, Aptana Studio, WebSphere MQ
- Proficiency in **English** and fluent in **Spanish**.

Extracurricular Activities

- Eta Kappa Nu (2014 – Present)
- Tau Beta Pi – Engineering Honor Society (2013-Present)

Appendix B: Metrics to Assess the Progress of the Project

We will use the Gantt Chart to keep track of task completion as a measure of progress. The percentages displayed are bound to the duration of each task on the Gantt chart. The table 4 provides a description of the tasks to be fulfilled.

Task	Percentage
Server	50%
Data Serialization	2%
Fetch of Data from the crimes database	10%
Location Handling	6%
Frequency regulation of location requests	3%
Identify transition between zones	3%
Geo-zone Generation	20%
Clustering method to identify crime zones	5%
Dynamically generation of fences around clusters identified	5%
Calculation of risk factor in an identified zone	5%
Storage of Information in local database	5%
Request Handling	5%
Telemetry Collection	7%
Collected from the user	5%
Storage of results in local database	2%
Database	10%
Geolocations Storage	5%
Telemetry Storage	5%
Android	10%
Application Interface	2.5%
Notification views	5%
Communication protocol	2.5%
Web Administrator Dashboard	10%
Fetch of data from server	2%
Dashboard Interface	3%
Visualize zones from the data obtained on map	5%
Risk Factor	20%
Metric Research	15%
Experimentation	5%

TABLE 4: Task Completion Assessment

Appendix C: Detailed Calculations of Budget

HUMAN RESOURCES

Name	Role	Stipend [16]	Working hours	Total Wages
Christian D. Vazquez	Software engineer / Project Manager	\$ 2,435/month \$ 14.04/hr	210	\$ 2,948
Joel Corporan	Software engineer	\$ 2,435/month \$ 14.04/hr	210	\$ 2,948
Luis R. Escobar	Software engineer	\$ 2,435/month \$ 14.04/hr	210	\$ 2,948
Christian Montes	Software engineer	\$ 2,435/month \$ 14.04/hr	210	\$ 2,948
Total cost				\$ 11,792

TABLE 5: Labor Costs

$$\frac{\$2435}{[month]} \cdot \frac{12[months]}{1[yr]} \cdot \frac{1[yr]}{52[weeks]} \cdot \frac{1[week]}{40[hrs]} = \frac{\$14.04}{1[hr]}$$

Equation 2: Calculation of hourly salary

Benefit	Quantity per employee	Cost per employee	Cost
Paid vacations	2 days (6 hours)	\$ 84.24	\$ 2,400
Health Insurance	1	\$ 400.00	\$ 180
Retirement plan	1	\$ 100.00	\$ 90
Total cost			\$ 2,336.96

TABLE 6: Fringe Benefits

EQUIPMENT

Item	Price	Quantity	Total
Web hosting [17]	\$ 4.99/month	6 months	\$ 30.00
Domain name*	\$ 9.99/yr	1 yr	\$ 9.99
Android Dev registration fee	\$ 25.00	1	\$ 25.00
Database (Azure standard tier)	\$0.0202/hr (~\$15/mo)	6 months	\$ 90.00
Android watch (Moto 360)	\$ 149.00	2	\$ 298.00
Android phone (Nexus 5)	\$ 260.00	2	\$ 520.00
Total cost	\$		972.99

TABLE 7: Equipment Costs

*Price for a .xyz domain name

FACILITIES

Item	Price	Time	Total
Rent	\$400/month	6 months	\$ 2,400
Electricity	\$30/month	6 months	\$ 180
Water	\$15/month	6 months	\$ 90
Internet Service Provider	\$45/month	6 months	\$ 270
Total cost	\$		2,940

TABLE 8: Facilities Costs

MISCELLANEOUS

Item	Price	Quantity	Total
Flight + Hotel*	\$980	2	\$ 1,960
Food and transportation reimbursement	\$250	2	\$ 500
Total cost	\$		2,940

TABLE 9: Miscellaneous Costs

*Subject to change

Category	Human Resources	Equipment	Facilities	Miscellaneous	Total estimated cost
Cost	\$ 14,128.96	\$ 972.99	\$ 2,940.00	\$ 2,460.00	\$ 20,501.95

TABLE 10: Summary of the Costs

Appendix D: Budget Justification

As it was mentioned in the budget and financial aspects section of this document, the budget required for the project is divided into four categories. These categories will be described below.

HUMAN RESOURCES

This category includes labor costs. The team is composed of four members with different roles, one project manager and three software developers. As this project is oriented toward research the salary will be assigned accordingly.

EQUIPMENT

This category includes both hardware and software component's cost. For the successful completion of the project the team will require testing devices, such as android wear and mobile devices. For the software side the team will require a web hosting service, a domain name, a database server, and a one time android developer registration license.

FACILITIES

This category includes all the expenses incurred on having adequate facilities for the development of the project. Some costs considered in this category are utilities, electricity, water, and internet service provider. The costs in this section fall in the category of indirect costs, therefore they will be considered in the calculation of overhead costs.

MISCELLANEOUS

This category is used to group any expenses that do not fit any of the main categories but that are important for the completion of the product. One example of an item that may fall into this category is the expenses for traveling at least twice to meet with the client personally in Massachusetts.

Appendix E: Risk Management

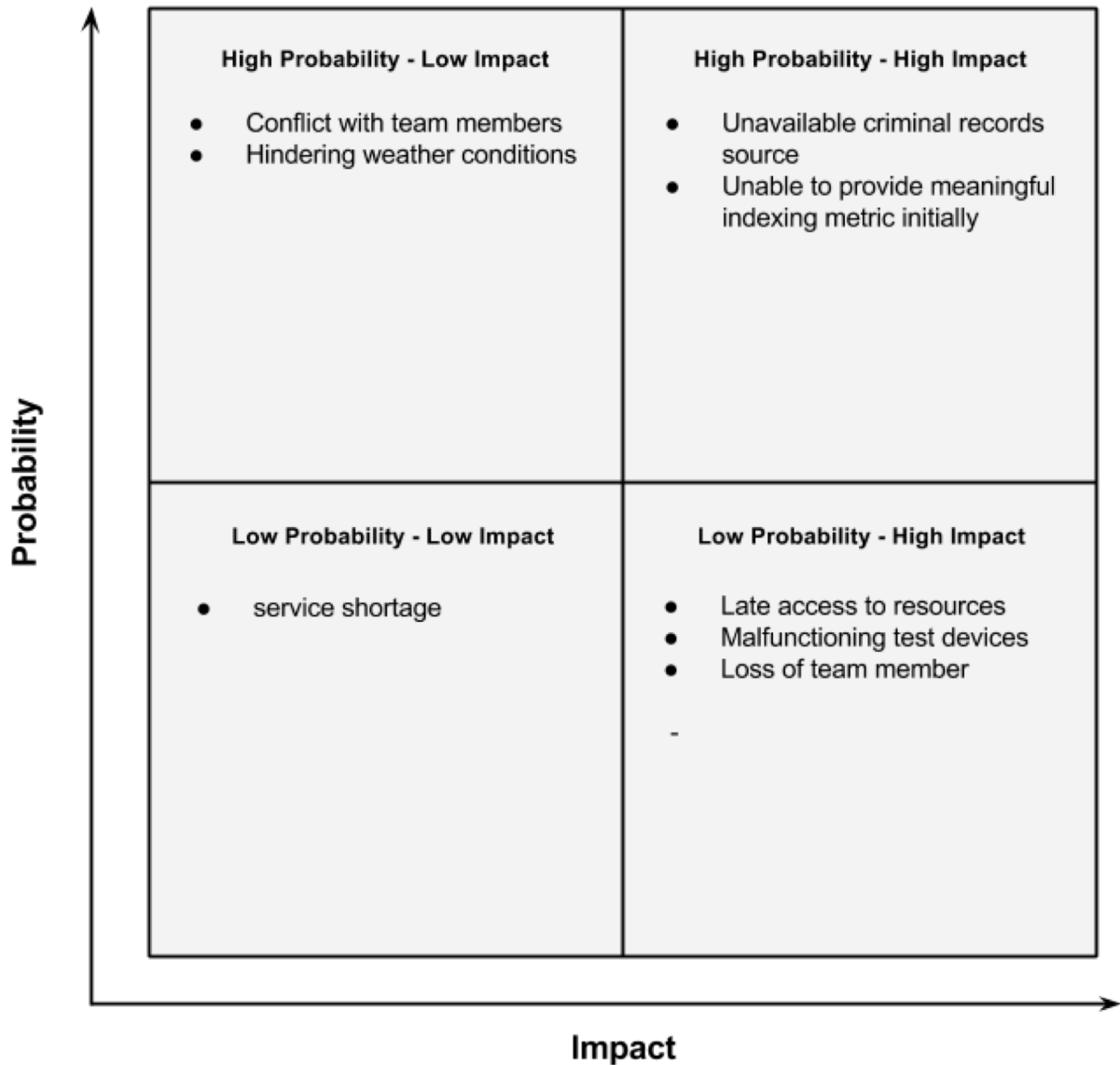


FIGURE 2: Risk Matrix

Risk	Probability	Impact	Strategy
Service shortage	Low	Low	<ul style="list-style-type: none"> • Switch to local environment • Monitor outages
Unavailable criminal record source	High	High	<p>Proactive</p> <ul style="list-style-type: none"> • Create mechanism to switch among different sources. • Find multiple sources <p>Reactive</p> <ul style="list-style-type: none"> • Switch to a secondary source
Loss of team member	Low	High	<ul style="list-style-type: none"> • Reevaluate project goals • Discuss alternative with stakeholders • Change project schedule • Distribute task among the other team members. <ul style="list-style-type: none"> • If Christian Vazquez is absent, his tasks will be distributed between Luis Escobar and Joel Corporan • If Luis Escobar is absent, his tasks will be distributed between Christian Vazquez and Christian Montes • If Joel Corporan is absent, his tasks will be distributed between Christian Montes and Christian Vazquez • If Christian Montes is absent, his tasks will be distributed between Joel Corporan and Luis Escobar
Lost or malfunctioning test devices	Low	High	<ul style="list-style-type: none"> • Purchase replacement • Use Android emulator

Risk	Probability	Impact	Strategy
Unable to initially provide meaningful metric	High	High	<p>Proactive</p> <ul style="list-style-type: none"> • Develop multiple metrics concurrently • Implement mechanism to swiftly switch metrics in geo-zone generator <p>Reactive</p> <ul style="list-style-type: none"> • Continue development of other modules while iterating on metric in parallel.
Late access to resources	Low	High	<ul style="list-style-type: none"> • Outsource to another entity • Generate placeholder content
Conflict with team members	High	Low	<ul style="list-style-type: none"> • Employ conflict resolution techniques
Hindering weather conditions	High	Low	<ul style="list-style-type: none"> • Work remotely and adjust schedule

TABLE 11: Risk Assessment

Appendix F: Market Overview

KYA (“Know Your Area”) is a product to inform tourists about potential risks when entering areas with increased criminal activity area. When using the KYA product, tourists can have a better perception of the area that they are about to enter, reducing the tourist’s vulnerability to “crimes of place”. KYA will be available as an Android application for the Android Wear platform. The tourists will receive notifications on their smartwatches, allowing them to consciously make an informed decision as to whether or not they want to expose themselves to the potential risk of entering to a high criminal activity area.

Potential Customers

The KYA product is aimed to tourists visiting new areas, where the potential risks of being a victim of a “crimes of place” increases. In addition, the product could potentially benefit crime enforcement entities or tourism agencies by reducing criminal activity and increasing the income of the local economy. MIT Media Lab’s Fluid Interfaces group is also interested in exploring mechanisms to influence human mobility using wearable devices.

Current or Potential Competition

In the US market, there are similar applications that provide lists of crimes committed around the user’s location. Among them is “SpotCrime”, which provides current events and breaking crime stories around the user [3]. “Localcrime” keeps their users informed about crimes or wrongdoing in their neighborhood [18]. “CrimeReports” gives access to neighborhood level crime and sex offender information [19]. In Puerto Rico’s market, “BastaYa Crime Report” is an application to submit incident reports to a designated government public safety agency [20]. All previous applications offer a proactive approach, where users need to do something to be informed. Additionally, the applications require users to create accounts. None provide compatibility with any smartwatch or wearable device.

Competitive Advantage

KYA’s main advantage is its reactive approach, that reduces the cognitive load on the user by requiring no prior action to capitalize on the benefits of the application. KYA provides the capability of generating risk-indexed geozones and notifies the user only when he/she moves to a geozone of increased risk classification. Tourists do not have to sacrifice their time to investigate which areas are dangerous, instead they are notified automatically when entering an unsafe area, allowing for reactive correction of his/her mobility pattern. Additionally, the application does not require the user to create an account to use the service.

Appendix G: Global System View



FIGURE 3: Global System View



FIGURE 4: Android Wear Application View

Appendix H: Statement of Work

Statement of Work			
Date:	August 24, 2015	Immediate Customer:	MIT Media Lab
Contributors:	MIT Media Lab	Final End User:	Android Users

Project Title:

Know Your Area (KYA)

Purpose:

Wandering into the wrong neighbourhood can be a frightening experience. When people travel, or simply move beyond a certain familiar geographical boundary, they unconsciously expose themselves to unnecessary risk. KYA ("Know your area") seeks to solve this problem by providing a method to seamlessly inform users when they increase their level of potential risk. Using an Android watch or phone, users can be notified of their potential risk when they are on the move, allowing them to consciously make an informed decision as to whether or not they want to expose themselves to it.

Project Background:

For years people have been moving around without knowing for sure how safe they are, or at least how risky it is in terms of criminality. According to the PR Police Department, only in 2015, more than 54,000 Class A felonies have been reported. Class A felonies in Puerto Rico include crimes such as murder, robbery, raping, carjacking, grand larceny or grand theft, burglary, aggravated assault, and other serious crimes that may threaten the life of a citizen. One specific case that occurred in Puerto Rico in 2009 shows us how important it is to know where you walk if you are visiting a foreign country. An American woman visiting from the state of Georgia was abducted while jogging in the marina area of Fajardo. She was stuffed into the trunk of the perpetrator's car and later found dead with her throat slit. She was five months pregnant. While incidents like these are unlikely it is always better to be prepared and aware.

In recent years, persuasive technology is regularly used in different fields such as sales, marketing, politics, public health, or advertising in order to change people's attitudes or behaviors. By using persuasive technology, KYA aims to investigate how different modalities of informing the user about a high criminal area can influence people's actions. A notification to the user is displayed when a transition between a lower criminal incidence and a higher criminal incidence area occurs. Different notifications styles will be displayed, KYA can retrieved how the user reacts to the notification in order to obtained the best persuasive method.

Project Deliverables:

- To design and deliver, in collaboration with Media Lab's Fluid Interfaces group, a Three-tiered computer system that enables the storage and generation of risk classified geo-zones. This system should notify Android wear devices that move between geo-zones in the direction of increasing risk. This system should be delivered by November 11, 2015.
- To define a meaningful metric that classifies generated areas of interest using a computed safety factor, i.e., how safe is an area based on previous criminal history. A relative percentage difference of around 10% should exist between classified ranks of adjacent zones (e.g. a zone classified with risk level 2 should show at minimum 10% increase in crime incidents from an adjacent zone classified with risk level 1)
- To define an approach to transforming clustered areas of interest into storable, programmatically generated geo fences.
- To design and implement a web admin interface that allows visualization of procedurally generated areas of interest on a map.
- To design and implement a remote cloud service that:
 - Generates areas of interest by fetching new criminal entries and feeding it to the geo-zone generator.
 - Serves HTTP requests inquiring about the current security zone occupied by a specific device.
- To design and implement a prototype, Android watch application that:
 - Shares user location with a remote cloud service.
 - Notifies user when a transition between a lower criminal incidence and a higher criminal incidence area occurs.
 - Send telemetry data about user mobility in response to notification.
- To design and implement a database that stores:
 - Mobility related telemetry data
 - Areas of Interest

Measurable Success Indicators:

1. Geo-zone generator is able to discriminate between areas of interest and represent them on a two-dimensional map.
2. The definition of an indexing metric that provides a meaningful discriminator between zones of risk.
3. Validation of the concept of transition based geofencing and its application in the realm of ubiquitous computing.
4. Minimization of the communication latency between the application and the remote service.
5. The delivery of mechanisms to gather instrumentation data (e.g. action upon notification, mobility patterns of notified user).
6. The battery efficiency of location based services on android devices.
7. The delivery of a functional, demoable prototype.

Customer Support:

- Customer will provide mentorship throughout the Capstone project.
- A weekly video meeting with the customer will be hosted throughout the project planning stage.
- A Bi-weekly video meeting with the customer will be hosted throughout the implementation stage.
- Weekly progress report will be made available to the customer.
- A closing meeting will be held to evaluate the success of the project.

Risk Plans:

1. **If online service shortage occurs (such as the remote database server is down) then we will react by switching to our local environment to continue testing and development.** Given these services are commercial products that enforce redundancy and replication, it is likely a shortage will be fixed quickly with little to no impact on delivery. We will monitor web service status to know when a shortage occurs.
2. Criminal records are a vital resource in our project. Without them, we cannot generate areas of interest, or define a meaningful metric for risk indexing such areas. **If the data source becomes unavailable, then we need to take the following measures:**
 - a. **Proactive measures**
 - i. If the data is lost or it becomes unavailable, we will create mechanisms to allow swift transition between distinct data sources, to minimize the overhead of changing the database.
 - ii. We will find multiple data sources, and keep them available to our geo-zone generator.
 - b. **Reactive measures**
 - i. In the event that our primary source for data is lost, we will swiftly transition to a secondary source.
3. Our project schedule is planned under the assumption that four team members will be fully involved. **If we lose a team member** during the course of the semester for unexpected circumstances (e.g. sickness, unenrollment , etc.) **then we will react by reevaluating the project's goals, and perform corrective action to ensure that the project is viable for a smaller team.** These changes must be discussed and agreed upon by the project's stakeholders (Media Lab, Capstone professors, and team).
4. We currently own two Android watch devices. **If test devices are lost, damaged , or malfunctioning, then we will purchase an additional device.** While a suitable replacement is found, we will continue testing and development using the Android emulator.
5. Given the research nature of defining a meaningful metric for risk indexing geozones, the possibility exists that initial definitions might not prove meaningful. **If a meaningful metric is not achieved, then we need to take the following measures:**
 - a. **Proactive measures**
 - i. Explore and develop multiple metric definitions during initial stages of the project.
 - ii. Develop a mechanism to easily switch metric definitions for the geozone generator.
 - b. **Reactive measures:**
 - i. Continue development of the system using existing metric, while iterating metric definition in parallel.

6. During our project, there are several resources that come from third party entities. If we are not given access to these resources, the project might be delayed. **If a resource is not available by its scheduled time, then we can:**
 - a. Outsource it to another entity.
 - b. Generate placeholder content and continue development efforts.
7. If a conflict with a team member occurs, then we will take reactive conflict resolution methods (e.g. mediation) to resolve the conflict and reduce impact on project schedule.
8. If hindering weather conditions occur (e.g. tropical storm), then we will continue development individually from our respective homes to reduce impact on project schedule.

Note/Support Information:

This project is focused primarily on research, however, it does involve components that are expected to be delivered to end users.

Signatures

Project Manager: Christian D. Vázquez

Customer: MIT Media Lab - Fluid Interfaces

TABLE 12: Statement of Work

Appendix I: Work Breakdown Structure

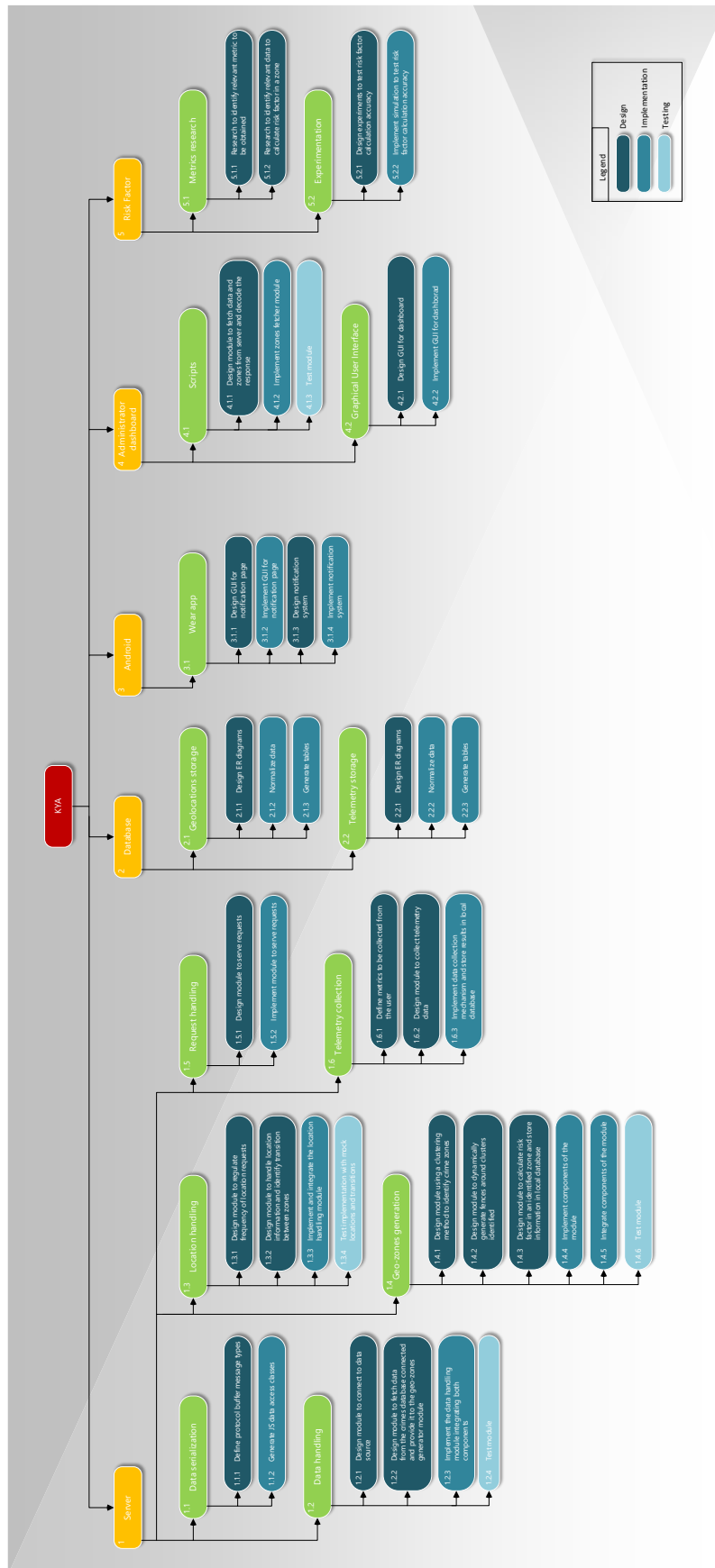


FIGURE 5: Work Breakdown Structure

Appendix J: Gantt Chart

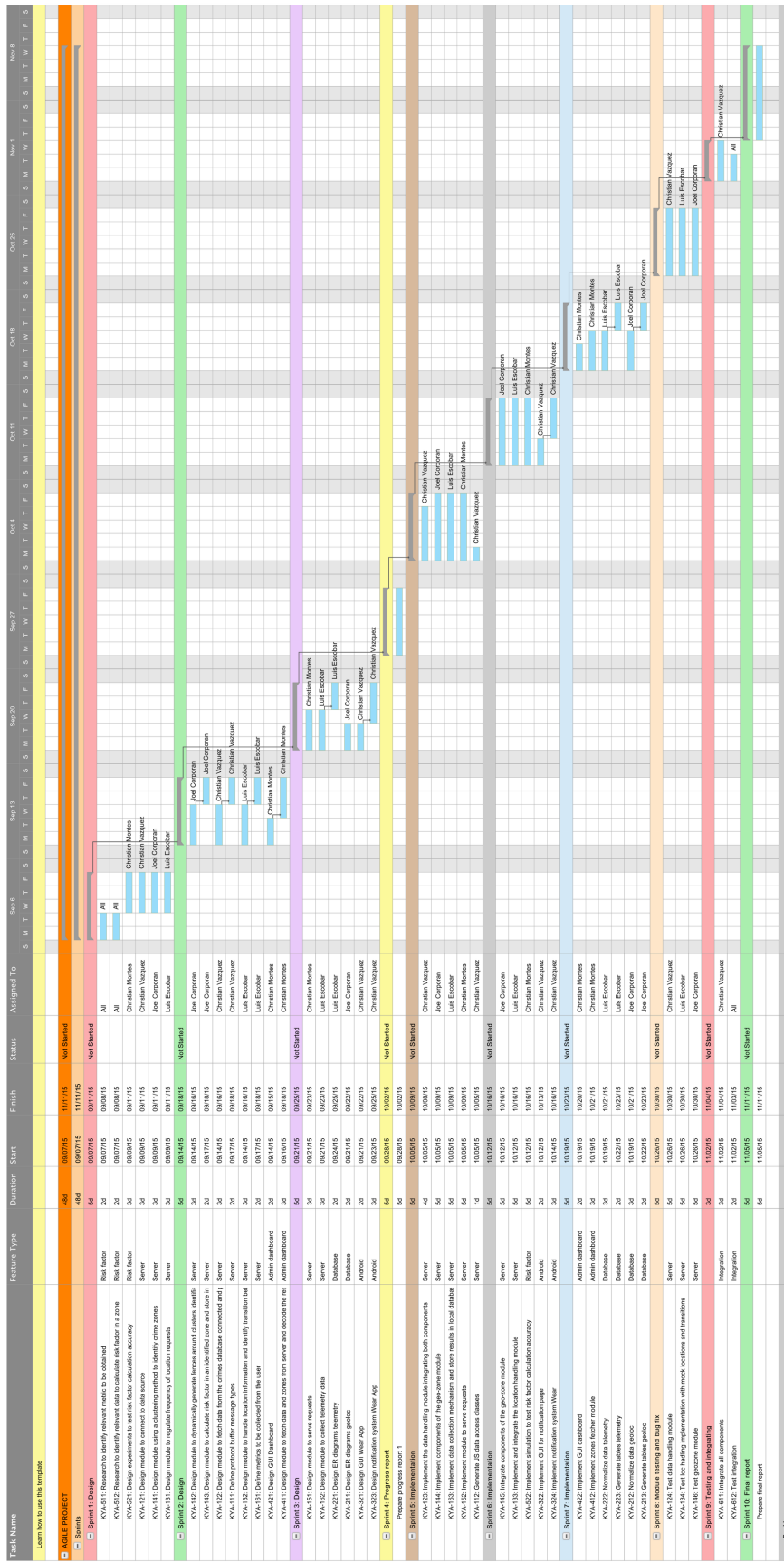


FIGURE 6: Gantt Chart