Demonstrating the Power Of A Context Aware Mobile Application

Dissertation Submitted To
Damien Costello

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of the award of the degree

Bachelor Of Science (Honours) In Software Development

by

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Table of Contents

Abstract. Context aware applications use Global Positional Systems(GPS) to locate your GPS at all times. With these applications, this could be the start of a new medium of advertisement. As a result, the dissertation describes the implementation of a cross platform mobile application with a context aware system.

1 Introduction

GPS and LBS are a staple feature in all mobile applications. I am proposing to create a cross platform mobile that uses GPS at it's core function. This application works on the principle of sending the user advertisements based on their location. In this dissertation, we will see what other people have done in this area of GPS/LBS and it's ethical use with people. There will be a section describing the applications design and the architecture being used to create it. The following section will talk about the evaluation of the system, in relation to testing, and finally conclusion. My aims of the GPS project are:

- Create a GPS project through the cross platform framework Ionic.
- Connect the server side to the client side through the application Node.js.
- Create a database with a NoSQL format.

2 Literature Review

The Ethics of GPS Tracking

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Abstract. Global Positional Systems(GPS) are becoming more ubiquitous, making more applications to track people for Location Based Services(LBS). These applications are on the market not to just the law enforcement anymore but to anyone in the public, examples spouses, parents, and doctors. This paper aims to discuss the unethical use of these new tracking and monitoring of people in society, and explore these affects will have on the future.

Keywords: Global Positional Systems(GPS), Location Based Services(LBS), Ethics, Security, family, health care, Society

2.1 Introduction

With Global Position Stystem(GPS) developed by the military in the 1960's, it's applications have rapidly grown.[7] These devices range in sizes from hand held to small microchips that could be implanted into a person. [9] There are loads of

commercial applications on the market making GPS really show its full potential in many area's. But at what cost will this have on society, in this research paper we will unearth the problems that these emerging applications have on us. There our numerous people that our studying in this field but Michael et al. [7] has been at the fore front in many papers, either as the main author or as a collaborative author. [2, 4, 6, 7, 9]

In secton two of this paper , it will focus on the breakdown of the core aspects of society, security, health care, and family, and taking a look at the affects of GPS tracking in them. In section three, it will discuss George Orwell's "Big Brother" concept in relation to the modern century. And the last section 4 will cover the future work in planning safeguards for people.

2.2 Affects on Society

There are many ways the GPS applications can be used. The function and purpose of these applications vary[8] This section will talk about GPS and LBS enabled devices in relation to society, and if it has any serious side effects.Michael and Aloudat [9] did study the socio-ethical view on LBS and his findings, were primarily, in relation to security, health care, and family. But the same socio groups where discussed in Chen and Shi [2], Dobson and Fisher [3], Michael and Aloudat [9].

2.3 Security

Security is defined as *"the state of being free from danger or threat."[10]* GPS and LBS devices are used a lot in this area because of its many applications, example the enhanced 911 service, and ePassports in America. Technology in this sector has a lot of good outcomes but it can also can present a treat to people's privacy.[8] In the United States of America, in some states, the police tracking people is not deemed in violation of a persons' rights or the courts can warrant the placing of tracking devices on a person, if believed to have committed a crime.[7] But America have started to introduce amendments to their laws, example would be **"5. State of Colorado, 5.1 HB 07-1082, A Bill For An Act Concerning A Prohibition On Requiring An Individual To Be Implanted With A Microchip "[4]** here the use of micro chips on people is now against the law.

In America there have been cases where the use of GPS information has prosecuted the person in question.[7] Terrorism has gotten a lot of press in the past few years and due to this anyone suspected with terrorists are actually tracked with a GPS device with a period of six to twelve months, depending on the country.[7] For that time period in which the suspected person is tracked, does Dobson and Fisher [3] Geoslavery if the police deem the individual could harm other people. He mentions a social responsibility that covers the aspect of terroism. With America's crisis in 2001, their view on non-national citizens were

jaded, implementing a series of measures to protect themselves, but he makes an example if America tag people who were in America while they were staying there.[3] But in security, the main area GPS is really used in is the parolees and sex offends monitoring.. It is estimated, in the United States, to be one hundred and twenty thousand tracked parolee's pedophiles but other fifty thousand convinced that are not tracked.[4]

2.4 Health care

Health care is becoming more and more in demand but there are not the same amount of doctors and nurses as there are patients coming in. This is where technology is playing its role. [11] There has been technology developed to try reduce the volume and one area the health care focused on is the elderly. [4, 8, 11] There have been great ideas and development, example, the implementation of a real-time monitoring system. [8] But is there an unethical application towards it? In Wagner and Nielsen [11] describe a new device that allows the hospital or local doctor to monitor a patient health with GPS application added too. This device was to record a patients vital signs, location, and transmit it to the doctor. This could be deemed a new form of surveillance.[8] Whats worrying is the huge amount of data thats being sent, in the Irish **Data Protection (Amended) Act Government [5] ,** it stipulates, in a section, the person that is accessing this information has to respect the person's data therefor keeping the information to themselves and importantly the data obtained is not kept for longer then its actually needed.

In America there have been legislation brought in to prevent this situation from happening, i.e. The anti-chipping laws. Six States have implemented amendments to their laws in relation to micro-chipping people for any form of monitoring or tracking. [4]. In the state of Georgia, they have brought in the **"11.1 HB 38, Microchip Consent Act"** , which clearly states *"(2) 'Microchip' means any micro device, sensor, transmitter, mechanism, electronically readable marking, or nano technology that is passively or actively capable of transmitting or receiving information. This definition shall not include pacemakers."* and *"(4(b)) No person shall be required to be implanted with a microchip."* The amended laws cover citizens , hospitals, parents, and yourself from micro-chipping. According to Michael et al. [8], they talk about an application that combine LBS with a biomedical device that records and transmits information about the individual about their physiology change or the environmental change on them. When the medical care get to that stage of advancement, these laws in America will prevent these doctors and hospitals from chipping people. [4]

2.5 Family

Its has never been easier to get technology with GPS or LBS built in, therefor monitoring and tracking family members has never been easier. [9] One of these products is the Wherifone, and is the most popular on the market to date. The

device is the size of a bank card with the capabilities of contacting the emergency service, their parents contacting them, and a GPS application which parents can access by Wherifone's website.[7] According to Michael and Aloudat [9], a parents trust is based on *a)* the child's beliefs or values *b)* information on past violations *c)* and the child's responsibility and judgment. But if the parent does use technology as a form of surveillance, an issue arises, a breach in trust, from parent to child and from child to parent.[8] But it wasn't until Dobson and Fisher [3] brought this concept with Slavery a step further. He introduced a modern version of slavery where "slaves" where tracked and monitored through GSP and LBS by "Master". There is a fine line between parents wanting to keep their children safe and crossing that ethical boundary where its deemed "Geo-Slavery".[3]

This idea of monitoring children is becoming more and more popular among parents, as a result it is perceived to be enhancing parenting in 21st century [3].According to Chen and Shi [2], *"Generally, people would like personal information to be known by a small circle of close friends and family, and not by total strangers."* In Michael et al. [8] paper, they talk about the aspect of trust when it comes to humancentric LBS, and they discover the negative, damaging affect it has on relationships. The undermining of trust in people and trust in technology will be the breakdown in society.

2.6 Big Brother Idea

Dobson and Fisher [3] mentions George Orwell's "Big Brother" concept in todays world. Since Orwell first wrote about his concept, technology has seen rapid growth and development, example GPS and LBS. We talked about their applications in most areas. [1, 4, 8, 11] According to Orwell, television was going to be the medium which in surveillance would happen and it would be the government that would control people, but that's not the case as discovered in this paper. [3] If we look at Orwell's first thought about surveillance, his television concept is nothing compared to GPS and LBS enabled devices and the thoughts of micro chipping people today.[4, 8, 9] The technology ranges from GPS enabled devices, to implants that are embedded into people.

Orwell's second fear was that the government would use the technology to actually control people. But government have brought in legislation to protect people from technology. [4] Its individuals themselves that are using the technology on other people,Dobson and Fisher [3] defines Geoslavery as *"a practice in which one entity, the master, coercively or surreptitiously monitors and exerts control over the physical location of other individual, the slave."* If the master has or hasn't told the slave about the monitoring, trust then comes into question. Trust is an important part of any relationship, and maintaining it too,but humancentric applications demonstrate the beginning of the end t the relationship. [8] This ties into Dobson and Fisher [3] "Geoslavery" concept making Orwell's nightmare becoming more scary with the fact one individual could monitor, and potentially, control numerous people.

2.7 Future Work

We can see that tracking and monitoring through GPS and LBS is becoming ubiquitous in nature.[9] They have many benefits, but what about the negatives, we can see there needs to be more safeguards for society. [2] We have seen the United States of America has already begun setting new laws about chipping people. [4] Other countries need to follow in the America's lead, in Ireland for example, there are no laws that really cover GPS, the closest law is the **Government [5]** We can see the amended act isn't cover anything in relation to the GPS information, the obtaining of the data,or anything about micro chipping. [4, 7] In Michael et al. [7] paper unanswered questions have arisen, i.e. Do private companies require the persons permission to track them through their GPS enabled devices? They make the point of creating a ethical framework.

In Michael et al. [8] paper, they say there is a potential change to societies ethical due to the use of GPS and LBS applications. But the change is happening sooner than they believed, like Michael et al. [7], they make a suggestion that safeguards need to be in place if anything should go wrong.

2.8 Conclusions

In Dobson and Fisher [3] paper, he makes a good point *"technology per se is neither good nor evil, and it certainly can not be held responsible for the sins of society"*. He sums it up perfectly, the technology on the market is there for people but it's people themselves that are misusing it. Therefore, we see an emergence of unethical behavior that needs laws, or what Michael et al. [7] described, an ethical framework. It shouldn't overshadow or demote the benefits that are happening with GPS, ans LBS applications, but should protect the individuals freedom being removed by others using this technology. The aim from this paper was to discover the potential implications that GPS and LBS applications have on society.

3 System Architecture/ System Design

To design my application I used the Ionic framework architecture. Ionic uses Hyper Text Markup Language(HTML) and the scripting language Java-script to create, build native feeling applications all with web technologies. Ionic's focus's on building an application from the front in, in other words, from the user interface(UI) to the code in background. The framework does require Angular Js , a structural framework for dynamic web app, to reach the frameworks full potential. Angular's data binding and dependency injection eliminate much of the code you would otherwise have to write. I chose to design my application with Ionic because it uses Apache's Open source at its core. This open source is called Cordova, its Phonegap without Abobe's extras. Ionic gives use UI design and powerful features.

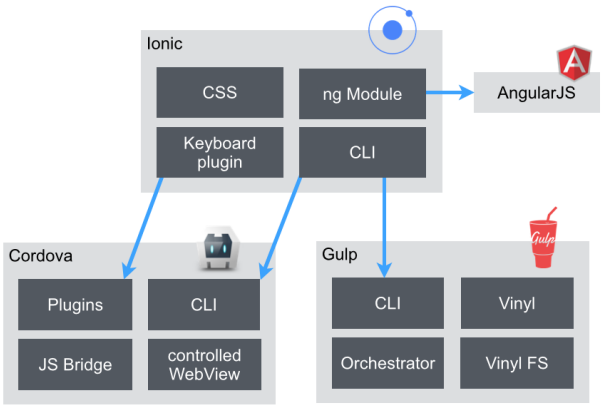


Fig. 1. Ionic Framework

For the server side , I used a NoSQL database, MongoDb. MongoDb is an open source, document oriented database designed with both scalability and developers in mind. MongoDb takes a step away from traditional relational databases of storing data in tables and rows, instead MongoDb stores data in Json like documents. The data model I've decided to use is the embedded one to many, this let's me embed extra information within my Json document.

Key	Value	Type
(1) ObjectId("54c9176ce4...	{ 10 fields }	Object
_id	ObjectId("54c9176ce4b053fb2c2b...	ObjectId
user	{ 2 fields }	Object
userName	0001	String
password	Password	String
owner_name	Joe Blogs	String
email	example@whatever.com	String
phone_num	0123456789	String
categories	Restaurant	String
deal	Soup and sandwich for 4.50	String
code	GBC_Deal_Code	String
price_plan	A	String
address	{ 7 fields }	Object
business_name	GBC Restaurant	String
address1	Williamsgate St	String
address2	N/A	String
town	Galway	String
post_code	00	String
latitude	53.274208	String
longitude	-9.050672	String

Fig. 2. Extract from my Mongo database

As you can see in Fig.2, MongoDb is powerful form of data storage, in the example I can store a group of information within a field. i.e. I could have multiple address in the address field. I'll be using the web application MongoLab, which will help me host the database on Microsoft Azure for me once created.

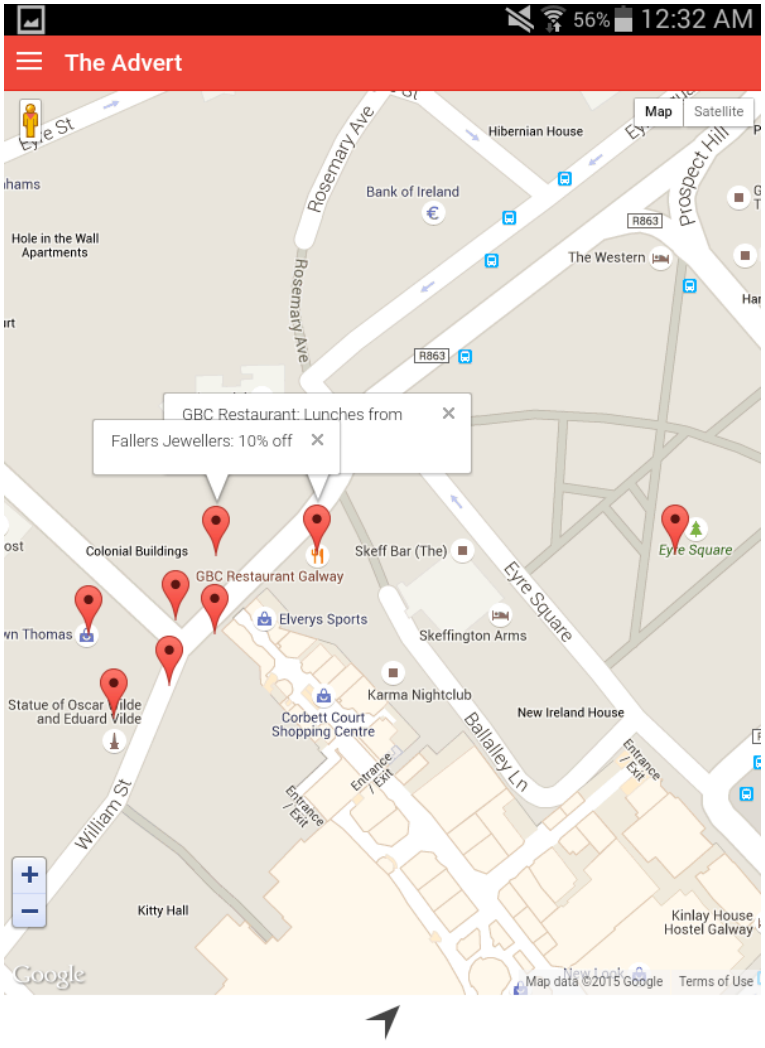
To bind all these elements together is the application Node.js. Node.js, like the previous applications, is open source, cross-platform runtime environment for the server-side and networking applications. It is an asynchronous event driven framework, Node.js is designed to build scalable network application. It uses Google V8 Java-script engine to execute code, and a large percentage of the basic modules are written in Java-script. Node.js contains a built-in library to allow application to act as a web server without software as Apache HTTP Server and Internet Information Service(IIS).

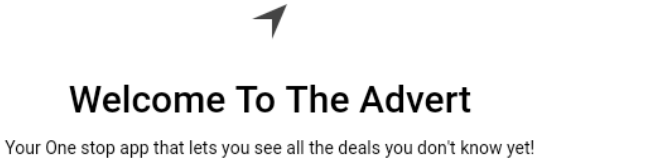
```
var mongo = require('mongodb');

var Server = mongo.Server;
var Db = mongo.Db;

var server = new Server('ds062797.mongolab.com', 62797, {auto_reconnect : true});
var db = new Db('dummy_info', server);

db.open(function(err, client)
{
  console.log('server running');

  client.authenticate('AdminScott', '6tfc7ygv?', function(err,success)
  {
    if(err)
    {
      console.log('Can not do it', err);
    }
    else {
      console.log('can do it?');
    }
  });

  //find all
  var findDocuments = function(db, callback)
  {
    var collection = db.collection('dUser');

    collection.find({});
  }
});
```

Fig. 3. Server.js Extract

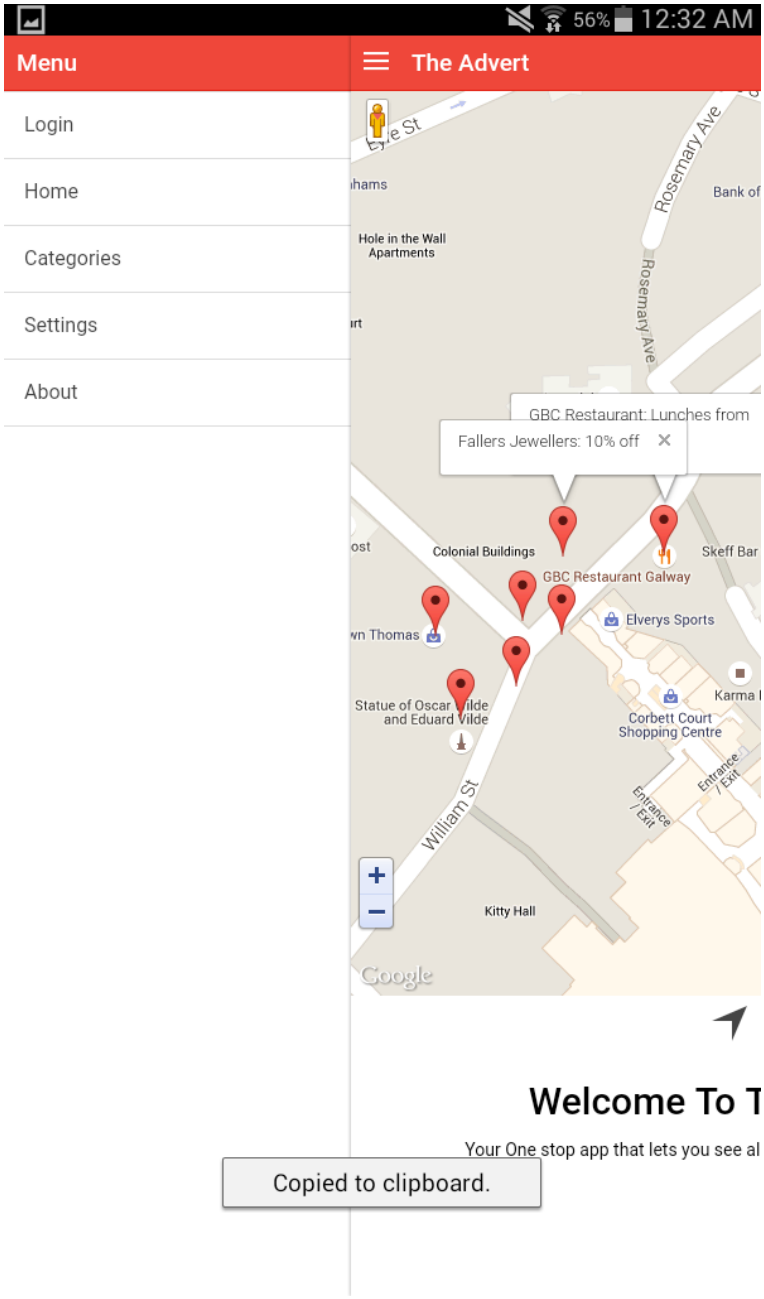
3.1 UML Diagram

3.2 screen Shots

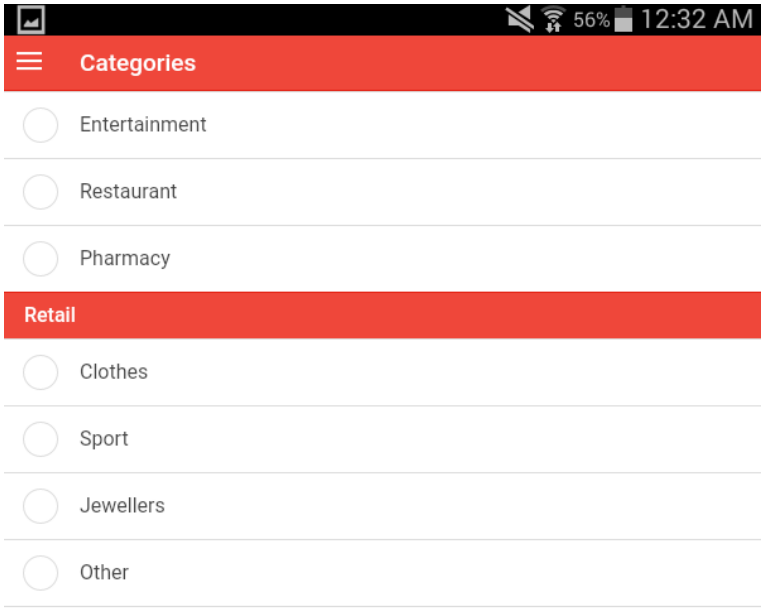




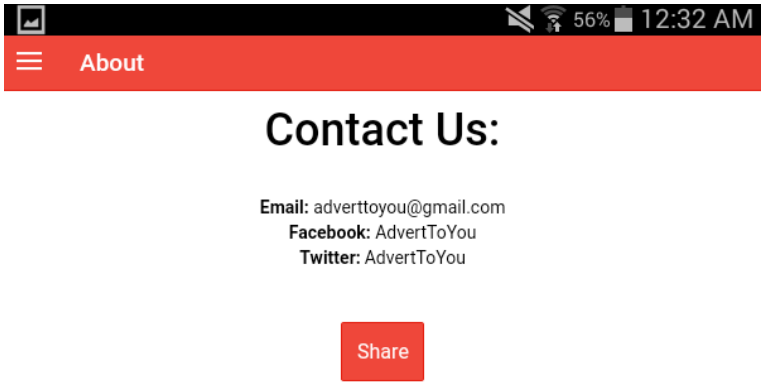
Screen Shot 1. Home Page



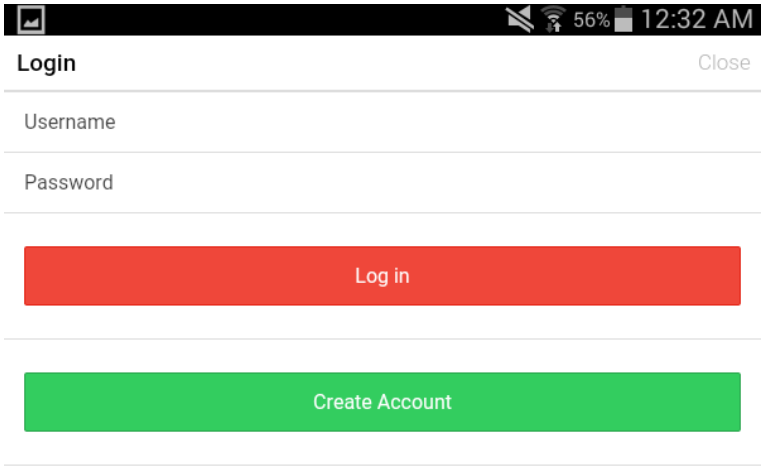
Screen Shot 2. Navigation Panel



Screen Shot 3. Categories Page



Screen Shot 4. About Page



Screen Shot 5. Login Page

4 Software Evaluation

4.1 Testing

For the evaluation of the application, i preformed a functionality test. This form of testing is preformed as a "Quality Assurance" process that is broken down into a subsection, aka Black box testing. With black box testing, it relies on testing the functionality of the application without looking at the internal structure or design of the code. To run this test, I built and ran the project on three end devices:

1. On the laptop, through the Internet browser
2. An Android phone
3. A Windows 8 phone

On the Internet browser, you can not preform all events like you would on a mobile, i.e. In the application, i have a "Share" option which allows the user to share what they have done/got, withe link to thee facebook via social media, texting, email, etc. As the Internet browser goes for debugging, it is efficient for design the front end. i.e. How the it looks aesthetically and it's navigation through pages.
On the Android device, the application preforms the best. But it doesn't mean it didn't have any disadvantages, it is a bit sluggish if loading the UI at the start. As the disadvantages go, the application can run optimally compared to the other devices I tested. On the Windows 8 phone, there was a few functionality issues, this is because of the packages you can download for Ionic in general. i.e. some of the node modules or/and extensions were not compatible to the windows software. This made the application a little glitchy .

5 Conclusion

Context aware applications will always be around weather it's a small feature in an application, to a whole device in itself. GPS is becoming an ubiquitous in the Tech world. As seen in this dissertation, the power that a context aware system can have if done correct. With the introduction of cross platform mobile app's, making application has never been so popular.
My aims were:

Create a GPS project through the cross platform framework Ionic. I created the application using and following their detailed documentation.

Create a database with a NoSQL format, I created a database using MongoDb, a JSON document format database. This creating a quick, scalable database.

And finally to connect the server side and client side together through the application Node.js. his is where constraints were met. Node.js reads the file, locates

the necessary packages, and executes the code. The problems that was encountered was the Node Packet Manager(NPM), failed to download the packages. But the main error i had was the server file could not locate the server the database was located on i.e The Mongolab database.

6 Appendices

6.1 Installation

There are different ways to install the application:

1. Running it through the Git bash
2. Manually putting the .apk file(Android Only)

6.2 Running it through the Git bash

Step 1.
Through the Git bash, locate the project.

```
Scott@SCOTT ~/git/G00282748/code1 (master)
$
```

Step 2.
Depending on how you want to build and run the application there are different ways.
To deploy onto the Internet browser you use this command:

```
Scott@SCOTT ~/git/G00282748/code1 (master)
$ ionic serve
```

To build it for the Android, this will take some time the first time you build it:

```
Scott@SCOTT ~/git/G00282748/code1 (master)
$ ionic build android
```

To build it for Windows phone, this will take some time the first time you build it:

```
Scott@SCOTT ~/git/G00282748/code1 (master)
$ ionic build w8p
```

Step 3.
Once the application has been built, connect the device to the laptop in order for the application to be deployed to device
For Android:

```
Scott@SCOTT ~/git/G00282748/code1 (master)
$ ionic run android
```

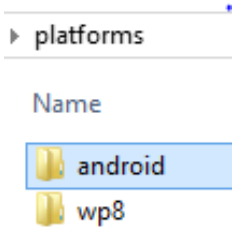
For Windows:

```
Scott@SCOTT ~/git/G00282748/code1 (master)
$ ionic run w8p
```

Step 4. Success, the application to launch and its on your device to use.

6.3 Manually putting the .Apk file(Android Only)

This installation only works for Android only. Step 1. Locate the project folder through the Git bash.
Step 2. Run the command to build the Android platform.
Step 3. In your File Explorer, locate the application folder. In the folder, there will be a new folder created called Platforms. Navigate to it.



There will be the android folder, navigate to it. After this you navigate to the Cordova folder, in there the .apk file will be.
Step 4. Connect the Android the device.
Step 5. Copy the file onto the device.
Step 6. Find and launch the application on device.

6.4 Code Listings

Server.js

```
var mongo = require('mongodb');

var Server = mongo.Server;
var Db = mongo.Db;

var server = new Server('ds062797.mongolab.com', 62797, {auto_reconnect
    : true});
var db = new Db('dummy_info', server);
```

```
db.open(function(err, client)
{
  console.log('server running');

  client.authenticate('AdminScott', '6tfc7ygv?', function(err,success)
  {
    if(err)
    {
      console.log('Can not do it', err);
    }
    else {
      console.log('can do it?');
    }
  });

  //find all
  var findDocuments = function(db, callback)
  {
    var collection = db.collection('dUser');

    collection.find({});
  }
});
```

Controller.js

```
var cntr = angular.module('starter.controllers', [])

cntr.controller('AppCtrl', function($scope, $ionicModal, $timeout) {
  // Form data for the login modal
  $scope.loginData = {};

  // Create the login modal that we will use later
  $ionicModal.fromTemplateUrl('templates/login.html', {
    scope: $scope
  }).then(function(modal) {
    $scope.modal = modal;
  });

  // Triggered in the login modal to close it
  $scope.closeLogin = function() {
    $scope.modal.hide();
  };

  // Open the login modal
  $scope.login = function() {
    $scope.modal.show();
  };
```

```
  // Perform the login action when the user submits the login form
  $scope.doLogin = function() {
    console.log('Doing login', $scope.loginData);

    // Simulate a login delay. Remove this and replace with your login
    // code if using a login system
    $timeout(function() {
      $scope.closeLogin();
    }, 1000);
  };
});

cntr.controller('MapCtrl', function($scope, $ionicLoading) {
  $scope.mapCreated = function(map) {
    $scope.map = map;
  };

  $scope.centerOnMe = function () {
    console.log("Centring");
    if (!$scope.map) {
      return;
    }

    $scope.loading = $ionicLoading.show({
      content: 'Getting current location...',
      showBackdrop: true
    });

    navigator.geolocation.getCurrentPosition(function (pos)
    {
      console.log('Got pos', pos);
      $scope.map.setCenter(new google.maps.LatLng(pos.coords.latitude,
          pos.coords.longitude));
      $scope.loading.hide();
      marker = new google.maps.Marker({
         position: new google.maps.LatLng(pos.coords.latitude,
             pos.coords.longitude),
         message: 'You have created a marker here',
         draggable: false,
         map: map
        });
    }, function (error)
    {
      alert('Unable to get location: ' + error.message);
    });
  };
});

cntr.controller('mongoCntr',function($scope, $stateParams, $http)
```

```
{
   $http.get('/contactList').success(function(response)
   {
      console.log("I got the data requested");
      $scope.contactList = response;
      $scope.contact = "";
   });
});

cntr.controller('feedController', function($http, $scope)
{
   $scope.init = function()
   {
      $http.get("http://ajax.googleapis.com/ajax/services/feed/load",{
         params: {
            "v": "1.0",
            "q" : "http://blog.nraboy.com/feed/",
            "num" : "10"
         }
      })
      .success(function(data)
      {
         $scope.rssTitle = data.responseData.feed.title;
         $scope.rssUrl = data.responseData.feed.feedUrl;
         $scope.ressSiteUrl = data.responseData.feed.link;
         $scope.entries = data.responseData.feed.entries;
         window.localStroage["entries"] =
              JSON.stringify(data.responseData.feed.entries);
      })
      .error(function(data)
      {
         console.log("ERROR: " + data);
         if(window.localStorage["entries"] !== undefined)
         {
            $scope.entries = JSON.parse(window.localStorage["entries"]);
         }
      });
   }

   $scope.browse = function(v)
   {
      window.open(v, "_system", "location=yes");
   }
});

cntr.controller("shareCntr", function($scope, $cordovaSocialSharing)
{
  $scope.shareAnywhere = function()
  {
    //(message, title, image, url)
```

```
    $cordovaSocialSharing.share("Check out the great app Here:
        ","AdvertToYou", null, "https://www.facebook.com/Adverttoyou")
  }
});
```

Home.html

```
<ion-view view-title="The Advert">
   <ion-content scroll="false">
     <map data-tap-disabled="true" on-create="mapCreated(map)"></map>
        <center>
            <a class="button button-icon icon ion-navigate"
                ng-click="centerOnMe()"></a>
        </center>
     <h2>
        <center>
          Welcome To The Advert
        </center>
      </h2>
     <p>
        <center>
            Your One stop app that lets you see all the deals you don't
                know yet!
       </center>
      </p>
    </ion-content>
</ion-view>
```

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