E 322 DESIGN 6 - SMART PARKING SYSTEM

Section 1

Summary of Assignments of Individual Group Members

- **Joany Jores**- *Project overview, GPS Limitations and Solutions*
- **Afiq Izzat Mohamad Fuzi**- *SFPark, GPS System*
- **Mohd Danial Mohd Razemi** - *Further Explanation of the Parking Detection System, Parking Lot Detection*
- **Muhammad Amir Mohd Azmi** - *System Components (Main Components)*
- **Muhammad Syahir Shahimi** - *System Components(Peripherals), Park Smart NYC*

Project Overview

Our project mainly focuses on enhancing the existing parking system by integrating additional modules to the current system. It includes adding more functionality to how the system would work and getting accurate information from the system out to the user. By identifying the problems from current parking system, we came out with ideas that will not only solve the problems but will improve the current system at the same time. For us, quality and accessibility of the system are our main goal. Therefore, in our system, we will be integrating new modules such as GPS and phone applications. These modules would give additional functionality and capability to the current system. In general, the GPS module will be used to identify the exact location of the parking lot in a certain local area. We prefer such module in our system because we are certain that this would help the user to locate the nearest parking lot in a certain local area. Therefore, the user would be able to save their traveling time and gas as well. In addition to that, we are also interested in expanding the GPS capability so that it could be used indoor such as in a parking complex. The stumbling block that we might face is to find the best way to implement this. There are several solutions to this problem as we will addressed them later in the other sections. Furthermore, we are also interested in finding the best method on how to present the information form the system to the targeted user in a much simpler, short and accurate information. For this, we have came out with the idea to create an application based on Android platform because we have seen the ubiquity of such application in the society. Hence, we use this opportunity of the application's availability to far reach all users. The application will be equipped with local layout of the current parking lot and the current status of the parking lot. This would include the availability of parking spaces, its location and the route to which the user should take. In overall, our system should solve all the possible problems not only from the current system but from the future system as well. The implemented system therefore should be user-friendly, easy and fast.

GPS System

GPS uses satellites to determine and lock its position. At least four GPS satellites are needed to calculate the position of a certain GPS receiver. The signals from the satellites (moving at the speed of light) are transmitted at the exact same time but may arrive at the receiver at different time, depending on the distance between the satellites and the receiver. This distance is then used by the receiver to calculate its position in three dimension.

For our project, we have decided to make improvements to enhance the GPS connectivity. The known problem with GPS is that the connection would be lost in indoor places such as in a confined building. To deal with this problem, we have several possible solutions. The first solution is to capture the GPS signal and re-transmit the original signal inside the confined building. Special antenna module will be used to carry out the task. The technique is basically to repeat the signal that is captured outside the building by a special module known as a GPS repeater. This technique should not be a new idea since the availability of such module in the market is well-known. For that reason, we use this availability as our advantage. Moreover, by having this technique, we should be able to re-transmit the captured signal in different spots by using multiple transmitter. Similar techniques but different project objectives are used and explained in the reference work#. More information can be read in this link. Secondly, we also have other alternative to make the GPS works indoors, which is by using an internet connection; either with Wi-Fi or 3G. Basically, the GPS will be assisted (aGPS) by the internet connection in place where there is no satellite coverage. It can supply orbital data for the GPS satellites to the GPS, enabling the GPS receiver to lock to the satellites with more accuracy. In addition, there will be a built in application in the GPS that contains pre-loaded maps for each outdoor and indoor parking area (for example, Walmart or Best Buy).

Usually indoor parking has several levels. To integrate parking system in GPS by using satellite is quite impossible because it does not know the exact level of the car. To overcome this, the GPS will be installed with wi-fi receiver. When the car enter the hotspot location, the GPS will automatically connect to the wi-fi. Wi-fi will locate the location of the car and at the same time provide the local map (map of the parking location) to the GPS so that the GPS will not have to download maps of every buildings that are using this system.

System Components

Main components:

1. **Central Controller Unit (CCU)**

- Central controller of parking guidance system. Main module in the system.
- Responsible for data collecting and data processing.
- Gets information from Zone Controller Unit (ZCU) and sends feedback to peripherals.

2. **Zone Controller Unit (ZCU)**

- Zone Control Unit of parking system. The LCD in ZCU is to show the detector's work status.
- Main function is to request information from the UD sensor, and send the data to CCU.

Peripherals:

1. **Ultrasonic Sensors**

- An ultrasonic proximity sensor will be placed on the pavement (for outdoor parking) and on the parking spot (for indoor) for each individual parking space.
- When this sensor is blocked within a particular time limit (15-30 seconds), it will register that a vehicle is parked. The sensor will send this information to the server. The server then change the status of that particular parking space as 'occupied'
- When the sensor is not blocked within a particular time limit (2-3 minutes), it will assume that there is no vehicle in that parking space. This information will be sent to the server and the server will change the status of that parking space to 'available'
- All these information can be viewed via the parking application in the GPS
- This method requires a lot of sensors. It would be quite difficult and costly to set these sensors at every place.

2. Cameras

- Several small towers equipped with digital cameras will be placed at the parking lot. These cameras will capture images at regular intervals.
- The images are then sent to the server. By comparing the images taken at different time, the server will be able to determine the status of the parking spot.
- The status of each parking spot will be displayed in the application.

Further Explanation of the Parking Detection System

- In the parking detection system, it will use Ultrasonic Detector (UD) as one of the main part of parking guidance system which will detect the parking space and transfer the information/message to Zone Control Unit (ZCU).
- Then, the ZCU will collect the data/message and send it to central control unit (CCU); CCU processes these data and sends the relevant command to specific PCs or other relevant equipment (e.g GPS Navigation System or mobile phone with GPS capabilities)
- The GPS will display the information received and aid the drivers to a parking spot.

Section 2

Related Works

1. Parking Lot Detection

The parking lot detection is a project as a part of Smart Parking System. It has been developed by Jake Reisdorff, Aldo Arizmendi and Jason Armstrong under the supervision of Dr. Sharad Seth in School of Computer Science & Engineering at University of Nebraska-Lincoln (UNL). The objective of the project is to provide a parking garage detection that is accessible to appear in mobile website as apart of mobile application. The project involves three distinct functions.

Specifically, the first function is capturing an image from the parking garage using a digital camera. The second function is by comparing the current image taken against an earlier version to verify that a vehicle occupies the parking space. They use a mounted camera in the garage to take images from a static position, and send to a web server. The third function is the web server will detect the available parking spaces by running an image processing. Then, after determining vehicle absence or presence, a server will update the database server through a data stream containing an array representing a row of parking spaces and their availability to park status. Based on the data taken from the web server, the website application will determine the total number of available parking spaces. The website application also will show a map of parking garage with availability information.

There are some important hardware uses in this project. The first hardware is a camera- Logitech Webcam Pro 9000. The camera offers USB connectivity to the microprocessor. It also provides auto-focus technology and can be controlled using the SDL image acquisition for the Ubuntu operation system. The second hardware is Microprocessor- (BeagleBoard + Wifi Adapter) which is used to provide communication between the camera and the server. The system will use Ubuntu to process images and send the result to WiFi adapter. Then, the Wifi adapter will use UNL's network to transfer data to the server. Lastly, the important hardware use in this project is the Server. by using this hardware, the system of the project will have interconnection to the server. The dynamic user interface of the server will have a picture of the garage floor and a map of parking garage with availability information.

2. Park Smart NYC

This is one of the projects in the Big Apps Competition held in 2010. It was developed by Erin Moore and Chris Fahey. Basically this parking system relies on a smartphone's built-in GPS and a specific mobile application. First, the user needs to take a picture of the spot that they want to park their vehicle. This is to verify whether it is legal or not to park there. A confirmation message will be received via the mobile application. The user will also be able to 'check-in' in that particular spot and this will make it easier for them to know the exact location of their parked vehicle. In addition, the mobile application also allows the user to set reminders or alerts to notify them when their parking time is almost up. The users can also write reviews about the parking place, which can be viewed by other users. Since the alert/notification feature is quite useful, our group might implement this feature in our smart parking system.

3. SF Park

SFpark is a project established by San Francisco Municipal Transportation Agency (SFMTA) in collaboration with various organizations and individuals. This system collects and distributes real-time information about the availability of a particular parking spot. It also uses a demand-responsive pricing to redistribute parking demand and reduce the need for circling or double parking. In comparison with our project, we use a fixed, flat-rate pricing in our system. SFpark parking system includes sensors located at each parking spot to locate empty spots. For metering system, SFpark offers variety of paying option which includes coins, SMTFA parking cards, credit and debit cards and pay by phone. To make the system more user friendly and efficient, SFpark creates applications software that can be used by smartphones and computers.

4. Urbiotica

Urbotica is a company that develops their own smart parking system which they called "The City Operating System". It is a company based in Barcelona, Spain. Their system is fairly simple and easy to manage and almost similar to what our group is planning to create. The system is basically consisted of a 1-1/2-by-5-inch battery-powered sensor that is embedded in the asphalt. Each sensor embedded has an optical detector which will notice when the space above the sensors suddenly darkens. To make the sensor much more efficient and useful, they add a magnetic field detector which confirms that the shadow is been produced by a metal vehicle rather than a passing cloud or pausing pedestrian. This information is little but crucial to our group since none of the member ever think of the simple problem that will occur if we were to use optical detector only.

Then, the information from both the optical and magnetic detector are sent out via a radio-frequency signal to a data collector which is placed on a common features on the streets such as lampposts and utility poles. These transceivers receive signal from roughly a dozen spaces and send out the information to a central database. The central can send the data to parking administrators, electronic billboards, or even drivers' smartphones.

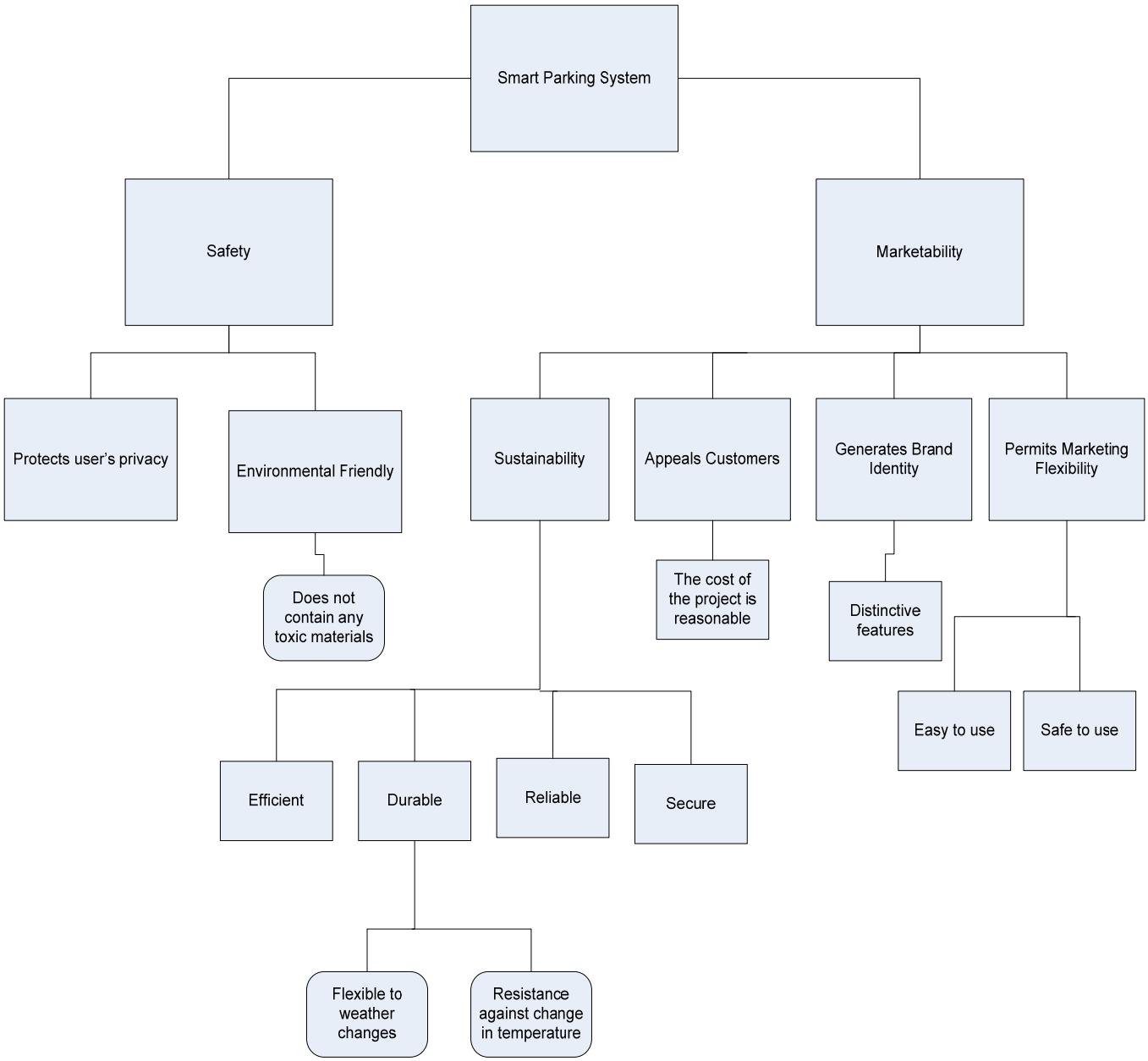
Other than parking system, Urbotica implement this system in waste management solution, green areas solution, and public lighting solutions. This shows that there are a lot of other potential systems that can be developed with this type of system.

Section 3.

Realistic constraints and professional/ethical responsibilities:

- Environmental friendly → safety
- Inexpensive to produce → permits marketing flexibility
- Easy to use → appeals customer
- Perceived as safe → appeals customer
- Secure → sustainability
- Permits marketing flexibility → marketability
- Generates brand identity → marketability
- Durable → sustainability
- Flexible to weather changes → durable
- Distinctive features → generates brand identity
- Reliable → sustainability
- Easy to use →appeals customer
- Environmental benign → appeals customer
- Efficient → sustainability
- *Does not contain toxic material*→ *constraint on* environmental friendly
- Does not invade privacy → safety
- Sustainability → marketability
- Appeals customer → marketability

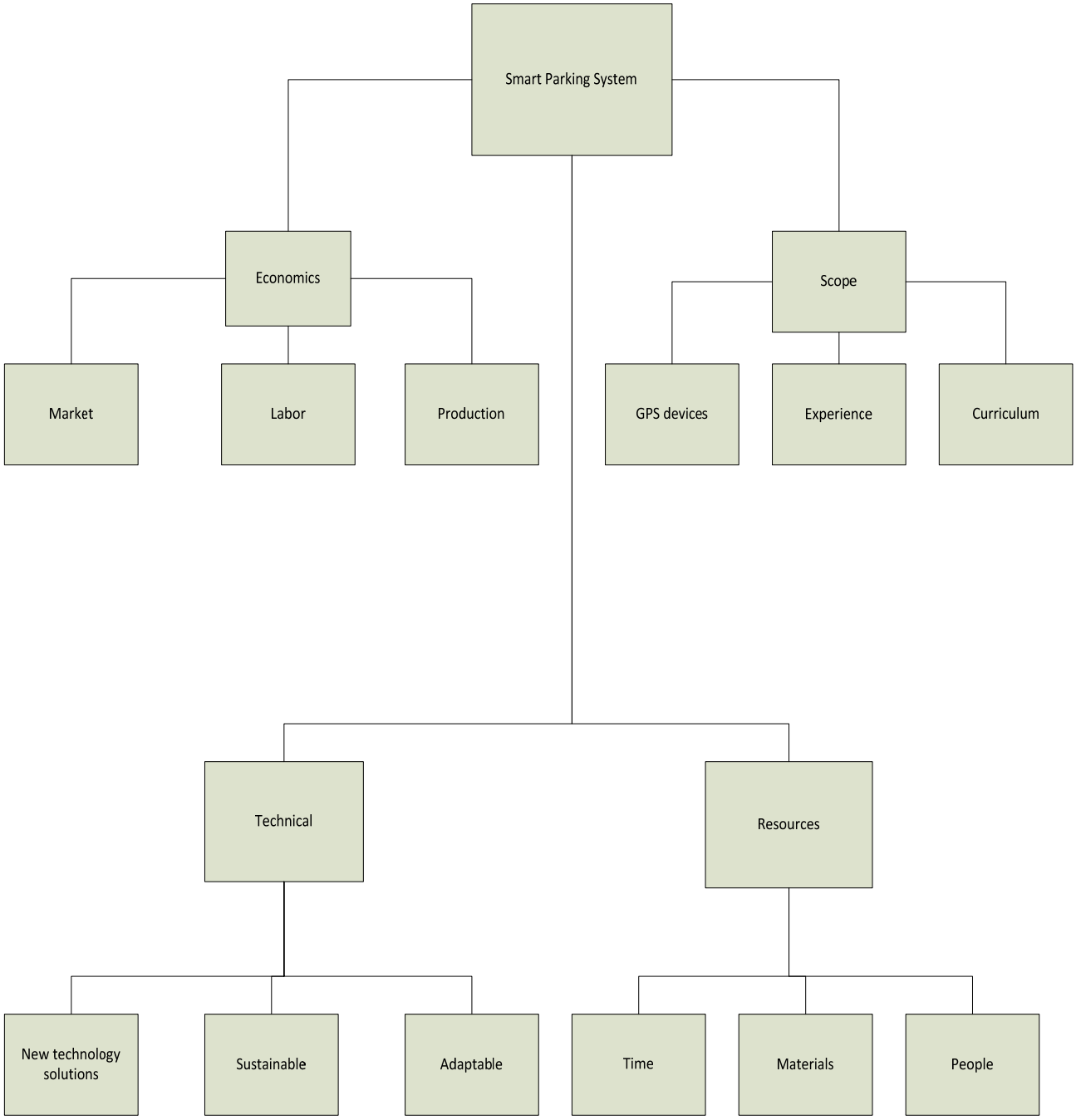
Section 4.


Smart Parking System
Safety
Marketability
Protects user's privacy
Environmental Friendly
Sustainability
Appeals Customers
Generates Brand Identity
Permits Marketing Flexibility
Does not contain any toxic materials
The cost of the project is reasonable
Distinctive features
Easy to use
Safe to use
Efficient
Durable
Reliable
Secure
Flexible to weather changes
Resistance against change in temperature

Object Attributes and Attribute List

- Market → economics
- Time → resources
- Labor → economics
- Production → economics
- People → resources
- Sustainable → technical
- Curriculum → scope
- Experience →scope
- Adaptable → technical
- New tech applications → technical
- Material → resources

Smart Parking System objective tree:



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“How GPS Receivers Works” *howstuffworks.* Web. 12 Feb. 2012
<http://electronics.howstuffworks.com/gadgets/travel/gps.htm>

Sensors:
http://www.alibaba.com/product-gs/486654318/TUS_100_Ultrasonic_Vehicle_Detector.html

Other links:
ZPU,CCU system:
http://www.ssspl.org/uploads/Products/Pdf/ParkingGuidancesystem.pdf
http://www.bikudo.com/product_search/details/292037/car_parking_system_led_display.html