EzPARK
Vehicle and Empty Spot Finding System

Business Plan

Prepared by:
Sinem Coleri
Mustafa Ergen
Armel Long
Murat Ozalp
Young Shon

http://www.eecs.berkeley.edu/~ergen/EZPARK/index.htm

Table of Contents

List of Figures and Tables

Mission Statement

EzPARK is a low-cost, wireless parking lot infrastructure that enables the customers to see the empty spaces at the entrance, and leads them to their vehicles on their way back.

Executive Summary

Parking has always been one of the major setbacks of customer satisfaction at big shopping malls, theme parks, airports etc. Especially during peak hours, weekends and holidays, the lines forming in and out of the parking lots are a significant source of frustration and inconvenience for customers. Surveys show that about 20% of customers have second thoughts going shopping during the peak times just because of the parking problem. Besides, among those who do go to the mall, many complain that so much time is lost in the parking lot that they have to cut from their shopping time to stay within their schedules.

It turns out with an efficient, automated parking system, which can (1) increase customer satisfaction, (2) minimize the time lost in parking and (3) eliminate the need for any attendants; shopping malls' revenues could go up as high as 5% per fiscal year.

EzPARK is a low-cost, wireless parking lot infrastructure project, which addresses all the issues mentioned above. This infrastructure will use the new wireless MOTE technology to detect the presence of vehicles in the parking spots and direct the incoming customers to the closest empty spots via a graphic user interface located at the entrance. The system will use disposable RFID tags to identify each vehicle and will be able locate the exact position upon the return of the customer. This way, the customers will not have to spend time to look for empty spaces, nor will they have to walk around trying to figure out where they had parked their vehicles. Since the EzPARK system is wireless and fully automated, it will eliminate the need for parking attendants and significantly reduce installation costs.

The research and development team working on his project will consist of 5 specialists; 2 computer programmers, 1 electrical engineer (MOTE expert), 1 mechanical engineer, and 1 materials expert. The preliminary coding will be done in Visual C++, TCL, TinyOS and 3D Studio Max, which can easily be converted to Java, if need be. The team will be able to develop a custom system within a 6-month time frame, and due to the wireless nature of the system, it will not take more than a week to install it to a parking lot. The estimated total production costs for the first year will be around $1,000,000. In case the system achieves the expected sales forecast (~10% market share at the end of 5 years), the company will begin profiting at the end of the second year and the profit margin at the end of five years (cumulative) will reach ~$6 million.

Key Facts about Parking Problems:

- Surveys show that about 20% of customers have second thoughts before going shopping on busy days just because of the heavy traffic and parking problems.
- Customers complain that searching for empty spots in huge parking lots often takes too much time and causes too much stress.
- Most customers complain about getting lost in the huge parking lots on their return.
- Extra parking personnel hired on holidays do not really solve the problem; plus they are expensive.
- Especially in the case of large malls, time lost in the parking lot has to be made up during shopping. Thus they end up buying only things they need, and do not have time to look around. (Surveys show that about 35% off all items purchased at malls are "off-the-list" items.)

Conclusion:

Inefficient parking does cause a significant reduction in potential revenue. With effective organization, revenues could go up as high as 5% per year. Besides, in today's severe competition for market share, customer satisfaction plays a vital role in determining which companies survive and which ones don't. Providing better service before anyone else could give a company significant advantage over its competitors.

The Solution: EzPARK

Background on MOTEs

A MOTE is basically a sensor node that can connect to other nodes or a central computer via a wireless connection. A sample design with several built-in sensors can be seen in Figure 1.

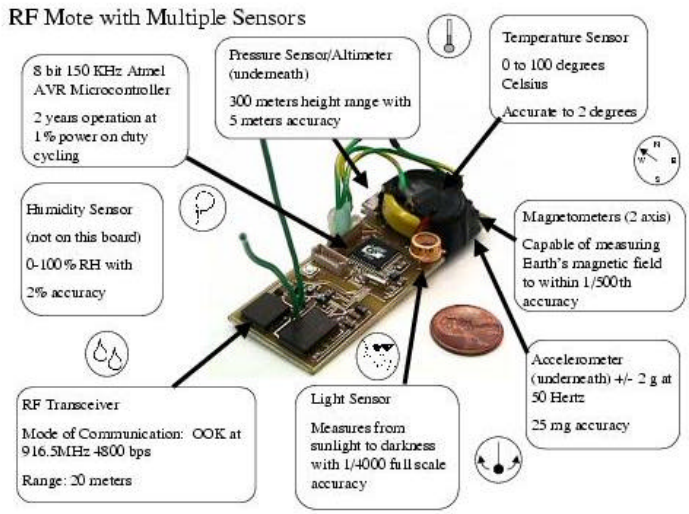

Figure 1. RF (Radio Frequency) MOTE with multiple built-in sensors.[1]

[1] From the website of Seth Hollar, http://bsac.eecs.berkeley.edu/~shollar/webthesis/formthe129a.html

The current built-in sensors in the MOTEs (magnetic or infra-red) will be sufficient to detect and recognize both the cars and the RF ID tags.

The MOTEs are still at an experimental stage, and currently are not mass produced. This does seem to increase their unit price a bit. On the other hand, since a successful implementation to a real life project would be a great advertisement for the developers (BMI), we have managed to get a very convenient price for experimental usage. By the time the whole infrastructure will be implemented (in about 5 months), mass production will also have begun and each MOTE will cost us about $10-15. The developers have also agreed to send us 2 MOTE experts, whose salaries will be paid in full by them.

Product Description

EzPARK is a low-cost, wireless parking lot infrastructure that enables the customers to see the empty spaces at the entrance, and leads them to their vehicles on their way back.

The Infrastructure:

- Each parking spot will have a MOTE capable of detecting (via magnetic sensors) and recognizing (via RF ID tags) a vehicle. The MOTEs will be communicating to a central computer, which will keep track of the time and location of parked cars.
- There will be an RF ID tag dispenser and a graphic user interface at each entrance. The dispenser will issue the tags (identifiers) and the interface will show the locations of the current empty spots.
- Exits from the mall into the parking lot will have a separate graphic user interface and a voice-recognition software, again connected to the central computer, showing the customers the locations of their vehicles.

The Principle:

Below is a simple representation of the system…

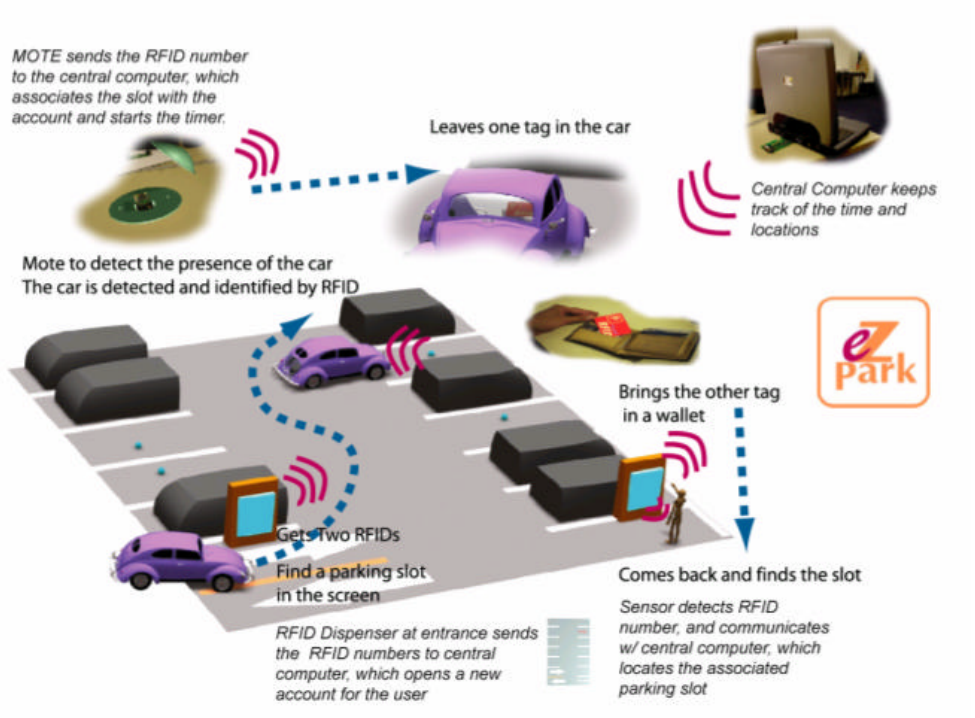

Figure 2. Representation of the EzPARK system

Almost everyone is familiar with the magnetic ticket dispensers at the entrance of parking lots. Our product will be similar in principle, only the system will prompt the users to swipe their credit cards to get the necessary information for charging[?] and it will issue 2 RF ID tags per user instead of one magnetic ticket. One card will belong to the driver and the other to the vehicle. Each card will have a unique identification number and thus the system will be able to recognize the vehicle and the driver separately. Upon issuing of the cards, the graphic user interface at the entrance will show a layout of the parking lot and hint the customer to an empty spot.

Once the car is parked at a spot, the MOTE sensor at the spot will detect the presence of the car and will read and transmit the RF ID tag number to the central computer. The driver will take the RF ID tag labeled "Driver", and leave the one labeled "Vehicle" in the car.

The exits from the mall into the parking lot will have another type of graphic user interface; once the boot detects the RF ID tag ("Driver") from the customer, it will communicate to the central computer and display the location of the associated vehicle ("Vehicle"). In case the driver somehow loses or forgets the RFID tag somewhere, there will be an alternate voice-recognition program, which will be able to recognize the first and last name of the driver and display the location of the vehicle.

Benefits:

- The EzPARK system will significantly reduce the time spent in parking lots and will increase customer satisfaction.
- Wireless nature of the MOTEs will get rid of labor and wiring costs.
- The system will eliminate the need for parking attendants.
- Premium parking and subscription services will provide extra convenience to willing customers, while increasing revenue from the parking lot.
- MOTEs and RF ID tags will provide a cheap, easily replaceable solution.
- Due to the advanced software and hardware capabilities, there is no size or capacity limitation for the parking lots that can be installed with EzPARK.
- None of the other current products address all of the issues EzPARK covers, neither are they as cost-effective.

Implementation

The Design Team

EzPARK Corporation consists of a talented and dedicated group of engineers, who are still involved in several research projects with the University of California, Berkeley. The following 5 specialists will be working to finalize the EzPARK Vehicle and Empty Spot Finding System:

- Mustafa Ergen, *Project Manager and Chief Engineer*
- Murat Ozalp, *Development and Design Engineer*

[?] For those customers without a credit card, a separate ticketing machine that works with cash could be installed upon request.

- Sinem Coleri, *Electrical Engineer*
- Young Shon, *Software Specialist*
- Armel Long, *Mechanical Engineer*

Mustafa Ergen, *Project Manager and Chief Engineer* – Mr. Ergen is a 4th year Ph.D. student at the Electrical Engineering Department at the University of California, Berkeley. He also has access to the Berkeley Wireless Research Center (BWRC). His research focuses on wireless and cellular networking and software development. He is currently in charge of the design for the voice recognition system of EzPARK.

Murat Ozalp, *Development and Design Engineer* – Murat Ozalp is a recent graduate from the Mechanical Engineering Department at the University of California, Berkeley. His area of expertise is on MEMS, NEMS and CAD design. He will be working on the design and implementation of the hardware for EzPARK.

Sinem Coleri, *Electrical Engineer* – Sinem Coleri is also a 4th year Ph. D. student at the Electrical Engineering Department at the University of California, Berkeley. Her area of expertise is on sensor networks and she is the MOTE expert of the EzPARK design team.

Young Shon, *Software Specialist* – Young Shon is a 3rd year Mechanical Engineering Graduate student at the University of California, Berkeley. His current research is on virtual reality, computer-human interaction and CAD design with Professor Sara McMains. He is working on the implementation of the software and graphic user interface design of EzPARK.

Armel Long, *Mechanical Engineer* – Armel Long is a 1st year Mechanical Engineering graduate student at the University of California, Berkeley. His topic of interest is CAD design and past achievements include several CAD projects back in France. He will also be responsible for the implementation and testing of the hardware components of EzPARK.

Project Timeline

The EzPARK team is confident that given the necessary financial support, we will be able to develop a custom system within a 6-month time frame. Due to the wireless nature of the system, it will not take more than a week to install it to a parking lot.

The figure below outlines the production and implementation timeline for the complete product.

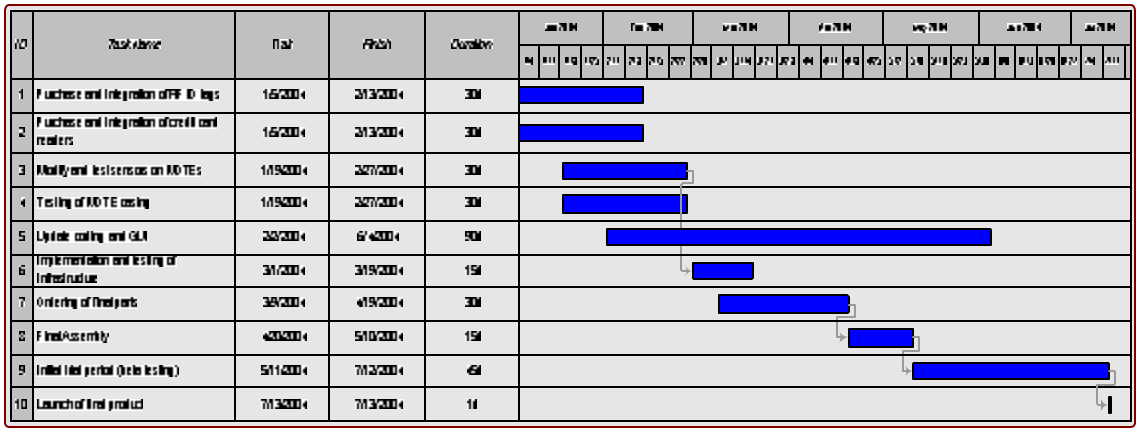

Figure 3. Project Timeline

Industry Overview

Analysis of Automobile Parking Industry

The US private parking market is estimated about a **$30 billion/year** ($26.5 billion in 1998), with about 3-4 major companies claiming a little more than 60% of the market. In 1998, the total number of private parking spaces was approaching **5 million** in a total of 16,000 parking lots. Of the 16,000 parking lots, about 50% consist of lots with 500+ spaces. Considering the ever increasing growth rate of the automobile industry and sales, this number is expected to double itself in the next five years.

Current Market Trends

Recent trends are looking to make use of the advancing technologies in sensors and communications to improve the efficiency in parking. More and more parking lots are now being equipped with systems that show the number of empty spots; enable online reservations and payments via smartcards. Several of the world's biggest companies, such as Siemens, are trying to come up with systems to more efficiently track empty spaces and integrate payments with the available mobile networks (mostly GSM).

Market Breakdown

The ownership and management of most private parking lots belong to the 4 major competitors in the market; Central Parking Corporation (CPC), Ampco System Parking (ABM), Imperial Parking Corporation and VINCI.

Central Parking Corporation holds about 25% of the whole market after merging with a lot of the smaller local companies. CPC growth rate alone in the last five years has been around 25%. Following CPC is Ampco System Parking, which is mostly dominant in California. Imperial Parking has about 1,600 parking lots compared to Central Parking's 3,800, but has been to grow in the recent years. Below is a chart to emphasize the market breakdown of the parking industry in the US.

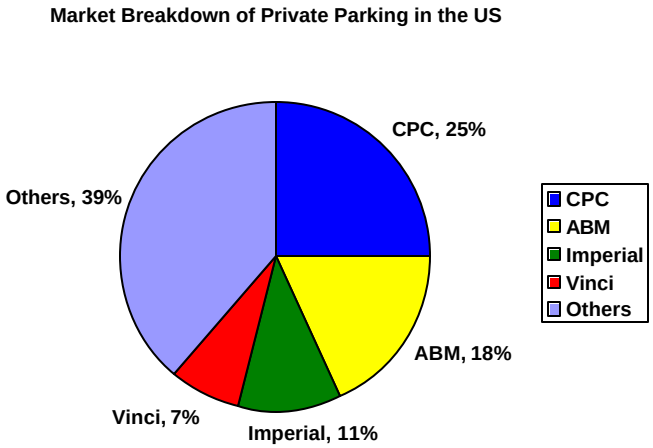

Figure 4. Market breakdown of parking in the US (Houston Chronicle)

EzPARK Corporation's Position in the Market

EzPARK Corporation is a recently established start-up company, who just focuses on developing advanced technology parking products rather than getting involved in the management aspect of the business. Thus the objective of EzPARK Corporation is to work in collaboration with companies like CPC, Ampco Systems Parking or Imperial Parking to further develop and implement its EzPARK Vehicle and Empty Spot Finder System to some of the biggest parking lots in the nation. EzPARK Corporation will act as a sub-supplier to these companies and will only install the MOTE infrastructure and the EzPARK software that contains the user interfaces and establishes network communications. Infrastructure such as LCD displays, RF ID dispensers, gates and the computer hardware will be assumed to be supplied by these companies.

Competitors

EzPARK's advantage to most of its other competitors, who also produce new technologies (i.e. Siemens, Siber Parking, etc.), is its low-cost wireless solution parking solution. None of EzPARK's competitors can offer the level of sophistication and convenience even though they are more expensive to install.

Most of the parking lots today are just equipped with systems that show the number of empty spots, but often times these numbers are not updated accurately. Only a few parking lots in the US have the necessary infrastructure to track the empty spaces (i.e. Washington DC Airport's parking lot), but none of the current products enable the customers to see the empty spaces at the entrance, and lead them to their vehicles on their way back.

Recently Siemens is coming up with a vehicle locating system; Sicalis RTL (Real Time Locating), which will be used to track the vehicles coming into the parking lots. The product uses another Siemens invention Moby R for identification, and seems to be the only significant competitor of the EzPARK system. However, even though this system seems to present similar capabilities to EzPARK, its tracking resolution is only as well as 3 meters. This makes it impossible to track the exact location of a vehicle in a parking lot and would only be able to suggest the whereabouts. To provide an accurate grid of the empty spaces, a much more accurate locating scheme would be needed, which only the EzPARK infrastructure can provide.

Future Markets

EzPARK's tracking functions can be applied to various industries in the future such as tracking empty shelves in warehouses or tracking containers in large port facilities.

Financial Analysis

EzPARK Corporation estimates that reaching 10% market share at the end of a 5-year period would be reasonable start point for the company. This corresponds to installing the system to nearly 1000 parking lots by the end of 2007. The below table summarizes expected, worst and best case sales scenarios in terms of sales.

	2003	2004	2005	2006	2007	TOTAL
Number of EzPARK Systems installed	**20**	**100**	**200**	**300**	**400**	**1020**
Best	50	250	500	750	900	2450
Most likely	20	100	200	300	400	1020
Worst	5	25	50	75	100	255

Table 1. Sales Volume Assumptions

As a result of the above assumptions, below is a 5-Year Profit/Loss Forecast for EzPARK. For more details associated with prototyping, manufacturing, management and administrative costs and analysis, and further best and worst case 5-year forecasts please see tables in Appendix A.

5-Year Profit/Loss Forecast (Expected)

	2003	2004	2005	2006	2007
Sales Price	$ 42,000.00	$ 37,000.00	$ 32,000.00	$ 28,000.00	$ 25,000.00
Number of Systems Sold	20	100	200	300	400
Net Sales	$ 840,000.00	$3,700,000.00	$ 6,400,000.00	$ 8,400,000.00	$10,000,000.00
Cumulative Net Sales	$ 840,000.00	$4,540,000.00	$10,940,000.00	$19,340,000.00	$29,340,000.00
Variable Manufacturing Cost/System	$ 13,500.00	$ 11,850.00	$ 10,505.00	$ 9,406.50	$ 8,507.45
Cost of Product Sold	$ 270,000.00	$1,185,000.00	$ 2,101,000.00	$ 2,821,950.00	$ 3,402,980.00
Gross Margin	$ 570,000.00	$2,515,000.00	$ 4,299,000.00	$ 5,578,050.00	$ 6,597,020.00
% Gross Margin	68%	68%	67%	66%	66%
Start-up Cost	$ 298,090.00	$ 65,000.00	$ 65,000.00	$ 85,000.00	$ 65,000.00
Payroll	$ 420,000.00	$ 462,000.00	$ 508,200.00	$ 559,020.00	$ 614,922.00
Sales Expenses	$ 84,000.00	$ 370,000.00	$ 640,000.00	$ 840,000.00	$ 1,000,000.00
Rent	$ 30,000.00	$ 33,000.00	$ 36,300.00	$ 39,930.00	$ 43,923.00
Professional Fees	$ 50,000.00	$ 55,000.00	$ 60,500.00	$ 66,550.00	$ 73,205.00
Marketing	$ 109,200.00	$ 481,000.00	$ 832,000.00	$ 1,092,000.00	$ 1,300,000.00
Other	$ 67,200.00	$ 296,000.00	$ 512,000.00	$ 672,000.00	$ 800,000.00
Total Operating Expenses	$1,058,490.00	$1,762,000.00	$ 2,654,000.00	$ 3,354,500.00	$ 3,897,050.00
Pretax Profit	$(488,490.00)	$ 753,000.00	$ 1,645,000.00	$ 2,223,550.00	$ 2,699,970.00
% Profit	-86%	30%	38%	40%	41%
Cumulative Profit	$(488,490.00)	$ 264,510.00	$ 1,909,510.00	$ 4,133,060.00	$ 6,833,030.00

Table 2. 5-Year Profit/Loss Forecast (Expected)

Assumptions:

- Each parking lot is estimated to have 500 spaces for all calculations
- Corporate income tax effects ignored
- Sales expenses are assumed to be 10% of net sales
- Marketing expenses are assumed to be 13% of net sales
- Extra expenses (other) are assumed to be 8% of net sales

Engineering Analysis

Equipment

The EzPARK system requires the below components to be installed in a parking lot:

- MOTE infrastructure
  - MOTEs
  - Protective MOTE casings mounted at the floor
- RF ID dispensers at entrances
- Electronic gates compatible with networking applications
- LCD displays at several locations inside the parking lot to display directions and parking lot grid
- Credit card readers at entrances
- Voice recognition system with noise canceling microphones at each customer entrance

EzPARK Corporation will act as a sub-supplier to the parking management companies and will only install the MOTE infrastructure and the EzPARK software that contains the user interfaces and establishes network communications. The rest of the above infrastructure will be requested to be supplied by the companies themselves.

Protective MOTE Casing Design

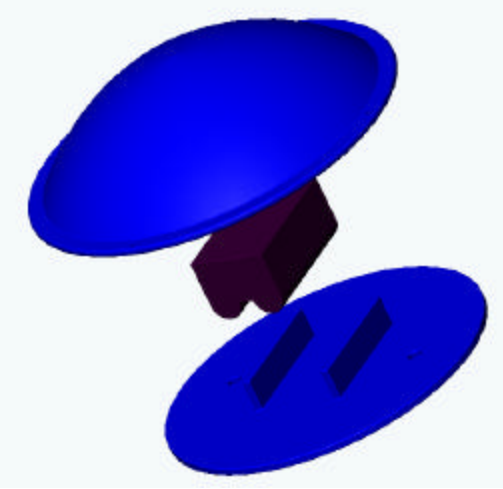

Figure 5. MOTE Casing Floor Piece

Above is the design for the protective MOTE casing for the EzPARK parking infrastructure. These parts will be installed to the floor on each parking slot and will detect and identify vehicles coming in and out. The MOTE itself will be placed in between the ribs on the bottom plate and will have a magnetic sensor to detect the presence of a vehicle and an RF-ID reader to identify the specific tag the vehicle carries.

Installation of the parts will be pretty straightforward. The bottom plate is press fitted to the upper dome piece. The holes at the bottom plate are designed to make disassembly easier. Once the parts are fitted together, the whole casing will then be installed to the holes driven in the floor via screws. The screw size and accuracy are not vital since vertical movement will not be that big an issue. The primary goal of screwing the casing to the floor is to prevent lateral displacement of the casing due to external forces.

Injection Molding Analysis

Both the upper dome piece and the bottom holder piece are designed to be compatible with injection molding design rules.

The dome shape of the upper piece will provide easy flow of the plastic into the mold, which will enable faster fabrication and will reduce the number of scrap pieces. This will significantly cut down on time and cost during manufacturing.

The holes for the screws are far enough from the edges to be well molded; those areas around the screws will not be as robust as the rest of the piece because of the “welding”. However this is not crucial to the robustness of the part.

The bottom casing will not present any difficulty either. However the “ribs” used to keep the MOTE in place will have to be drafted in order to make extraction of the piece easier. To be sure to fill these walls the flow of the incoming polymer could be split in the sprue into two “feeders” just above each wall. When the polymer solidifies a mark below the bottom part might form, but this would be only an aesthetics issue, and as this face will be against the floor it will be well hidden.

The kind of polymer or copolymer that will be used is not determined yet. The material has to be hard as well as tough, so as to stand the pressure if a vehicle runs over it. On the other hand the material also has to be moldable, which suggests toward using thermo-sets. The most likely candidate is a copolymer of ethylene-propylene (used in fabrication of bumpers), but it would be best to contact a materials expert before making any final decisions.

Appendix A: Tables and Figures

Prototype and Development Costs

The prototype costs include design of infrastructure and compatible software, building of a 10 car model parking lot for testing and two casing designs for floor parts. Also included are costs for molding the original floor pieces and on-going research and development costs for the next 5 years.

	Unit Amounts (Estimate)	Unit Cost	2003	2004	2005	2006	2007	TOTAL
Prototype and Development Costs			**$ 223,090.00**	**$50,000.00**	**$50,000.00**	**$50,000.00**	**$50,000.00**	**$ 423,090.00**
Materials			**$ 2,290.00**					**$ 2,290.00**
Mote	10	$ 135.00	$ 1,350.00					$ 1,350.00
Sensor Package (Magnetic, RF ID)	10	$ 65.00	$ 650.00					$ 650.00
Batteries	20	$ 1.00	$ 20.00					$ 20.00
Base Station	2	$ 135.00	$ 270.00					$ 270.00
Equipment/CAD cost		$ 10,000.00	**$ 10,000.00**					**$ 10,000.00**
Casing Prototyping			**$ 800.00**					**$ 800.00**
Fused Deposition Modeling	2	$ 300.00	$ 600.00					$ 600.00
Z-Corp Machine	1	$ 200.00	$ 200.00					$ 200.00
Labor and Testing	2	$ 80,000.00	**$ 160,000.00**					**$ 160,000.00**
Other development costs		$ 50,000.00	**$ 50,000.00**	**$50,000.00**	**$50,000.00**	**$50,000.00**	**$50,000.00**	**$ 250,000.00**

Table 3. Prototyping and Developing Costs

Mass Production Costs

Initially each MOTE can be purchased for about $135, but once mass production is underway with Silicon chips, the price will expectedly to go down to about $5 per MOTE (already a smaller, cheaper version named “SPEC” has been manufactured by the university). A MOTE package including the casing, additional sensors and the battery pack should not exceed **$10** in total.

	Unit Costs					2003	2004	2005	2006	2007	TOTAL
	2003	2004	2005	2006	2007						
Mass Production Costs						**$ 270,000.00**	**$ 1,185,000.00**	**$ 2,101,000.00**	**$ 2,821,950.00**	**$ 3,402,980.00**	**$ 9,780,930.00**
Number of EzPARK systems sold						20	100	200	300	400	1020
Materials	$ 15.00	$ 12.20	$ 9.96	$ 8.17	$ 6.73	$ 160,000.00	$ 660,000.00	$ 1,096,000.00	$ 1,375,200.00	$ 1,546,880.00	$ 4,838,080.00
Mote	$ 5.00	$ 4.00	$ 3.20	$ 2.56	$ 2.05	$ 50,000.00	$ 200,000.00	$ 320,000.00	$ 384,000.00	$ 409,600.00	$ 1,363,600.00
Sensor Package (Magnetic, RF ID)	$ 4.00	$ 3.20	$ 2.56	$ 2.05	$ 1.64	$ 40,000.00	$ 160,000.00	$ 256,000.00	$ 307,200.00	$ 327,680.00	$ 1,090,880.00
Batteries	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 1.00	$ 20,000.00	$ 100,000.00	$ 200,000.00	$ 300,000.00	$ 400,000.00	$ 1,020,000.00
Base Station	$ 5.00	$ 4.00	$ 3.20	$ 2.56	$ 2.05	$ 50,000.00	$ 200,000.00	$ 320,000.00	$ 384,000.00	$ 409,600.00	$ 1,363,600.00
Assembly Labor	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 50,000.00	$ 250,000.00	$ 500,000.00	$ 750,000.00	$ 1,000,000.00	$ 2,550,000.00
Manufacturing Cost	$ 5.00	$ 4.50	$ 4.05	$ 3.65	$ 3.28	$ 50,000.00	$ 225,000.00	$ 405,000.00	$ 546,750.00	$ 656,100.00	$ 1,882,850.00
Shipping Cost	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 5,000.00	$ 25,000.00	$ 50,000.00	$ 75,000.00	$ 100,000.00	$ 255,000.00
Warehousing Cost	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 0.50	$ 5,000.00	$ 25,000.00	$ 50,000.00	$ 75,000.00	$ 100,000.00	$ 255,000.00

Table 4. Mass Production Costs

Assumptions:

- Each parking lot is estimated to have 500 spaces for all calculations
- Unit costs of MOTEs and sensor packages are assumed to drop by 20% annually

Management and Administrative Costs

Management and administrative costs include legal and accounting issues related to managing the company.

	2003	2004	2005	2006	2007	TOTAL
Management and Administrative Costs	**$ 1,081,590.00**	**$ 1,765,500.00**	**$ 2,750,500.00**	**$ 3,511,000.00**	**$ 4,027,550.00**	**$ 13,136,140.00**
Start-up Costs	**$ 298,090.00**	**$ 65,000.00**	**$ 65,000.00**	**$ 85,000.00**	**$ 65,000.00**	**$ 578,090.00**
Professional Fees (Legal & Accounting)	$ 25,000.00	$ -	$ -	$ -	$ -	$ 25,000.00
Prototyping Costs	$ 223,090.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 423,090.00
Steel Mold	$ 20,000.00	$ -	$ -	$ 20,000.00	$ -	$ 40,000.00
Website & Collateral creation	$ 30,000.00	$ 15,000.00	$ 15,000.00	$ 15,000.00	$ 15,000.00	$ 90,000.00
Operational Costs	**$ 783,500.00**	**$ 1,700,500.00**	**$ 2,685,500.00**	**$ 3,426,000.00**	**$ 3,962,550.00**	**$ 12,558,050.00**
Operational Fixed Costs	$ 520,000.00	$ 550,000.00	$ 605,000.00	$ 665,500.00	$ 732,050.00	$ 3,072,550.00
Payroll	$ 420,000.00	$ 462,000.00	$ 508,200.00	$ 559,020.00	$ 614,922.00	$ 2,564,142.00
Professional Fees (Legal&Accounting)	$ 50,000.00	$ 55,000.00	$ 60,500.00	$ 66,550.00	$ 73,205.00	$ 305,255.00
Rent	$ 30,000.00	$ 33,000.00	$ 36,300.00	$ 39,930.00	$ 43,923.00	$ 183,153.00
Patents	$ 20,000.00	$ -	$ -	$ -	$ -	$ 20,000.00
Operational Variable Costs	$ 263,500.00	$ 1,150,500.00	$ 2,080,500.00	$ 2,760,500.00	$ 3,230,500.00	**$ 9,485,500.00**
Marketing Expenses (13% of Sales)	$ 143,000.00	$ 650,000.00	$ 1,170,000.00	$ 1,560,000.00	$ 1,820,000.00	$ 5,343,000.00
Sales Expenses (10% of Sales)	$ 110,000.00	$ 500,000.00	$ 900,000.00	$ 1,200,000.00	$ 1,400,000.00	$ 4,110,000.00
Office Supplies	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 2,500.00
Software/CAD Licences	$ 10,000.00	$ -	$ 10,000.00	$ -	$ 10,000.00	$ 30,000.00

Table 5. Management and Administrative Costs

Assumptions:

- Each parking lot is estimated to have 500 spaces for all calculations
- Payroll and rent are assumed to increase by 10% each year.
- Steel mold and software packages are assumed to be renewed every two years and every other year respectively.

5-Year Profit/Loss Forecast (Worst)

	2003	2004	2005	2006	2007
Sales Price	$ 42,000.00	$ 37,000.00	$ 32,000.00	$ 27,000.00	$ 25,000.00
Number of Systems Sold	5	25	50	75	100
Net Sales	$ 210,000.00	$ 925,000.00	$ 1,600,000.00	$ 2,025,000.00	$ 2,500,000.00
Cumulative Net Sales	$ 210,000.00	$ 1,135,000.00	$ 2,735,000.00	$ 4,760,000.00	$ 7,260,000.00
Variable Manufacturing Cost/System	$ 13,500.00	$ 11,850.00	$ 10,505.00	$ 9,406.50	$ 8,507.45
Cost of Product Sold	$ 67,500.00	$ 296,250.00	$ 525,250.00	$ 705,487.50	$ 850,745.00
Gross Margin	$ 142,500.00	$ 628,750.00	$ 1,074,750.00	$ 1,319,512.50	$ 1,649,255.00
% Gross Margin	68%	68%	67%	65%	66%
Start-up Cost	$ 298,090.00	$ 65,000.00	$ 65,000.00	$ 85,000.00	$ 65,000.00
Payroll	$ 420,000.00	$ 462,000.00	$ 508,200.00	$ 559,020.00	$ 614,922.00
Sales Expenses	$ 21,000.00	$ 92,500.00	$ 160,000.00	$ 202,500.00	$ 250,000.00
Rent	$ 30,000.00	$ 33,000.00	$ 36,300.00	$ 39,930.00	$ 43,923.00
Professional Fees	$ 50,000.00	$ 55,000.00	$ 60,500.00	$ 66,550.00	$ 73,205.00
Marketing	$ 27,300.00	$ 120,250.00	$ 208,000.00	$ 263,250.00	$ 325,000.00
Other	$ 16,800.00	$ 74,000.00	$ 128,000.00	$ 162,000.00	$ 200,000.00
Total Operating Expenses	$ 863,190.00	$ 901,750.00	$ 1,166,000.00	$ 1,378,250.00	$ 1,572,050.00
Pretax Profit	$ (720,690.00)	$ (273,000.00)	$ (91,250.00)	$ (58,737.50)	$ 77,205.00
% Profit	-506%	-43%	-8%	-4%	5%
Cumulative Profit	$ (720,690.00)	$ (993,690.00)	$ (1,084,940.00)	$ (1,143,677.50)	$ (1,066,472.50)

Assumptions:

- Number of systems sold is dramatically reduced compared to the expected values (~75%)
- Each parking lot is estimated to have 500 spaces for all calculations
- Corporate income tax effects ignored
- Sales expenses are assumed to be 10% of net sales
- Marketing expenses are assumed to be 13% of net sales
- Extra expenses (other) are assumed to be 8% of net sales

5-Year Profit/Loss Forecast (Best)

	2003	2004	2005	2006	2007
Sales Price	$ 55,000.00	$ 50,000.00	$ 45,000.00	$ 40,000.00	$ 35,000.00
Number of Systems Sold	30	150	300	450	600
Net Sales	$ 1,650,000.00	$ 7,500,000.00	$ 13,500,000.00	$ 18,000,000.00	$ 21,000,000.00
Cumulative Net Sales	$ 1,650,000.00	$ 9,150,000.00	$ 22,650,000.00	$ 40,650,000.00	$ 61,650,000.00
Variable Manufacturing Cost/System	$ 13,500.00	$ 11,850.00	$ 10,505.00	$ 9,406.50	$ 8,507.45
Cost of Product Sold	$ 405,000.00	$ 1,777,500.00	$ 3,151,500.00	$ 4,232,925.00	$ 5,104,470.00
Gross Margin	$ 1,245,000.00	$ 5,722,500.00	$ 10,348,500.00	$ 13,767,075.00	$ 15,895,530.00
% Gross Margin	75%	76%	77%	76%	76%
Start-up Cost	$ 298,090.00	$ 65,000.00	$ 65,000.00	$ 85,000.00	$ 65,000.00
Payroll	$ 420,000.00	$ 462,000.00	$ 693,000.00	$ 1,386,000.00	$ 2,772,000.00
Sales Expenses	$ 165,000.00	$ 750,000.00	$ 1,350,000.00	$ 1,800,000.00	$ 2,100,000.00
Rent	$ 30,000.00	$ 33,000.00	$ 36,300.00	$ 39,930.00	$ 43,923.00
Professional Fees	$ 50,000.00	$ 55,000.00	$ 60,500.00	$ 66,550.00	$ 73,205.00
Marketing	$ 214,500.00	$ 975,000.00	$ 1,755,000.00	$ 2,340,000.00	$ 2,730,000.00
Other	$ 132,000.00	$ 600,000.00	$ 1,080,000.00	$ 1,440,000.00	$ 1,680,000.00
Total Operating Expenses	$ 1,309,590.00	$ 2,940,000.00	$ 5,039,800.00	$ 7,157,480.00	$ 9,464,128.00
Pretax Profit	$ (64,590.00)	$ 2,782,500.00	$ 5,308,700.00	$ 6,609,595.00	$ 6,431,402.00
% Profit	-5%	49%	51%	48%	40%
Cumulative Profit	$ (64,590.00)	$ 2,717,910.00	$ 8,026,610.00	$ 14,636,205.00	$ 21,067,607.00

Assumptions:

- Number of systems sold is increased by ~50%
- Due to high volume of sales, additional personnel are hired after 2005 and raises are increased.
- Each parking lot is estimated to have 500 spaces for all calculations
- Corporate income tax effects ignored
- Sales expenses are assumed to be 10% of net sales
- Marketing expenses are assumed to be 13% of net sales
- Extra expenses (other) are assumed to be 8% of net sales

Appendix B: Glossary and Abbreviations

CAD	**C**omputer **A**ided **D**esign
GSM	**G**lobal **S**ystem for **M**obile Communications is an international standard, mostly used in Europe. (Originally, the acronym **GSM** stood for **Groupe Spécial Mobile**, a group formed by the **Conference of European Posts and Telegraphs (CEPT)** in 1982 to research the merits of a European standard for mobile telecommunications)
LCD	**L**iquid **C**rystal **D**isplay
MOTE	A sensor node that can connect to other nodes or a central computer via a wireless connection using RF.
RF	**R**adio **F**requency
RF ID	**R**adio **F**requency **ID**entification (Electronic barcodes)

References:

Beckwith, T. G., R. G. Marangoni, and J. H. Lienhard (1993). *Mechanical Measurements, 5th Edition*, Addison-Wesley Publishing Co., Menlo Park. ISBN 0 201 56947 7

Seth Hollar's Web Site,
http://bsac.eecs.berkeley.edu/~shollar/webthesis/formthe129a.html

Hoover's Online, Hoover's Inc. *2003*
http://premium.hoovers.com/subscribe/co/factsheet.xhtml?COID=44530

RDS, Business & Indsutry Web Site,
http://rdsweb2.rdsinc.com/texis/rds/suite?Session=3fd50c9e2|BNI&isCached=y&ipCnt=0

Style Manual Used

Markel, Mike, (2001). *Technical Communication, 6th Edition.*
Boston: Bedford / St. Martin's. ISBN 0-312-24890-3

Software

Report prepared with Microsoft Word 2002 for Windows XP
Graphs Generated with Microsoft Excel 2002 for Windows XP
Project Timeline prepared with Microsoft Visio 2002