

Final Project
GBA573 – Summer 2003
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Development of a mobile graphics engine:

MGraphixE

Table of Contents

- I. Executive Summary**
- II. Project Analysis**
 - a. Problem Statement**
 - b. Project Objectives**
 - c. Project Scope**
- III. Return on Investment Analysis**
 - a. Expected benefits**
 - b. Expected Costs**
- IV. Measures of Success**
- V. Project Design**
 - a. Requirements Analysis**
 - b. Feasibility Study**
 - c. Risk Management Strategy**
 - d. Communication Management Strategy**
- VI. Project Development**
 - a. Timelines/Work Breakdown**
 - b. Staffing**
 - c. Implementation Method**
- VII. Testing & Documentation**
- VIII. Final Analysis**
- IX. Appendix**

I. Executive Summary

a. Need for *MGraphixE*

New mobile devices, both PDAs and mobile phones, will have added requirements for new and compelling software applications that will attract and retain new consumers. One of the critical enabling technologies for these compelling applications will be the software based 2D/3D graphics engine. These graphics engines will enable applications such as games, multimedia animations, ring-tones, multimedia messaging, rich user interfaces, etc. Mobile device manufacturers will look externally for this technology since it is not their traditional area of expertise. The *MGraphixE* mobile graphics engine will solve this need.

b. Summary project deliverables

The deliverables for this project will be the *MGraphixE* mobile graphics engine, the *MGraphixE* Software Development Kit, and a demonstration game that highlights all the key features of our graphics engine. Additionally, there will be a variety of documentation that will be produced in parallel to the development and will be made available with our product.

c. Required development team/skills

This development will require an overall team of 8 people; One program manager, two Sr. software programmers, four Jr. software programmers, and one game programmer. Their software programming skill sets must include C, C++, Visual Basic, and TI Code Composer Studio.

d. Expected Return on Investment

The development costs for this product are overwhelmingly labor costs. Since this is a relatively short design cycle of 48 days, the total development cost is only \$133,000.00 while the target market segment is huge, numbering in the 100's of millions of units. It is conservatively estimated that the estimated revenue for *MGraphixE* could be \$13.5 Million. If this type of revenue is generated then the return on investment would be 9958%, which would more than justify the project and its associated risks

II. Project Analysis

a. Problem Statement

As mobile devices become more powerful, in terms of processing power, there will be an increased need for compelling applications that end users will be willing to pay extra money for. The cellular carriers are counting on this well documented¹ consumer behavior. These applications will consist of games, streaming media, customizable user interfaces, multimedia messaging, ring-tones and countless others. An indispensable

software technology required to make these applications compelling is the 2D/3D graphics engine. In general, the original equipment manufacturers (such as Nokia, Motorola, Samsung, etc.) will look to Independent Software Vendors (ISV) for this technology, since it is not their traditional area of expertise.

The ISVs that develop the 2D/3D graphics engine will target the multiple OEMs with optimized software for the specific application processors they use in their mobile devices. This is extremely important because of how sensitive mobile devices are to power consumption and the higher the optimization the lower the power consumption. ISVs will typically derive revenue from a one time licensing fee, usually \$10,000-\$250,000, plus a recurring per unit royalty, usually in the \$0.10-\$1.00 range. It is estimated that the graphics engine market will be worth \$500 million in 2004, and well over \$1 Billion by 2010ⁱⁱ.

b. Project Objectives

?? To develop a 2D/3D graphics engine called *MGraphixE*

for Texas Instruments' OMAP mobile application processors

?? Develop a Software Development Kit for *MGraphixE*

?? Develop one demonstration game to run on *MGraphixE*

While there are many integrated circuit manufacturers that target the mobile market, such as Qualcomm, Infineon, STMicroelectronics, and others, it is Texas Instruments that currently has about 55% of the market share. It is for this reason that we will focus our development efforts on TI's OMAP platform and deploy our first product

for TI's OMAP mobile application processors. In addition to the large install base that will provide access to millions of mobile devices from dozens of OEMs, TI offers mobile market focused ISVs membership in their OMAP Developer Network, which offers a variety of business development activities & technical resources.

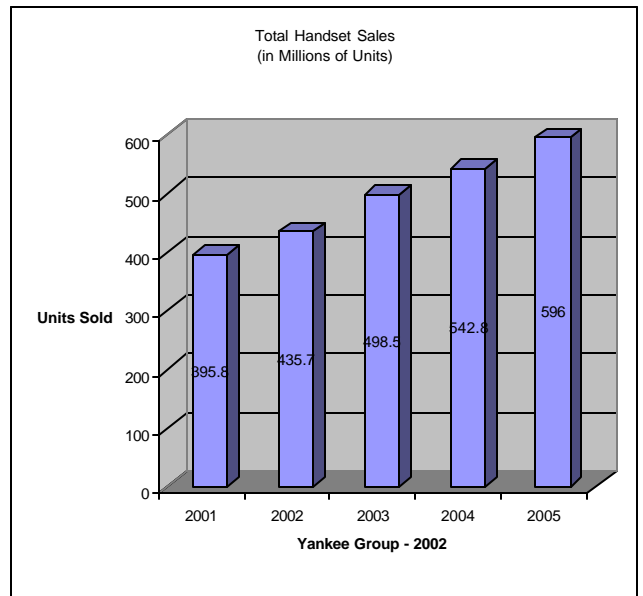
Finally, there are also many operating systems that run these mobile processors, such as the Symbian OS, Linux, ATI's Nucleus, and Microsoft's PocketPC. We have selected PocketPC because it is the basis for both PDA's and mobile phones, it has relatively free development tools and a joint reference design with TI's OMAP application processors.

c. Project Scope

MGraphixE Justification

The mobile phone market was 435.7 million units in 2002 and is forecasted to be 542.8 million units in 2004ⁱⁱⁱ. Texas Instruments will supply the application processors for approximately 55% or 300 million mobile devices, and the OMAP application processors will sell into 73% of the 300 million, or about 216 million units^{iv}. By focusing our development on the OMAP platform, we will have a total available market of 216 million units. If we assume

MGraphixE will capture a conservative 10%



market share, and we charge a \$0.50 per unit royalty, our revenue could be \$10.8 million, and greater once the one-time license fee and the SDK licensing fees are added in.

Finally, the market for the OMAP platform is forecasted to grow heavily in the coming years and so will provide many years of growth for *MGraphixE* as well.

MGraphixE Characteristics & Requirements

- ?? 2D/3D graphics engine with built in rasterizer, texturizer, pixel transformer, and fragment processor
- ?? No great than 500Kbytes in memory size
- ?? Optimized for TI's OMAP application processors
- ?? *MGraphixE* Software Development kit with built in design tool, application prototyping engine, and application production tool
- ?? *MGraphixE* demonstration game to highlighting all key features

MGraphixE Project Deliverables

- ?? MG mobile 2D/3Dgraphics engine
- ?? MG Software development kit
- ?? MG demonstration game
- ?? NG Technical Reference Manual
- ?? Software Development Kit User's Guide
- ?? Application Development Note
- ?? API Reference Guide
- ?? Demonstration Game Source Code CD-Rom

III. Return on Investment Analysis

a. Expected benefits

Forecasted MGraphixE Revenue	
	2004
Total Mobile Market	542.8
Total TI Market Share	55.0%
Total TI Market Share (M units)	298.5
OMAP710 Market Share (M units) & MGraphixE Total Available Market	217.9
10% Projected MGraphixE Market Share (M units)	21.8
Royalties (\$0.50/unit)	\$ 10.9
One Time License Fees (per OEM, in \$M)	\$ 2.4
MGraphixE SDK License Fees (in \$M)	\$ 0.2
Total MGraphixE Revenue (in \$M)	\$ 13.5

b. Expected Costs

Forecasted MGraphixE Costs (in \$K)	
Labor Cost - MGraphixE Mobile Graphix Engine	\$ 89.99
Labor Cost - MGraphixE Software Development Kit	\$ 19.27
Labor Cost - MGraphixE Demonstration Game	\$ 16.56
Material Costs	\$ 8.40
Total MGraphixE Cost	\$ 134.22

c. Return on Investment

Return on Investment	
Expected Revenue (in \$K)	\$ 13,500.00
Expected Cost (in \$K)	\$ 134.22
ROI (Rev-Cost/Cost)	9958%

IV. Measures of Project Success

For the *MGraphixE* mobile graphics engine to be successful we must ensure that we accomplish the following:

- ?? We deliver *MGraphixE* on time and fully functional as described in the Detailed Design Specification
- ?? We deliver a fully functional SDK
- ?? We deliver a demonstration game that exercises all of *MGraphixE*'s critical features
- ?? We pass TI Certification

V. Project Design

a. Requirements Analysis

The software market for mobile device has two major constraints. The first is the memory requirements of the software, in other words, how much memory will the software require when it is not running, and how much memory will it require when running. The numbers best be as small as possible because memory is always a precious commodity since it is expensive and takes up a lot pf PCB board space. Secondly, is the processing power required to run the software and this number best be small as well, since this will directly affect the battery life of the device and hence is of critical importance to OEM.

With these two items in mind, the *MGraphixE* will be designed to provide the highest level of functionality with the lowest level of both memory and processing power utilization (see section II-C)

b. Feasibility Study

?? Technical – The development tools are widely available and reasonably priced. The programming resources are also widely available in the current economic environment. Finally, there is extensive industry and academic research regarding graphics engine architectures

?? Operational – The development tools are widely available and reasonably priced. The programming resources are also widely available in the current economic environment

?? Economically – The return of investment of 9958% more than justifies the development and risk

c. Risk Management Strategy

?? The architecture of the *MGraphixE* mobile graphics engine is modular so as to ease the debugging process, allow for flexibility of iterating in new features or fixes

?? Each module will be thoroughly tested as it is designed, then it will be tested upon system integration, and finally will be submitted for TI certification

?? The *MGraphixE* demonstration game will provide a final check on the full functionality of *MGraphixE*

d. Communication Management Strategy

?? The MG program manager will have overall responsibility to ensure that communication is proactive between team members. This will be achievable since the program manager will have a development role in each of the module development teams

?? Communication will occur via weekly team meetings, biweekly written status reports, and via person-to-person, phone and email as needed

?? Communication will begin during the development of the functional specification (first task in project) and conclude once MG has passed TI certification

VI. Project Development

a. Timelines/Work Breakdown

Project Timeline	
Start	8/4
Finish	10/8
Duration Days	48
Work Hrs	1,516
Number of tasks	28

Major Milestones (Date)	
Design Start	8/4
Product Development Start	8/20
MGraphixE Engine Completion	10/3
MGraphixE SDK Completion	9/30
MGraphixE Demo Game Completion	9/19
TI Certification	10/3
Project Completion	10/8

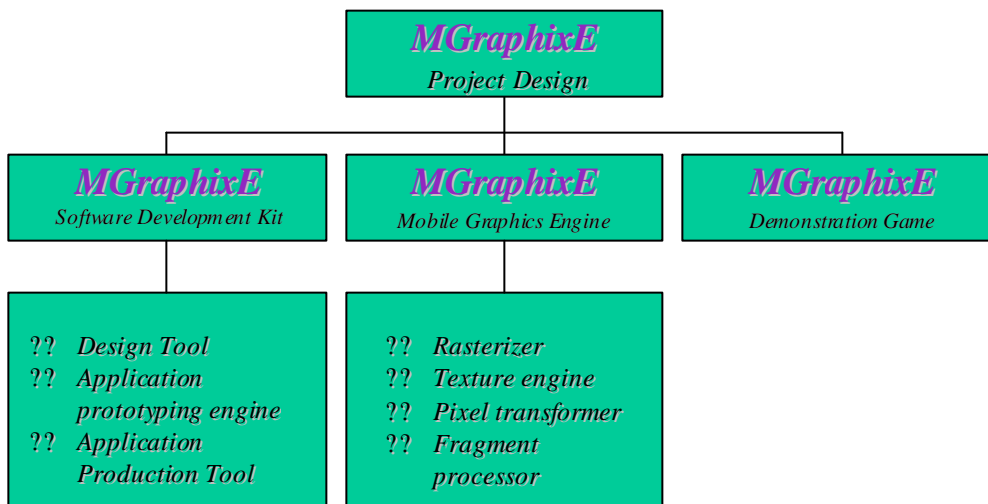
b. Staffing

Resources (in Hrs worked)	
Program Manager	324
Sr.Programmer1	226
Sr. Programmer2	194
Jr. Programmer1	144
Jr. Programmer2	124
Jr. Programmer3	216
Jr. Programmer4	104
Game Programmer	184

c. Implementation Method

The *MGraphixE* project will use a parallel development methodology by which we will split the project into three major development sections; the *MGraphixE* mobile graphics engine, the *MGraphixE* SDK, and the *MGraphixE* demonstration game. Each section of the design will be assigned a development team ranging from one to four team members. Each section will have a team leader and the over all project will be lead by a program manager.

The *MGraphixE* development tree looks as follows:



VII. Testing & Documentation

Each development block will be tested at completion. Each section will be tested at completion of the integration of its blocks. Finally, the entire MG product line will be submitted for TI certification and upon successful completion they will be released to market.

All applicable technical documentation for each section of the product will be composed during the development phase.

VIII. Final Analysis

The ultimate determination of the *MGraphixE* mobile graphics engine success will be based on the amount of revenue the product will generate. We have based our cost analysis on the expectation that our product will be able to capture at least 10% market share, in such a case *MGraphixE* would generate \$13.5 Million. Clearly, the results could be less than those expected or be wildly greater.

IX. Appendix

Contents

? ? Selected MS Project printouts from file Final_Lezama.mpp

? ? Excel file Final_Lezama.xls

? ? MS PowerPoint file Final_Lezama.ppt

ⁱ The Strategis Group – Next Generation Mobile: Applications and Device Survey - 2002

ⁱⁱ The Strategis Group – Next Generation Mobile: Applications and Device Survey - 2002

ⁱⁱⁱ Yankee Group Wireless Report - 2002

^{iv} Texas Instruments Annual Report 2002