

Departamento de Engenharia Eletrotécnica
Instituto Superior de Engenharia do Porto



Instituto Superior de
Engenharia do Porto



Interim Report
European Project Semester 2012

Context-aware Smart Object

Anna Maria Janaszkiwicz, 1111368@isep.ipp.pt
Hannes Harms, 1111817@isep.ipp.pt
Jana Valauskaité, 1111819@isep.ipp.pt
Toomas Juht, 1111825@isep.ipp.pt

Contents

1	Introduction	1
1.1	Table of tasks	2
1.2	Gantt Chart	2
2	State of the Art	3
2.1	Microcontroller	3
2.2	Sensors	3
2.3	Power supply	3
2.4	Wireless data connection	4
2.5	Related Projects and Products	4
2.6	Conclusions	5
3	Marketing Plan	6
3.1	The market environment analysis	6
3.1.1	Micro environment analysis:	6
3.1.2	Macro environment analysis	7
3.2	Market segmentation	10
3.3	Basic marketing strategy	10
3.4	Marketing MIX	11
3.5	Action program	13
3.6	Budget	14
3.7	Control	14
3.8	Conclusion	14
4	Eco-efficiency Measures for Sustainability	16
4.1	Design of the product	16
4.2	Production	16
4.3	Packaging, Recycling and Transport	17
4.4	Conclusion	17
5	Project Development	18
5.1	System Architecture	18
5.2	Hardware Specifications	18
5.2.1	Arduino BT	18
5.2.2	IMU Digital Combo Board - ITG3200/ADXL345	19
5.3	Information flow from the sensors the the PC	20
5.4	Programming a representation of the object	20
5.5	Conclusions	21
5.6	Future Developments	21
	Appendix	22

A	Java Source Code for Modelling the Object	22
A.1	HelloMaterial.java	22
A.2	angles.java	23
A.3	global_vars.java	23
	Bibliography	24

List of Figures

1.1	Gantt Chart	2
2.1	3Dconnexions 3d mouses	5
3.1	Wii Remote	7
3.2	Gamepad	7
5.1	Smart Object in modeling stage.	18
5.2	Arduino BT	19
5.3	IMU	19
5.4	infomation flow	20
5.5	Smart Object in Java	21

List of Tables

1.1	Table of tasks	2
3.1	SWOT analyses	9

Glossary

Arduino is a microprocessor that is commonly used for prototyping or for educational purposes.

CAD-Programm computer-aided design -program , is a computer program that is used for 3D modelling.

IMU Inertial measurement unit, the sensor that measures movement using accelerometer and gyroscope.

Java object-oriented programming language, that we used on the PC for 3D modelling and a Bluetooth connection to the SO.

Logical Level Converter steps up the 3.3 V level of the I²C interface from the IMU to a 5V level.

Abstract

This report talks about the development of a Smart Object used as an interface for CAD-programs or computer games. The main idea is to develop a more intuitive device than the existing products on the market like the 3D mouse. We want to achieve this by integrating a inertial measurement unit, a touchpad, a microphone and a Bluetooth interface in one small device. In the first step we have analysed the existing technologies and products that are state of the art. Furthermore we developed a marketing strategy to sell this product. Also we collected ideas for develop, produce and sell the smart object in a sustainable way. In addition we describe the project development for construction the object, setting up the sensors and programming the software. To test all sensors and to demonstrate the solution a Java application is used on the PC side.

1. Introduction

Progress in technology, especially in fields of embedded systems, communication and sensor systems, give rise to new types of applications and devices. Also Micro-Electrical-Mechanical Systems (MEMS), where very small mechanical devices allow on chip measurement of acceleration and rotation are part of mass market product nowadays. This has led to a price reduction and allows us to combine several sensor technologies to test new methods of human computer interactions.

Our goal is to develop and construct a smart object for an interaction with a virtual environment. The main purpose of the object is a professional use for CAD-Programm or as a helpful device for smart product presentations. Second the interface could be used as an intuitive game controller. You will be able to rotate your model by rotating the object, to zoom in and out with a touch pad, and to give voice commands.

The first chapter presents the problem, the motivation, the objectives, the expected results and the work plan of this project. In the second part we give a short review of the state of art of the technologies we want to use. After that we present our marketing plan, including a market analysis and a SWOT analysis. The next chapter describes the state of our project development. It includes the design and construction of the device and also the programming of the object, the data connection and the representation in a virtual environment.

Problem

The existing computer interfaces are bound to the table tops like the computer mouse. The user has the 2D movement freedom in x- and y-axis. The computer mouse hasn't changed a lot from the day it was invented. The user still holds his hand on the mouse and moves it on a table. Our idea is to make the movements free and versatile. [1]

Motivation

Motivation to build a wireless interface came from the fact that we all are computer users and that freedom of movement that our product offers is innovative. We want to "free" the users from the table tops and give them liberty of movement.

Expected Results

When using the Smart-Object the user will be able to turn, rotate, zoom in and out when modeling an object in CAD- programs. When the user is holding the object in his hand, the movement is detected by an IMU and then transmitted via Bluetooth to the PC. The product has a wireless connection to the user's PC. The product will have a battery that is rechargeable using an USB- cable.

Work Plan

The tasks are allocated between the team members. Every task is defined by a start and end date in Gantt chart.

1.1. Table of tasks

Task	Responsible
Research	Jana, Anna, Toomas, Hannes
Make the final list of materials	Jana, Anna, Toomas, Hannes
JAVA modeling	Hannes
Preparing interim report	Jana, Anna, Toomas, Hannes
Drawings	Toomas
Building	Jana, Anna, Toomas, Hannes
Programming	Hannes
Interim report	Jana, Anna, Toomas, Hannes
Testing	Jana, Anna, Toomas, Hannes
Marketing	Anna
Paperwork	Jana, Anna, Toomas, Hannes
Upload all deliverables	Jana, Anna, Toomas, Hannes
EPS final assessment	Jana, Anna, Toomas, Hannes

Table 1.1.: Table of tasks

1.2. Gantt Chart

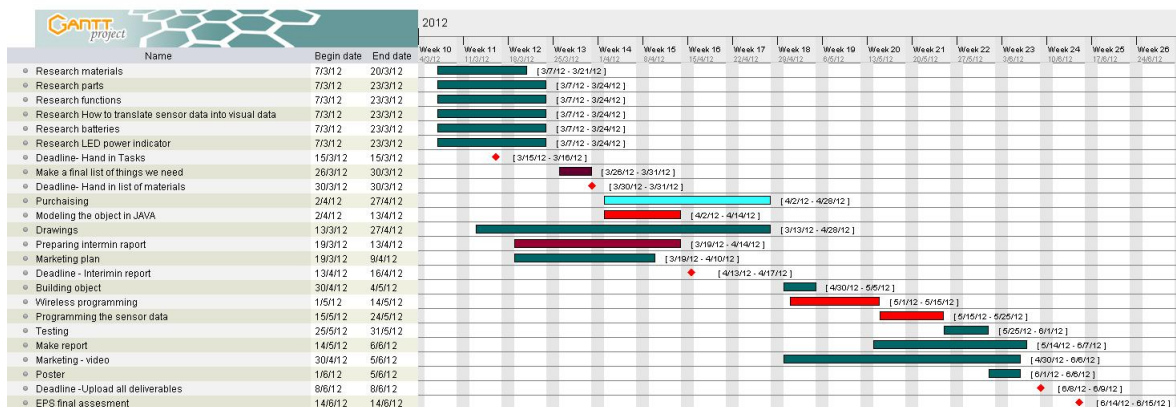


Figure 1.1.: Gantt Chart

2. State of the Art

2.1. Microcontroller

Arduino

Arduino is a popular open source single-board microcontroller, it is designed to make the process of using electronics in multidisciplinary projects more accessible. The hardware consists of simple open hardware design for the Arduino board with an Atmel AVR processor and on-board input/output support. The software consists of a standard programming language compiler and the boot loader that runs on the board. [9]

2.2. Sensors

IMU

IMU is an electronic device that measures and reports on craft's velocity, orientation and gravitational forces it uses a combination of accelerometers and gyroscopes. Typically they are used to maneuver aircraft, including UAVs (unmanned aerial vehicles), among many others and spacecraft, including shuttles, satellites and landers. It is also the main component of internal navigation systems used in aircrafts, spacecrafts, watercrafts and guided missiles. In this capacity, the data collected from the IMU's sensors allows a computer to track a craft's position. In our project we are going to use the IMU for sensing movement we translate that sensor input so that it is applicable in a CAD-program. [8]

Touch screen

Touchscreen is an electronic visual display that can detect the presence and location of a touch within the display area. The term generally refers to touching the display of the device with a finger or hand, it can also sense other passive objects such as a stylus. Commonly the touch screens are in game consoles, all-in-one computers, tablet computers and smartphones. It has two main attributes, firstly, it enables one to interact directly with what is displayed, rather than indirectly with a pointer controlled by a mouse or touchpad. Secondly, it lets one do so without requiring any intermediate device that would need to be held in the hand (other than a stylus, which is optional). [11]

2.3. Power supply

To power a wireless device we can use solar panels or rechargeable batteries, other options would be too difficult to implement.

Lithium-ion polymer battery- LiPo battery

Li-Po batteries are rechargeable batteries, they are usually composed of several identical secondary cells in parallel to increase the discharge current capability.[12]

Solar panels

A solar panel is a packaged, connected assembly of photovoltaic cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. A photovoltaic system typically includes an array of solar panels, and inverter and sometimes a battery and or solar tracker and interconnection wiring. [13]

2.4. Wireless data connection

Wi-Fi: Wi-Fi is a technology that allows an electronic device to exchange data wirelessly over a computer network, it includes high-speed internet connection. There are a lot of devices that can use Wi-Fi, such as PC, video game console, smartphone, tablet or digital audio player. All of these can connect to a network resource such as the Internet via a wireless network access point. Indoor use the range is about 20 meters and outdoors it's greater. Access point, also called hotspot, coverage can comprise an area as small as a single room with walls that block radio waves or as large as many square miles - this is achieved by using multiple overlapping access points. [5]

Bluetooth: Bluetooth is widely spread wireless connection option, it can be found on PC-s, smartphones, laptops etc. It is used for exchanging data over short distances from fixed and mobile devices. Bluetooth creates personal area networks-PANs with high levels of security. [6]

ZigBee: ZigBee is intended to be simpler and less expensive than other WPANs, such as Bluetooth. It is targeted at radio-frequency applications that require a low data rate, long battery life and secure networking. ZigBee is best suited for periodic or intermittent data or single transmission from a single transmission from a sensor or input device. [10]

2.5. Related Projects and Products

For the same purpose one can use 3Dconnexions 3D mouse. The user can rotate, zoom, turn and pan the object when using it. The 3D mouse resembles a joystick a device that is placed on a table. From the products homepage one can find this sentence: "It's a level of control that's simply not possible with a traditional mouse and keyboard". They launched their first product in 2009. 3Dconnexions has 5 different products that can be used for the same purpose the difference is in segmentation. [7]



Figure 2.1.: 3Dconnexion 3d mice

2.6. Conclusions

For the wireless data transfer we will choose Bluetooth because it is built in most of the computers and smartphones. If we are planning to use ZigBee the users should buy a software and a receiver for that. Wifi would consume the biggest amount of energy so we exclude it because of that. Our main competitor is the 3D mouse the company that produces it has several products segmented for different customer groups. They differ in size and functions that the product offers.

3. Marketing Plan

After the development of the Smart Object is finished and the production has started we have to put it in the market. Our company will be called Smart Interfaces JATH. Nowadays in order to sell the product it is not enough to produce it. If we want to sell our product we have to concentrate on customer, cost, communication and convenience. It is important to concentrate on meeting the needs of our customers. Moreover a observation of the market is necessary to recognize changes on the market. To do it we need some special tools and analysis.

3.1. The market environment analysis

In general two types of environment are distinguished: micro and macro. Firstly we will analyse the micro environment, which includes the company's internal environment, suppliers, marketing intermediaries, customers, competitions, publics. Secondly we will analyse the macro environment.

3.1.1. Micro environment analysis:

Our product will be made of high quality materials and we are trying to get a modern and innovative solution. Furthermore it is important to know, that are no identical products in the market. In the first phase of the project our supplier is ISEP. If the product goes in production we are going to address a mass market. When we are introducing the object to the market we will need some suppliers. We have to remember, that all companies which are cooperating with us, are going to be checked carefully. Important things are the price and quality of resources and time of delivery.

The product will be advertised and sold on the Internet. The distribution will be done by a logistic company. The object is small so we can put it into special package which prevents damage.

We can identify the market by:

- Type of goods traded: market for goods
- According to geographical: now local in the future could be global
- According to the criterion of scale or size of transactions: retail but in the future could be wholesale
- According to the character of the merchandise: goods and services
- According to the degree of satisfaction of needs: consumer

Competitors

At the moment the same product that we are offering does not exist on the market.

But the market for smart electronic devices, that simplify life is huge and rapidly growing. However, one competitor for our product can be the 3D mouse. 3D mouse devices generally function through ultrasound and provide at least three degrees of freedom. On the market there are a lot of companies producing 3D mouses. The product is gaining popularity. An Example of such a product can be found here: [14]

Our product is more innovative, because one can also use voice command and the user can hold it in his/hers hand. It does not have to lie on the table, but it can. The other competitive product is the Wii Remote. It is not our direct competitor, but the product uses some same components and it can be used for the same purposes. The Wii remote is used for games. It is the primary controller for Nintendo's Wii console. Wii Remote has a motion sensing capability, which allows the user to interact with the game and manipulate items on screen via gesture recognition and pointing through the use of accelerometer and optical sensor technology. Another feature is its expandability through the use of attachments. The attachment bundled with the Wii console is the Nunchuk, which complements the Wii Remote by providing functions similar to those in gamepad controllers. This is an example of the Wii Remote:



Figure 3.1.: Wii Remote

Another product is the typical gamepad. It is a type of game controlled, held in two hands, where the fingers (especially thumbs) are used to provide input.



Figure 3.2.: Gamepad

However, these two products can be used only for gaming. So our product can be distinguished from the exiting product, because it gives more possibilities and can be used for a professional purpose and also for fun.

3.1.2. Macro environment analysis

Macro environment includes demographic, economic, natural, technological, political, and cultural forces.

Demographic forces result from population age structure, sex structure, etc. Our product is addressed particularly to professionals and younger people (between 17 to 35 years) , because they follow the course of time more. For example young people play games which need a certain freedom of movement that comes from our product. Professionals,who work a lot with computers need a product which gives more possibilities than the ordinary mouse. These people can work for example in design field, as engineers or architects.

Economic forces stem from the overall economic condition. Nowadays in many countries there is the economic recession. In this phase of development we are not 100% sure how much our product will cost. However we would like that the price is not higher than the price for a professional 3D mouse, which is between 100 € to 400 €. But we also do not want to sacrifice quality.

Technological forces are arising from the level of technological development. Currently technological progress is huge. It is a threat, sell new version and earn money, but it can be threats because if the company does not track the development of competition, market it is easy to be left behind.

Political forces: In our opinion the EU is a good place to produce, buy and sell electronic products, because the EU has similar standards for production, quality and sales of products and services.

Cultural forces result from the prevailing fashion, lifestyle or habits and culture prevailing in the area. Nowadays everyone has at least one computer, mobile phone or iPad. Our product can cooperate with any of these devices.

To summarize the environmental analysis we did a SWOT analysis. In our case we will concerted on our company which is our team and our product which is the Smart Object.

The following table shows the SWOT analyses:

Strengths	Weaknesses
<ul style="list-style-type: none"> • ability to think logically • use new technology • well-equipped laboratories • quality of product • own sales network • sales by Internet (7 days a week, 24 h per day) • possibility of selling the product around the world • good quality of materials used in production • modern solutions • functionality of the product produced • human potential • average price of product • possible to adapt the product to suit your needs 	<ul style="list-style-type: none"> • problem with communication • lack competitive edge • inexperience • lack of a position in the market • only advertising on the Internet • small financial resources • instability of the production line • need to build a positive image • difficulty with the first customers • short product life cycle
Opportunities	Threats
<ul style="list-style-type: none"> • patronage of ISEP • opportunity to work with a qualified people • ISEP-s good reputation • demand for such products • EU membership • common currency in the EU • absorbent, growing market 	<ul style="list-style-type: none"> • unemployment • low income of society • rapid development of technology • increasing competition in the market • strong position of technology leaders • existence substitute product on the market • customer loyalty relative to our competitors

Table 3.1.: SWOT analyses

3.2. Market segmentation

The next step in the marketing procedure is to choose the market segment. This is important because we have to know the needs of our customers to meet them. Market segmentation is to make a distribution of the market into a relatively homogeneous group of consumers, because of the similarities of characteristics reveal a similar demand. Knowing the target segment will help us to prepare a product that meets the needs of our clients and helps us to obtain advantage in the market. We chose two segments for our product. The first one is people who are working with engineering programs meant for drawing. They are designers, architects or engineers. They spend a lot of their time using computer to draw sketches, diagrams, plans and models. Our product can facilitate the implementation of these activities. We are particularly interested in this segment. The other target group can be young people (17-35 years) who use their computers or mobile phones to play games. Our product gives them freedom of movement. Moreover young people like modern things and technical innovations.

Objectives:

- meet customer needs – satisfied customers 90%
- achieve operational excellence in the internal processes of marketing, supplier, product development, logistics
- make that brand recognizable about 30% in the end of year 2013
- occupy 20% of the market by the end of 2012
- by higher sales reduce the price of the product about 10% when our sales rise to 20 000 pieces
- expand product lines (new version of product) after first year on market

3.3. Basic marketing strategy

Marketing strategy is actions and producing plan, the sales of the product and dealing with problems. The prototype is product for the ISEP, but the product can be sold in open market. Our Smart Object is addressed to young people and older workers as designers, architects and engineers. We are going to sell our product on the Internet, because this distribution way is cheap and we are able to address a big market. We do not have to rent space in the shop. Our offer will be in website, we want to generate a bookmark with the product order form. Moreover on our website we would like to place a description of the product along with photos, video illustrating the use of the product. The website will be in Portuguese, English and German language. We will pay for position in Google. We are thinking about place to advertising on complementary products for example: PC, drawing programs, etc. That will be a source of additional earnings. If we have to think about distribution, we use companies in the fast delivery of mail, shipments of goods and advertising. The object is small so we can put it to special package which prevents damage. If our product will be well received by users of ISEP, we would like to sell it on a broader market. If there is big demand for our product we can afford to cut prices.

When it comes to promotion we will do posters and some leaflets. In the future we are thinking about two types of advertising. First we will address to young people

and the other to workers. Advertising for young people should be more modern and we can do some animations, 3D effects, etc. advertising for older people should be more professional and factual.

If we think about the long-term strategy we would like to develop a product line. For example we can develop a product for professionals with very precise sensors and a support for many engineering software. On the other hand we can develop a cheaper product for the gaming market. Another aspect is the aesthetics of the product. It is possible to extend the color variations of the product, change shape or do our product smaller to better fit a woman's hand and to meet the need of young consumers. We extend our offer also for various types of connection to the computer object, it need not be only Bluetooth, but we can use WiFi or ZigBee. A second option might be installing a larger battery that allows for longer use of the product, but this solution might make the object bigger so that the battery would fit inside of it.

3.4. Marketing MIX

Marketing mix is a business tool used for marketing products. It is composed of four Ps/Cs .

- Product / Customer
- Price / Cost
- Promotion / Communication
- Place / Convenience

Ad1. Product / customer

One can use the SO as an input device for CAD-programs. By using the device one can turn the model (with the sensor data) in the program 3D space, zoom in and out (with touch pad) and use some voice commands (microphone). With the acceleration data the program decides if the SO is held in hand or lies on the table. The wireless connection is achieved via Bluetooth.

Ad2. Price / cost

We do not know yet how much our product will cost, but the price includes: cost of materials, cost of packaging, distribution costs, advertising costs and labor costs. But we know that we have to remember the fact that the price can not be too high because no one will buy the product. If we will have production lines we will buy materials in bulk so price of material will be lower. Advertising costs will be spread over more units so that the price of the product in mass production will be lower. As for the price of the product, we can give only the costs incurred for materials and it is around 300 € for the prototype.

In terms of the method of payment available are:

- Prepayment
- Transfer
- Check
- Credit Card and Online Transfer

The payment will be facilitated to customer preference. Furthermore we want to apply some discounts for the customers who purchase 5 units of our product we offer a discount of 5%. The customers who purchase more than 10 units of our product we offer a discount of 10%.

Ad3. Promotion / communication

Promotion is various types of advertising the product. Discovery in the clients wish to own the product and encourage the customer to buy it. Moreover it is communication with client. We would like to in this phase of project do some poster and leaflet. We are thinking about some slogans:

- Feel the corner
- Catch the corner
- touch the corner
- Feel the motion
- touch the motion
- It's the smart thing
- See what you keep in mind
- Let's make things better/rotate/easier
- Easy as XXX
- Control your power/motion of mind

When we generate a web page we are going to put a description of the product there along with photos, videos illustrating the use of the product. The web page will be available in Portuguese, English and German language . We will pay for position in Google, because for the clients it will be easier to find us. We want to design two types of it: for people playing games and for professionals. First one can be modern and less official. Second one should be more professional and factual. If ISEP agrees we could put a link to our offer at ISEP's web page. Moreover we will have opportunities to present our Smart Object for clients in events organized by ISEP that will be cheap promotion addressed to the large number of consumers. Collaboration with ISEP gains the trust of customers thanks to their good opinion of ISEP. To attract the attention of customers and encourage them to purchase our product we want to send our product to reporters working in specialist / professional magazines. These reporters can test our product and write an objective view about it. We would like to send our product to four the biggest professional magazines. The readers will have independent opinion about the product. Good opinions in these magazines are the best publicity.

For younger people we can generate a profile on Facebook. Nowadays everyone has Facebook and get a lot of information from this page. There we can put information about our product, some simulation, prices and promotion. Users can share their opinion between then.

Ad4. Place convenience

Place is a really important thing. If you have a shop near the main street you have more clients. But currently a lot of people use online shops in the Internet. We want to sell our product in the Internet. It is better because we do not have to

pay rent for the shop. It is more convenient for the client because he/she can do his/her shopping seven days a week, twenty four hours a day without leaving home. To distribute our product we use outsourcing, it is a cheaper alternative for us than creating our own department, at least at this stage. We want to sign a contract with a company that shipments drop distribution. Moreover we need some special packages to carry the product. This package should prevent damage. In our opinion this solution is convenient for client. They send to us their order and after five days they have the product in their house. This is a good solution, because it is cheap. But in the first phase of the product life no one knows it a better solution would be to place it in the store. The client can see the product and buy it in chain stores. After signing the contract because our product is in every chain store.

3.5. Action program

We will sale the Smart Object in stores with multimedia devices and in the internet. On the first phase of promotion we are going to do some posters and leaflets addressed to all users from ISEP. In this time we are going to generate a web page. Moreover on our website we would like to place a description of the product along with photos, videos illustrating the use of the product. After that we want to do more posters, leaflets and advertising in web pages addressed to the two segments we have already presented. Advertising for young people should be more modern and we can use some animations and 3D effects. Advertising for engineers should be more professional and factual.

To promotion we want use also professional magazines. For an example:

- PCWorld: <http://www.pcworld.com/>
- PCPro: <http://www.pcpro.co.uk/>
- Blueprint Magazin: <http://www.blueprintmagazine.co.uk/>
- DesignEngenieering: <http://www.canadianmanufacturing.com/design-engineering>

We will offer the magazines a free exemplar of the product to test it and to write an article about it. Another way to promote the product can be Facebook. If our promotion will be effective we can get a goals (occupy 20% of the market by the end of 2012, by higher sales reduce the price of the product about 10% when our sales rise to 20 000 pieces, make that brand recognizable about 30% in the end of year 2013). All time we have to observe situations on the market and we have to be flexible to adapt to customer requirements. If we do that we can satisfy our customers. We have to pay particular attention to the objectives set. Operational excellence in internal processes, marketing, supply, product development and logistics can be achieved through appropriate management of resources. In the next year we would like expand product lines (new version of product) that will be possible if we sell 3 000 products. The last one but not the least is to make that brand recognizable about 30% in the end of year 2013. It can happen if we will have good cooperation with publicity and our client will be satisfied with the use of the product.

3.6. Budget

To well manage the project it is necessary to have permanent control over the costs incurred. Everyone remembers about cost of materials and employment costs but usually we forget to think about marketing costs. This cost include: advertising, leaflets, posters, websites, etc.

The estimated annual costs on our marketing plan might be:

- Cost of posters: 100€ per month /1200€ per year
- Cost of leaflets: 100€ per month /1200€ per year
- Cost of the web-site: 450€ (one-time cost)
- Cost of position in Google: about 35€ per month /420€ per year
- Cost of advertising in media: about 120€ per month /1440 per year

3.7. Control

To control, if our marketing strategy is successful, we have to observe all time the micro and macro environment. It is important to study the strategies of our competitors, analyses their product, promotion and clients. Otherwise we will not follow the changes and we will be left behind. We are also planning to look at customer needs and adapt to changes, keep customers and attract new. We should all the time look at offers for the materials because in the market new businesses can develop and they might have more favorable contracts. Good solution is to change your ad at least every six months to attract customers' attention. Otherwise it becomes monotonous and not effective. Another important thing is to monitor changes in macro environment. We have to be up to date with law and economical situation in Portugal and around the world. Of course the most important thing in our case is technological forces, because the technological development in these field is very fast. We must be up to date and continuously improve the product because otherwise it will be obsolete soon. Also we should follow fashion, because one of the segments is young people, and they like to be fashionable.

Moreover we have to have control on our objectives. This control will consist in comparing the present state of theoretical assumptions. To have a good control the situation we are going to prepared quarterly reports. Then we compare the results with previous ones, and the strategy plan and draw conclusions. After that we should do a plan for the next quarter and try realizing them.

3.8. Conclusion

We did a market analysis which includes micro and macro environment. After that we choose two segments for our product. First one is people who work with engineering programs that are meant for drawing. They are designers, architects and engineers. They spend a lot of their time using computers to draw sketches, diagrams, plans, models. Our product can facilitate the implementation of these activities. The other target group can be young people between 17 to 35 years who use their computers or mobile phones to play games. In our marketing plan we

3. Marketing Plan

adapt our promotion to these segments. We set up goals and prepare an action and control plan, which helps us to achieve our objectives.

4. Eco-efficiency Measures for Sustainability

When it comes to sustainable development our strategy includes the whole lifecycle of the product. It starts with the design of the product, the production for a mass-market, the transport and the recycling and also the culture of the company.

4.1. Design of the product

In the design stage we consider the impact that our product has to the environment. Our goal is to use sustainable ways to solve the problem. We use less materials, the parts are replaceable, the battery is rechargeable, we are going to use a USB cable to charge the battery because it can be used for other tasks also. Unfortunately we can't use renewable materials like wood to make the outer shell because wood expands in contact with humidity. Wood also cracks.

Most of the parts are made of recyclable materials. From the design stage we have kept in mind sustainability. Unfortunately we can't use renewable materials so we try to use materials that are recyclable. For prototyping the outer shell material should be easily shapeable and machinable. We were thinking about two materials what we could use: acrylic glass and ABS-plastic. Both of the materials are recyclable. They both are usable for this purpose. We have easy access to acrylic glass so for that purpose we are going to use it for the shell material. All the boards and microphone are made from silicon, metals and plastic, all these materials are recyclable. The screws, nuts and angle brackets are made of stainless steel. Lithium Polymer Batteries are also made from recyclable materials and they are rechargeable. The nylon standoffs that we are planning to use are made from thermoplastics- also a reusable material. The wires are made from metal and covered with plastic.

4.2. Production

On the first year we are planning to sell 10 000 pieces of our product in Europe and USA, if we have more orders then we may produce them more. Because we want to find our first customers in EU and USA then it would be economically useful for us to start our first production factory somewhere in Europe. Because we are nearer to the end consumers and we can save on transportation costs. Furthermore our production volume is small at first, so we should not consider moving out from Europe before it grows up to 50 000 pieces per year or more. The factories have to comply to all the rules and regulations for the environment protection. Also we have to introduce safe methods of working to exclude work related accidents and injuries. All the employees get a fair salary because we need their special skills and to show that we appreciate that. The salary consists of baseline salary plus bonuses

that motivate employees to be more productive.

In production we see some solutions to be more ecologically friendly and sustainable. With the production plan and appropriate management of materials we can save materials, that is to say reduce the number of waste generated during the production. If we will employ qualified staff they will know how to do their job, so they will make less mistakes. Consequently there will be less defective products and less waste. Work should be planned so that the machinery and equipment is not turned on for nothing - not to waste energy. But it is also important not to stop them too often, because it wastes time and energy to start them again. Moreover we can design production halls so that road transport is as short as possible. We also have to consider the supply of raw materials. If we order larger batches of materials they will not have to be so often transported. In our opinion a good idea could be taking the materials from local suppliers because, firstly, cost of transport will be less and transportation of materials will be much lower. Secondly, this solution gives employment to local community and will develop the region economically.

4.3. Packaging, Recycling and Transport

Our products packaging can be made completely from recyclable materials. The package can be made from carton, in the middle of the box there is a special bracket that is supporting the Smart Object and protecting it against damage. The package can be recycled after use one more time.

When it comes to supplying our product to the customers we want to use a logistic company with the highest standards of environment protection. They have to use modern cars that have low fuel consumption and low CO₂ emission.

General outsourcing saves costs. This is the main reason why we choose a logistics company to distribute our product. Also it is more sustainable. Because if we are providing products ourselves we send cars with only one package. When we use logistic companies, they send cars full of different packages to the same area. If we use logistic companies they transport our products to the customers and other packs in the same area.

4.4. Conclusion

We want to use recyclable materials for packing our product. After buying our product the consumer can throw the package to recyclable materials container. To distribute our product we are going to use logistics companies that have already invested to the labor force and equipment for that. We plan to use a economically friendly logistics company.

5. Project Development

This chapter describes the state of our product development, this includes the system architecture and hardware specifications. The main part of the object will be an Arduino microcontroller. The board will be connected to different sensors. Main part of the sensor system will be an IMU (inertial measurement system), to get a full 6 degree of freedom measurement of the position of the object. The sensor data will be transmitted to a PC over a wireless data connection. On the PC the object is modelled in a virtual environment. The programming language for this part will be Java.

5.1. System Architecture

All the parts are inside the outer shell except the touch screen. The outer shell will be made from acrylic glass that is machined and bent to the needed shape. There are several holes and openings machined in for bolts and parts, the corners of the object are bent. The shell is bolted together because we are making a prototype and there might be a need to reopen the shell. Also the parts and components are bolted together.

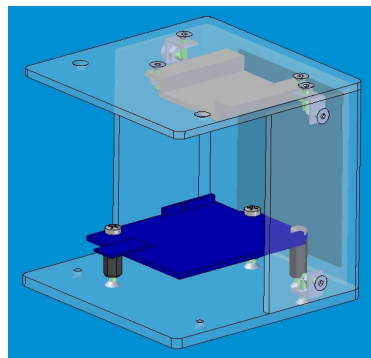


Figure 5.1.: Smart Object in modeling stage.

5.2. Hardware Specifications

Typical modern wireless devices contain the following building blocks: A controlling platform with a CPU, sensors, wireless communication interface, memory and a power source. In this project we chose these blocks considering the following constraints: price, ease of use, flexibility and energy consumption.

5.2.1. Arduino BT

The Arduino BT is a microcontroller board based on the ATmega328 and the Bluegiga WT11 bluetooth module. Main features a a wireless serial communica-

tion over bluetooth, 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a 32 KB Flash Memory and 2 KB SRAM. [4]

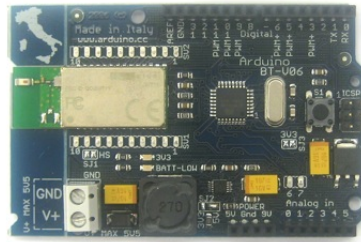


Figure 5.2.: Arduino BT

5.2.2. IMU Digital Combo Board - ITG3200/ADXL345

The IMU offers a 6 degrees of freedom measurement. The communicate is solved over I²C with the Arduino.

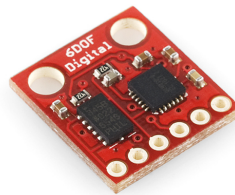


Figure 5.3.: IMU

ITG-3200 Integrated Triple-Axis Digital-Output Gyroscope

The Gyroscope is single-chip, digital-output, 3-axis MEMS gyro optimized for gaming, 3D mice, and motion-based remote control applications. It features three 16-bit analog-to-digital converters (ADCs) for digitizing the gyro outputs and a Fast-Mode I²C (400kHz) interface. The Digital-output X-, Y-, and Z-Axis angular rate sensors have a sensitivity of 14 LSBs per °/sec and a full-scale range of ± 2000 °/sec. [3]

Digital Accelerometer ADXL345

The ADXL345 is a small and ultra low power 3-axis accelerometer. It measures the static acceleration of gravity, as well as dynamic acceleration resulting from motion or shock. The measurement is done with a high resolution (13-bit) at up to ± 16 g. The data is formatted as 16-bit twos complement and is accessible through a I²C digital interface. The resolution of 3.9 mg/LSB) enables measurement of inclination changes less than 1.0° . [5]

5.3. Information flow from the sensors the the PC

The movement of the object is registered by an IMU. After that the electronical data is converted by a Logical Level Converter. At last the Arduino board sends the data via bluetooth to a PC. The microphone registers the voice input and sends it to the Arduino. The Arduino sends the data to a PC via bluetooth. The touch pad detects the input (touch) and sends it to breakout board. In the end the data is sent to the Arduino and from there it's sent to the PC via bluetooth.

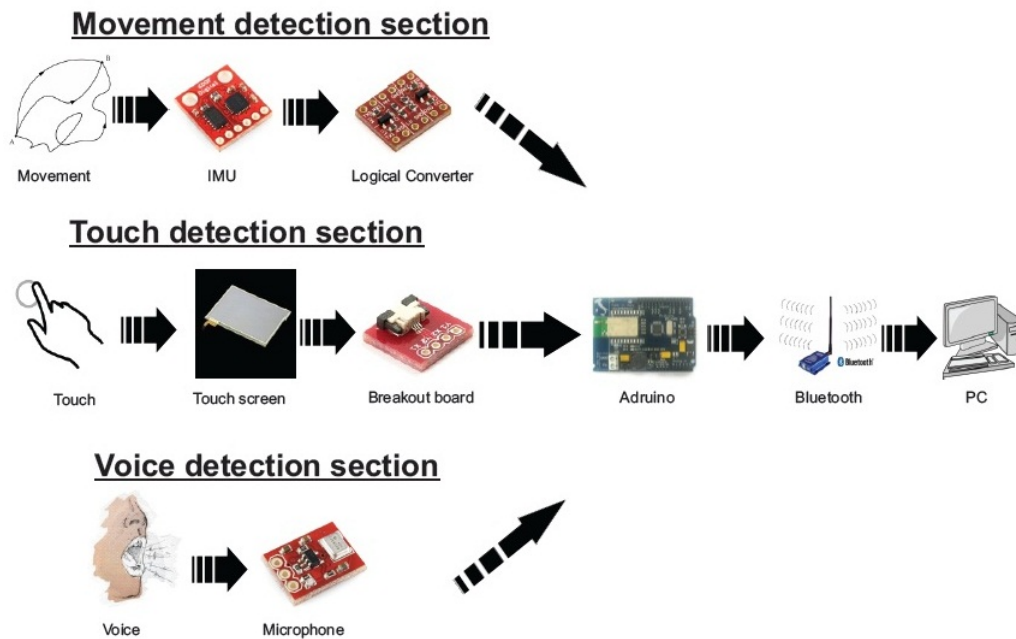


Figure 5.4.: infomation flow

5.4. Programming a representation of the object

The programming language on the PC side is Java. To get a powerful amount of functions we use a Java OpenGL engine called jmonkeyengine. All informations about this engine can be found here: [15] To develop the Java program we use Eclipse [16]. After creating a project and including the jmonkey libraries the initialization of the virtual environment is the following:

```

1  public void simpleInitApp() {
2
3
4      PointLight sun = new PointLight();
5      sun.setPosition(new Vector3f(-7, 2, -30));
6      sun.setColor(new ColorRGBA(1f, 1f, 0.8f, 0.4f));
7      sun.setRadius(3f);
8      rootNode.addLight(sun);
9
10     PssmShadowRenderer pssmRenderer = new PssmShadowRenderer(assetManager, 1024, ←
11         4);
12     pssmRenderer.setDirection( sun.getPosition() );
13     viewport.addProcessor( pssmRenderer );
14     rootNode.setShadowMode( RenderQueue.ShadowMode.Off );
15
16     Material mat_stl = new Material(assetManager, "Common/MatDefs/Misc/Unshaded. ←
17         j3md");

```



```

16 Texture tex_m1 = assetManager.loadTexture("images/ISEP.gif");
17 mat_stl.setTexture("ColorMap", tex_m1);
18 global_vars.cube.setMaterial(mat_stl);
19 global_vars.cube.setShadowMode( RenderQueue.ShadowMode.CastAndReceive);
20
21 }

```

We created a cube and set up the surface of the cube with the logo of the ISEP. The result is shown in the following picture.



Figure 5.5.: Smart Object in Java

In the Appendix the code for rotating this cube can be found. The rotation is achieved in a loop by changing the roll- pitch and yaw angle.

5.5. Conclusions

In this paper, we presented a context-aware smart object for communication with a virtual environment. This described object consists of three parts: (1) Arduino microcontroller, which connects with board of sensors, (2) an IMU (inertial measurement system) that gets a full 6 degree of freedom measurement of the position of the object, and (3) a wireless data connection and a virtual environment which is programmed in JAVA.

5.6. Future Developments

We have to make the product more marketable, at the moment the prototypes shell is made of acrylic glass. This material is not suitable for mass production. When the SO is going to hit the market the shell should be made from a moldable material like ABS- plastic. Also the outer design should be more attractive, at the moment it looks like box where we can put our hardware.

A. Java Source Code for Modelling the Object

A.1. HelloMaterial.java

```

1 import com.jme3.app.SimpleApplication;
2 import com.jme3.light.PointLight;
3 import com.jme3.material.Material;
4 import com.jme3.math.ColorRGBA;
5 import com.jme3.math.Quaternion;
6 import com.jme3.math.Vector3f;
7 import com.jme3.scene.Geometry;
8 import com.jme3.shadow.PssmShadowRenderer;
9 import com.jme3.texture.Texture;
10 import com.jme3.renderer.queue.RenderQueue;
11 import java.lang.Math;
12
13 /** Sample 6 – how to give an object's surface a material and texture.
14  * How to make objects transparent, or let colors "leak" through partially
15  * transparent textures. How to make bumpy and shiny surfaces. */
16
17 public class HelloMaterial extends SimpleApplication {
18     public static void main(String[] args) {
19         HelloMaterial app = new HelloMaterial();
20         app.start();
21     }
22     protected Geometry cube;
23     @Override
24     public void simpleInitApp() {
25
26         PointLight sun = new PointLight();
27         sun.setPosition(new Vector3f(-7, 2, -30));
28         sun.setColor(new ColorRGBA(1f, 1f, 0.8f, 0.4f));
29         sun.setRadius(3f);
30         rootNode.addLight(sun);
31
32         PssmShadowRenderer pssmRenderer = new PssmShadowRenderer(assetManager, 1024, ←
33             4);
34         pssmRenderer.setDirection(sun.getPosition());
35         viewport.addProcessor(pssmRenderer);
36         rootNode.setShadowMode(RenderQueue.ShadowMode.Off);
37
38         Material mat_stl = new Material(assetManager, "Common/MatDefs/Misc/Unshaded.←
39             j3md");
40         Texture tex_ml = assetManager.loadTexture("images/ISEP.gif");
41         mat_stl.setTexture("ColorMap", tex_ml);
42         global_vars.cube.setMaterial(mat_stl);
43         global_vars.cube.setShadowMode(RenderQueue.ShadowMode.CastAndReceive);
44     }
45     /** This is the update loop */
46     @Override
47     public void simpleUpdate(float tpf) {
48
49         rootNode.detachAllChildren();
50
51         Quaternion quad = new Quaternion().fromAngles(global_vars.ang.yaw, ←
52             global_vars.ang.pitch, global_vars.ang.pitch);
53         global_vars.cube.setLocalRotation(quad);
54         rootNode.attachChild(global_vars.cube);
55         if (global_vars.ang.pitch <= 2 * Math.PI) {

```

```

54     global_vars.ang.pitch = global_vars.ang.pitch + (float) 0.01;
55     }
56     else
57     {
58         global_vars.ang.pitch=(float) 0.5;
59     }
60     this.speed = 10; }
61 }

```

A.2. angles.java

```

1
2 public class angles {
3
4     float pitch;
5     float yaw;
6     float roll;
7 }

```

A.3. global_vars.java

```

1
2 import com.jme3.math.Vector3f;
3 import com.jme3.scene.Geometry;
4 import com.jme3.scene.shape.Box;
5
6
7 public interface global_vars {
8
9     angles ang = new angles();
10    Box boxshape1 = new Box(new Vector3f(0,0,0), 1f,1f,1f);
11    Geometry cube = new Geometry("My Textured Box", boxshape1);
12
13 }

```

Bibliography

- [1] Wikipedia, Computer mouse (April, 2012) [http://en.wikipedia.org/wiki/Mouse_\(computing\)](http://en.wikipedia.org/wiki/Mouse_(computing))
- [2] Java OpenGL Engine (April, 2012) <http://jmonkeyengine.com/>.
- [3] ITG-3200 Integrated Triple-Axis Digital-Output Gyroscope;(April, 2012) <http://invensense.com/mems/gyro/itg3200.htm>
- [4] Arduino Bt;(April, 2012) <http://arduino.cc/it/Main/ArduinoBoardBluetooth>
- [5] Wikipedia,Wifi (April, 2012): <http://en.wikipedia.org/wiki/Wi-Fi>
- [6] Wikipedia,Bluetooth (April, 2012): <http://en.wikipedia.org/wiki/Bluetooth>
- [7] 3D mouse (April, 2012): <http://www.3dconnexion.com/products/what-is-a-3d-mouse.html>
- [8] Wikipedia, IMU (April, 2012): http://en.wikipedia.org/wiki/Inertial_measurement_unit
- [9] Wikipedia, Arduino (April, 2012): <http://en.wikipedia.org/wiki/Arduino>
- [10] Wikipedia, ZigBee (April, 2012):<http://en.wikipedia.org/wiki/ZigBee>
- [11] Wikipedia, Touchscreen (April, 2012): <http://en.wikipedia.org/wiki/Touchscreen>
- [12] Wikipedia, Li-Po battery (April, 2012): http://en.wikipedia.org/wiki/Lithium-ion_polymer_battery
- [13] Wikipedia, Solar panel (April, 2012): http://en.wikipedia.org/wiki/Solar_panels
- [14] 3DConnexion (April, 2012): <http://www.3dconnexion.de/nc/videos.html>
- [15] JMonkey Engine(April, 2012): <http://jmonkeyengine.com/>
- [16] Eclipse: <http://www.eclipse.org/>