iBEX

Vision

Version 2.0

Revision History

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| --- | --- | --- | --- |
| **Date** | **Version** | **Description** | **Author** |
| 4/18/2015 | 2,0 | The vision and mission manifest of iBEX/SyncBox | Altay Brusan |
| 5/23/2015 | 2,0 | Corrections based on Alper Yaman comments | Altay Brusan  Alper Yaman |
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# Introduction

*The iBEX in conjunction with syncBox,* ***the system****, provides a platform that is flexible to change. The primary goal is to design the system such that it would be adaptable to any type change and simultaneously supports intelligent suggestion.*

*GOAL: THE SYSTEM IS FLEXIBLE TO ANY SORT OF CHANGE & INTELLIGENT*

*We have categorized “changes” into three types:*

*Device:*

*One or more peripheral devices may show up in on application but in another application it may not exist at all! For example, in one application an automatic Exposure Control (AEC) is critical. However, in another one it may not be used. Beside this, sometimes a device may be replaced by another one. As an example, a power generator may change or detector may be upgraded.*

*Operating Environment:*

*The platform is going to be implemented on portable and stationary versions. It may run on a single machine or network. Beside this it supports both Microsoft windows, Apple iOS and Android.*

*Modality:*

*The system is designed modular. So it is extendable to other modalities such as ultra-sound & MRI.*

*The purpose of this document is to collect, analyze, and define high-level needs and features of the iBEX. It focuses on the capabilities needed by the stakeholders and the target users, and* ***why*** *these needs exist. The details of how the iBEX fulfills these needs are detailed in the use-case and supplementary specifications.*

## References

* *iBEX Software requirement specification v.2, Jan.25.2015, Altay Brusan*
* *iBEX Software Architecture v.2 , April.20.2015, Altay Brusan*
* *FDA standards*

# Positioning

## Problem Statement

|  |  |
| --- | --- |
| The problem of | *X-ray imaging devices are developed in ad-hoc fashion in passive way.* |
| affects | * *Manufacturers have to develop a new (or upgrade their own old version) softwares for each new design.* * *The components made by different manufacturers may not be consistent with each other.* * *The devices are not perfectly designed to match the exact costumer’s expectation.* * *Most of the time there is no level of intelligence within the system.* * *Lack of flexibility* |
| the impact of which is | * *Missing cost-performance optimum point.* * Increase costs for final costumers. * *Hardship in upgrading and/or adaption to new requirements.* * *More vulnerable to human errors.* |
| a successful solution would be | * *Highly customizable by Plug and Play (PnP) approach.* * Intelligent. * Simple to understand by user. * *Provides optimum point in the sense of performance- cost trade off.* |

## 

## Product Position Statement

|  |  |
| --- | --- |
| For | * *medical x-ray imaging companies,* * *industrial x-ray imaging companies,* * x-ray imaging device manufacturers, * academic researchers, * *digital x-ray imaging device manufacturers.* * *intelligent signal processing people* |
| Who | * *wants to take digital x-ray images* * *analyze digital x-ray ray image* |
| The (product name) | * *is a platform* |
| That | * *That controls and synchronize diverse types of x-ray imaging devices, and let the researchers to develop their algorithms to process the acquired images.* |
| Unlike | * E-COM |
| Our product | * *is reliable, modular and intelligent that supports both medical and industrial needs.* |

# Stakeholder and User Descriptions

*This section provides a profile of the stakeholders and users involved in the project, and the key problems that they perceive to be addressed by the proposed solution.*

## Stakeholder Summary

|  |  |  |
| --- | --- | --- |
| **Name** | **Description** | **Responsibilities** |
| *Retailers* | *Sells and customize the platform to the customers and provide maintenance.* | *ensures that the system will be maintainable*  ensures that there will be a market demand for the product’s features |
| *Cooperators* | *These are manufactures of x-ray components. They provide us with their own devices, drivers and documentations of their own products* | *ensures that the system will be maintainable*  *ensures that the system will match their devices* |
| *3rd party developers* | *Developers and academic researchers that develops intelligent systems and image processing libraries.* | *Enrich the image processing algorithms library.*  Increase AI performance.  *Increase the overall system performance* |

## User Summary

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Description** | **Responsibilities** | **Stakeholder** |
| *Final customer (includes hospitals, factories and universities)* | *Directly get involved in using the platform.* | *involved in customizing the interface*  *Report bugs*  involved in customizing the intelligent unit | customer |

## User Environment

*The* ***final customer*** *orders an x-ray imaging device with specific configuration and level of autonomy. Based on the customer’s requirements and final application (i.e. medical or industrial), the platform is customized by the retailer to best fit the requirements.*

*In industrial applications, the platform is mounted on production line to monitor the products and classify them. A full autonomous system has an intelligent software inside that is trained dedicatedly to the products that passes through the production line. After then, the system decides on the new cases and classify them automatically. In a semi-autonomous system, in addition to the intelligent unit, there is an operator over the device that may (or may not) accept the intelligent suggestion and classifies the objects based on his/ her own perspective. In manual mode, the operator is the person in charge. The system provides the operator with the images and then s/he decides. In all cases, the components (e.g. power source, x-ray tube, detector, etc.) that are used are based on the user’s descriptions and are flexible to change.*

*In mobile and security applications in addition to the intelligence, the one the other issue is to customize the system to work in as minimum energy level as it is possible. This energy issue includes both x-ray energy and the computing device that the system runs on.*

*In all aforementioned applications, the imaging task may be ignited by the operator or system automatically detects and starts imaging. Also, in x-ray imaging the testaments usually require to be in a specific position just before the imaging. This could be done by hand (i.e. operator may get it to the coordinate) or an actuator could be used to position it. In the latter case, the platform can collaborate with mechanisms to handle the positioning issues.*

*In the medical applications, it is feasible to have an intelligent suggestion, however due to regulation and the other technical issues it is not a priority. Also, the imaging chamber has to comply with a set of regulations that are issued and updated by authorities. In these applications, there is always an operator that starts and ends images tasks. The operator, based on the doctors prescribe, selects an imaging protocol then starts that program. After acquiring, the images are sent to PACS server in DICOM file format.*

*iBEX is also required to support the PACS communication. However it is not confined to PACS. It also supports industrial version of DICOM which is DICONDE. To this aim, iBEX comes with a local implementation of PACS storage server.*

## Summary of Key Stakeholder or User Needs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Need** | **Priority** | **Concerns** | **Current Solution** | **Proposed Solutions** | |
| Flexible devices | High | Cost-performance optimization | Ad-hoc | | iBEX in conjunction with syncBox |
| Intelligent guidance | Medium | Quality | Restricted embedded solutions | | Unified and open to be extended in iBEX |
| Reduce unnecessary dose | High | Dose optimization | Dose tables and AEC | | Learn the dose performance from the previous images |
| Reduce human error factors | High | clear and easy-to-use system | Devices supports multiple languages. | | Customizable user interface to make it clearer. |

## Alternatives and Competition

*The only similar commercial solution to the system comes from E-COM. This company provides medical imaging workstation softwares. They have wide range of x-ray producer’s supports in their platform. However, their product is out dated, do not support intelligent and confined to just medical applications.*

*The general trend in medical imaging is that most producers have their own IT department. They develop their own softwares which most of the time are based on general purpose operating systems (like Linux or Microsoft windows). For complicated imaging modalities like MRI and CT , the developers and operators usually passes some training courses and acquire certificates and just after then they get specialist in products of that company.*

# Product Overview

*This section provides a high level view of the product capabilities, interfaces to other applications, and system configurations.*

## Product Perspective

*The complete details of the product is discussed in software requirement specification document.*

## Assumptions and Dependencies

* *This version of iBEX is developed on Microsoft Windows 7 and .NET 4.5*
* *The digital x-ray imaging is the only concentration of this document.*
* *A three-layer micro-kernel architecture is developed (Architecture document).The upper layer is presentation. It is based on Windows Presentation Foundation (WPF)*

# Product Features

*iBEX has:*

* *Built in intelligent tool which helps the operator on deciding on testaments.[Medium Priority]*
* *Let the operator to monitor the peripheral devices.[High priority]*
* *Let the operator to configure the settings of devices. [High priority]*
* *Let the operator to calibrate the devices. [Low priority, High risk]*
* *Let the operator to check the devices status and statistics. [Low priority, Low risk]*
* *Let the data to be stored in standard .dcm format. [Low priority, Low risk]*
* *Let the operator to view, manipulate and edit the images with built in image viewer. [Medium priority]*
* *Let the operator to search and retrieve inside data storage. [Low priority, Low risk]*
* *Let the operator to take back up from both system and data. [Low priority, Low risk]*
* *Let the operator to print the images. [Low priority, Low risk]*
* *Control the access level restrictions. [High priority]*

# Other Product Requirements

***Applicable standards****: AAPM radiology standards, FDA x-ray medical devices standards and CE certificate standards.*

***Hardware****: Depends on application and user demands, some components may exist in one customization but does not show up in the other one.*

***Platform requirements****: contemporary off the shelf operating systems.*

***Performance requirements****: Defined as number of testaments per 1 unit of time. As a roll of thumb, it will be slowest mechanical transaction times number of frames per object divided by unit of time.*

***Environmental requirements****: except mobile devices, for all other sort of applications there are standards and regulations.*

***Fault tolerance****: in emergency situation the x-ray emission is cut, mechanical units are locked and operator is notified.*

***Usability****: Menus and some functionalities are customizable based on the user demands.*

*External component requirements:*

* ***Database Server*** *: it is used for implementing local data storage (compatible with both medical and industrial versions of PACS)*
* ***DICOM writer****: in order to save images in dcm format, the system needs some special packages*
* ***Peripheral devices drivers***
* ***Graphic renders****: For rendering high quality x-ray images some external graphic libraries are required.*
* ***UI elements****: To make user interface more clear some extra elements from third party providers may be purchased.*
* ***PACS server****: In medical application it requires to have a standard PACS server or an interface to a server.*
* ***Graphical processors***: If accelerated graphical processor like NVidia or Cuda cards exists then the system uses them to run image processing algorithms over them and let the CPU be free for other tasks.

***Specific documentation requirements****: user manual and developer’s manual.*