

# Engineering in Bio-Medical Field Balancing User Experience, Social Impact and Commercialization

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6:30pm

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# Abstract

**Engineering** concerns with applying scientific knowledge, mathematics, design concepts, materials, fabrication processes, control, systemization, disciplines and innovation to develop solutions for specific technical challenges, while having to consider real life issues such as practicality, safety, cost and commercial-viability. Different from the academia in conducting basic studies on the upstream research, application engineers put more focus on the mid to downstream development, linking upstream scientific discoveries with subsequent applications of business value for the enhancement of human living.

**Bio-Medical Engineering (BME) is a multi-disciplinary field of engineering** gaining popularity in recent years, and has emerged as a discipline on its own. Due to the nature of biomedical applications requiring authorities in medicine, R&D engineers in this field are practicing with somewhat **different mentality** and work-ethics differentiated from engineers in other disciplines. One crucial factor in the BME R&D process is that the biomedical engineers need to serve the **end users** many of whom **are the authorities** in medicine, such as medical doctors, nurses, therapists, and other medical professionals, to meet the specific and unique requirements in their daily real-life operations. To certify an engineering solution for a specific problem in the BME field is therefore not the sole responsibility of the engineering team, but also the professional users in medicine. In other words, medical professionals should intimately be involved in the development of the solution with broad considerations of its compatibility with the professional practice, process, liability and regulatory.

This seminar is to share our engineering experience acquired in one of our recent completed projects of biomedical application as an example. During the project execution, **we had to intimately interact with a variety of medical professionals throughout the entire design and engineering processes.** The project and the solution setup have been reported in several media channels late last year. The prototype designs and solution setup have been deployed in one of the public hospitals in Hong Kong since last October. The ongoing trial uses are intended to satisfy the goal of enhancing patient experience in hospital.

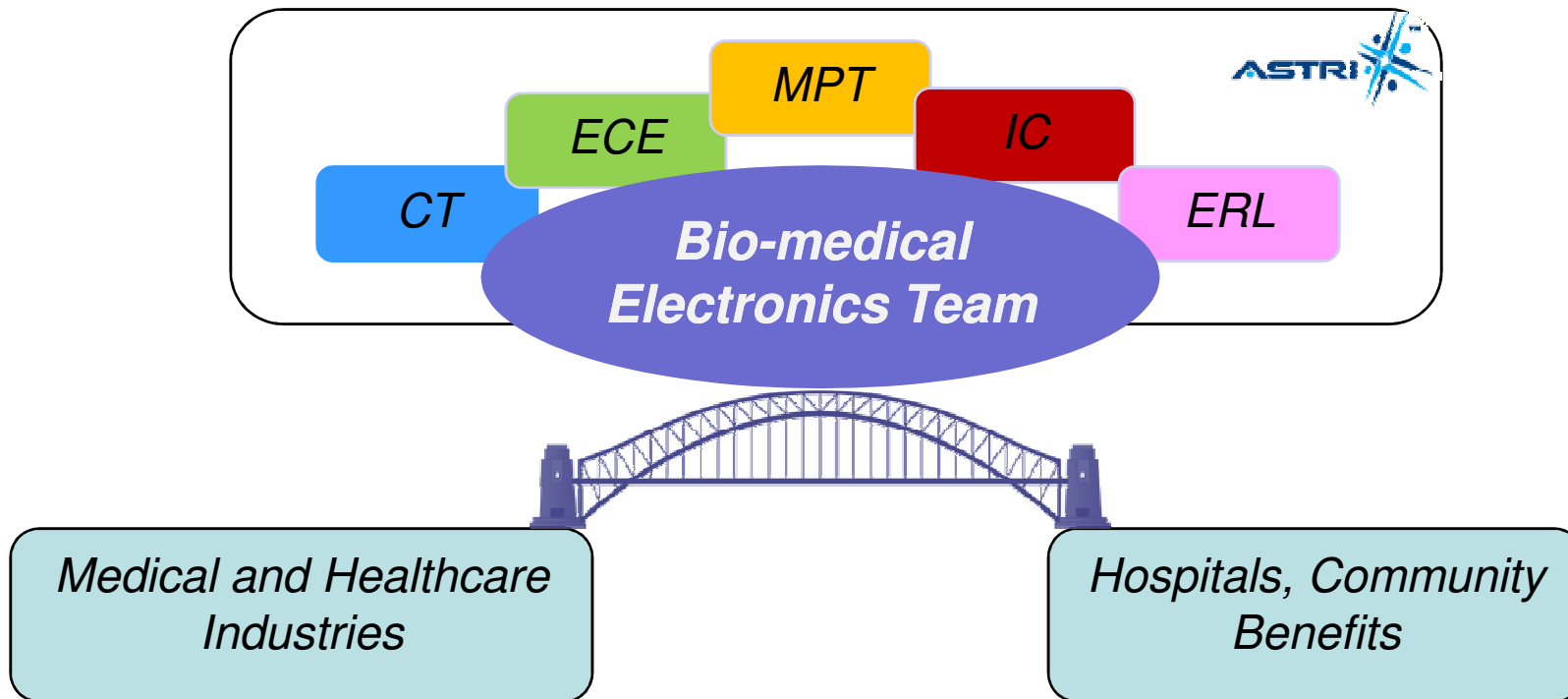
# Contents

- 1. ASTRI BME Background*
- 2. IDG Project*
- 3. Authorities*
- 4. Commercializations*
- 5. Concluding Remarks*

# ASTRI BME

## Mission

- To derive value-added biomedical applications for technology transfer to industry.
- To benefit Hong Kong healthcare by providing biomedical hardware and/or software solutions.



**Our Role: Solution Facilitator**  
**(NOT authority)**

# Projects

Completed:

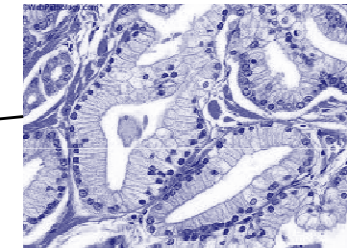
- ASTRI Tele-care System (ATS)*
- High Speed Digital Pathology (HSDP)*
- Brain Training Devices (BTD)*
- Minimally Invasive Surgery Goggle (MISG)*
- Immersive Distraction Goggle (IDG)***
- etc.*



**IDGPROJECT**  
ASTRI Bio-medical Electronics Team

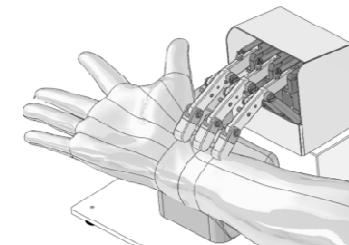
On-going:

- Computer-Aided Pathology Diagnosis (CAPD)*
- Cardiovascular Assessments via Chinese Medicine Approach (CACMA)*
- etc.*

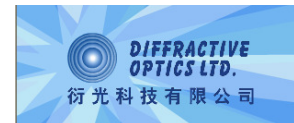
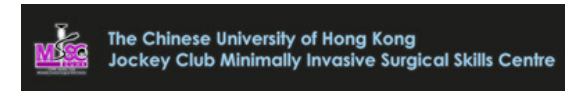


Future:

- Traditional Chinese Medicine (TCM)*
- People with Disabilities (PWD)*
- etc.*



# Our Partners



ASTRI Proprietary



# Background: IDG Project Summary

## Objective:

**Enhance Patient Experience** (Pain and Anxiety Relief)



Common negative experiences  
**Anxiety & Pain**

## Problem:

**Doctor specified solution is not available in the market**

## Period:

Apr – Sept 2012 (6 months)

## Major partners / authorities:

Medical professionals, play therapists from a local hospital (Paediatrics dept)



## Targeted Applications:

Injections, wound-care, dental, **laser-skin treatment**, physiotherapy, etc.

## Advantages:

Safe and efficient, save manpower and cost, benefits both patient and doctor

# Background: Diversionary Therapy

- **Pain, Anxiety, and Stress Relief**

Providing **audio and visual stimulus** to distract patient during medical procedure.

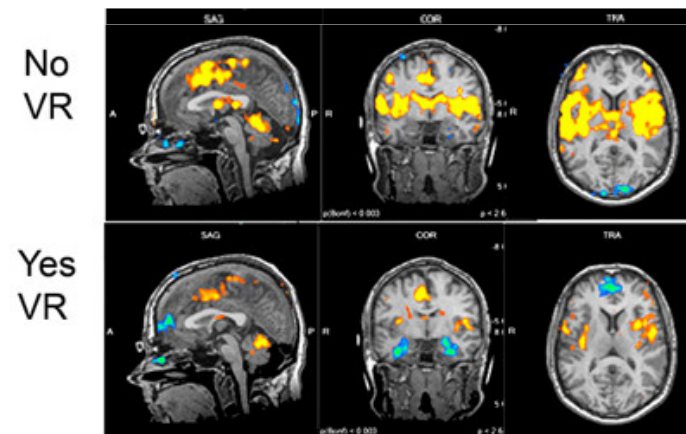
- **Proven Treatment / Therapy**

**Safe:** No or lesser dosage for sedation, only topical analgesic cream / local injection

**Effective:** Pain signal reduced (confirmed by MRI)\*



*fMRI Brain Scan*



*6 yrs old patient undergoes  
Diversionary Therapy  
(01:39)*

•Research in Virtual Reality Pain Reduction, <http://www.hitl.washington.edu/projects/vrpain/>  
•Prof. Hunter Hoffman, University of Washington <http://www.hitl.washington.edu/people/hunter/>





# Other Examples



(01:54)



(02:08)

## Soldiers Get Virtual Reality Therapy for Burn Pain



*Virtual reality 'aids burn victims'*  
(03:11)

- Research in Virtual Reality Pain Reduction, <http://www.hitl.washington.edu/projects/vrpain/>
- Prof. Hunter Hoffman, University of Washington <http://www.hitl.washington.edu/people/hunter/>



# Background

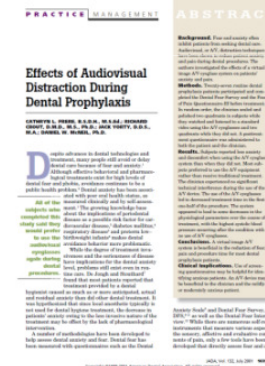
- **VR Therapy Research**  
**Very Bulky** Video Goggle System



- **Research in Dental Application** *in 2001\**  
An entertainment eyewear - **i-glasses™**

**Discontinued Product !**

<http://www.i-glassesstore.com/iglasses-video-hr.html>



- **Issues with Commercial Eye-wears**

**Solely for Entertainment, Not designed for medical, No kid-size**

# Entertainment Eyewears vs IDG system

Problem:

*“solution is not available in the Market” commented by Medical Professionals!*

	<b>Sony</b> <i>HMZ-T1</i>	<b>Epson</b> <i>Moverio</i> <i>BT-100</i>	<b>SiliconMic</b> <b>roDisplay</b> <i>ST-1080</i>	<b>Zeiss</b> <i>Cinemizer</i> <i>OLED</i>	<b>ASTRI</b> <b>IDG System</b>
Apps platforms	X	Android 2.2	X	X	<b>iOS</b> <b>Android 3.2</b>
Infotainment server	X	X	X	X	<b>YES</b>
Diopter-adjustable	X	X	X	Yes	<b>YES</b>
IPD-adjustable	Yes (5 fixed)	X	Yes	X	<b>YES</b>
Resolution	1280 x 720 OLED	960x540 LCD	1920x1080 LCoS	870x500 OLED	<b>852x480</b> <b>LCD</b>
FOV	45 deg (H)	23 deg (D)	45 deg (D)	30deg (D)	<b>35 deg (D)</b>
Size and Weight (Eyewear)	420g (210x257x126)	240g (205x178x47)	210g (202x193x52)	132g (165x190x38)	<b>85g</b> (125x40x27)
Kid size available	NO	NO	NO	NO	<b>YES</b>
Price	HK\$ 4980	US\$ 699.99	US\$ 799	Euro\$649	Goggle Set + Converter BOM < HK\$ 6.5K

*Unique and specific solution for medical applications*



# Children's Medical Service

- Short procedures
- Extreme anxiety
- Pain



*Laser treatment room*



*Patient well positioned for surgery*

# Series of requirements from Medical Professionals

## General:

- Mirroring display
- Laser safe / nonflammable
- Hygienic issue
- Size and weight

## Video Goggle:

- Immersive
- Kids->Adults
- IPD->Diopter
- Different mounting mechanism
- Toy-liked / cartoon mask
- Resolution vs FOV
- RCA ->HDMI

## Apps:

- Tablet -> Android -> iOS -> Lite
- Simple and easy navigation
- Patient ID
- Contents download

## Contents:

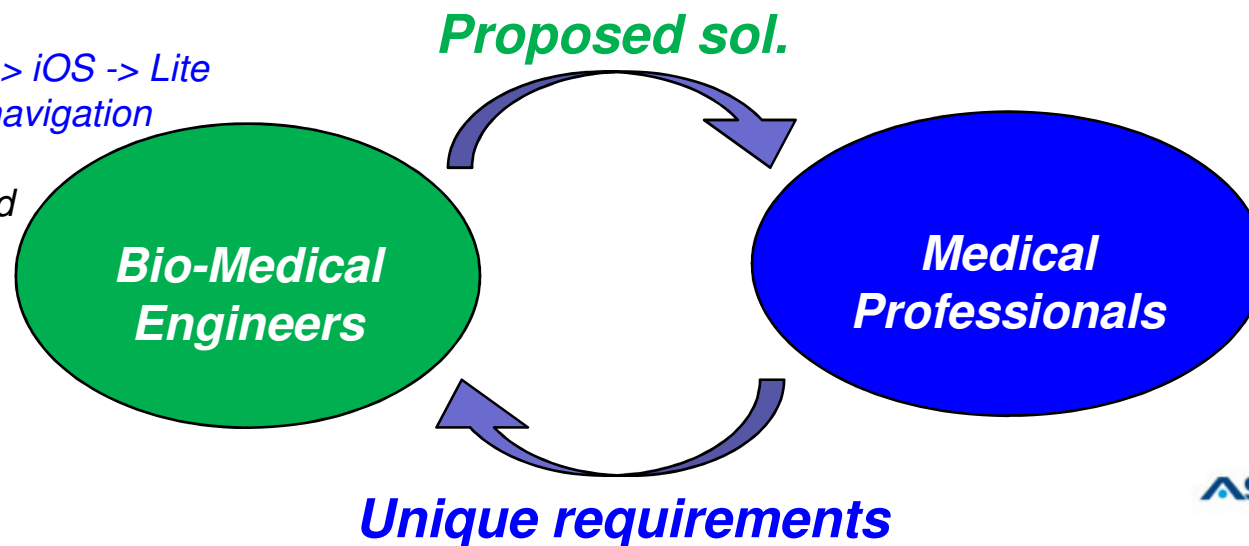
- 2D->3D
- Video call
- Picture in picture
- Game (e.g. bombarding the skin)
- VR / AR

## Server:

- Statics Categories
- Dynamic Categories

## Others:

- See through
- Emergency button
- Dummy setup / toys



# Series of requirements from Medical Professionals

## *Video Call*

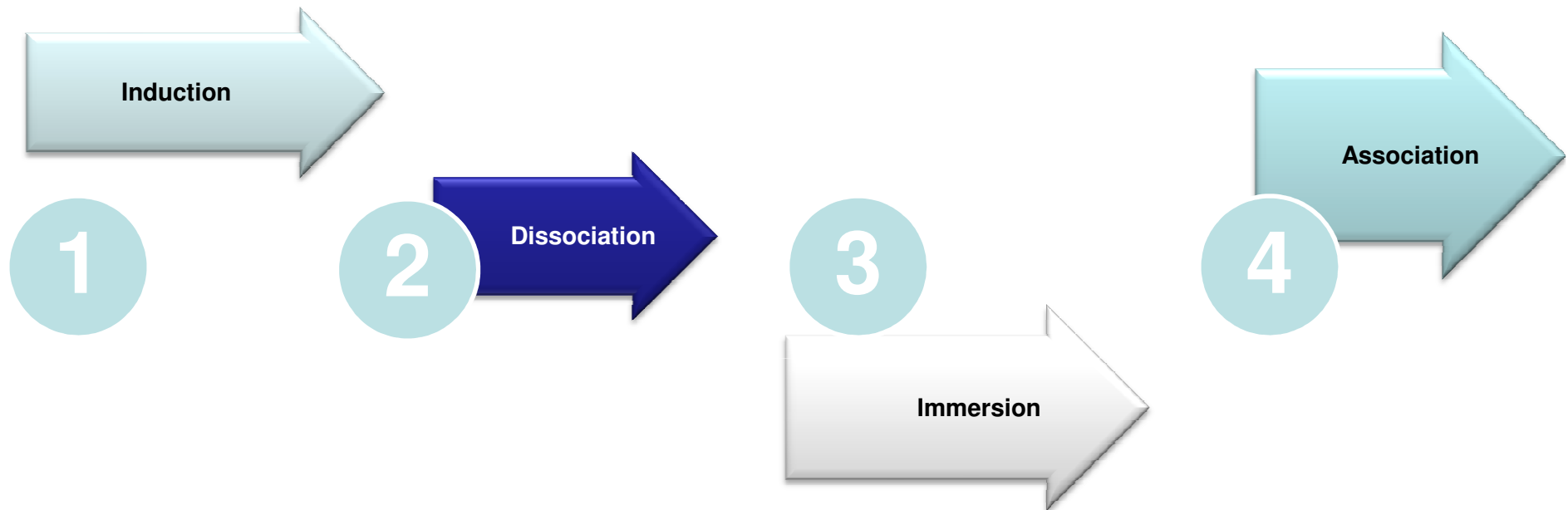


# Series of requirements from Medical Professionals

## *Augmented Reality*



# Series of requirements from Medical Professionals



*1<sup>st</sup> stage: Wear the eye-band first, and let the patient, especially kid, see his mother. (Dissociation)*

*2<sup>nd</sup> stage: Fit the goggle onto the eyeband.*



# Immersive Distraction Goggle (IDG)

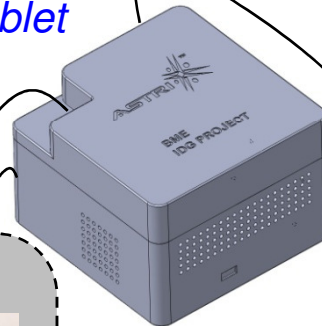
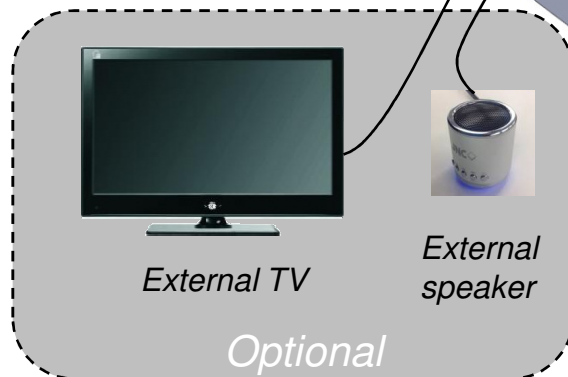
*In-house designed Apps*



*Doctor's master wireless control and display (mirroring) Tablet*

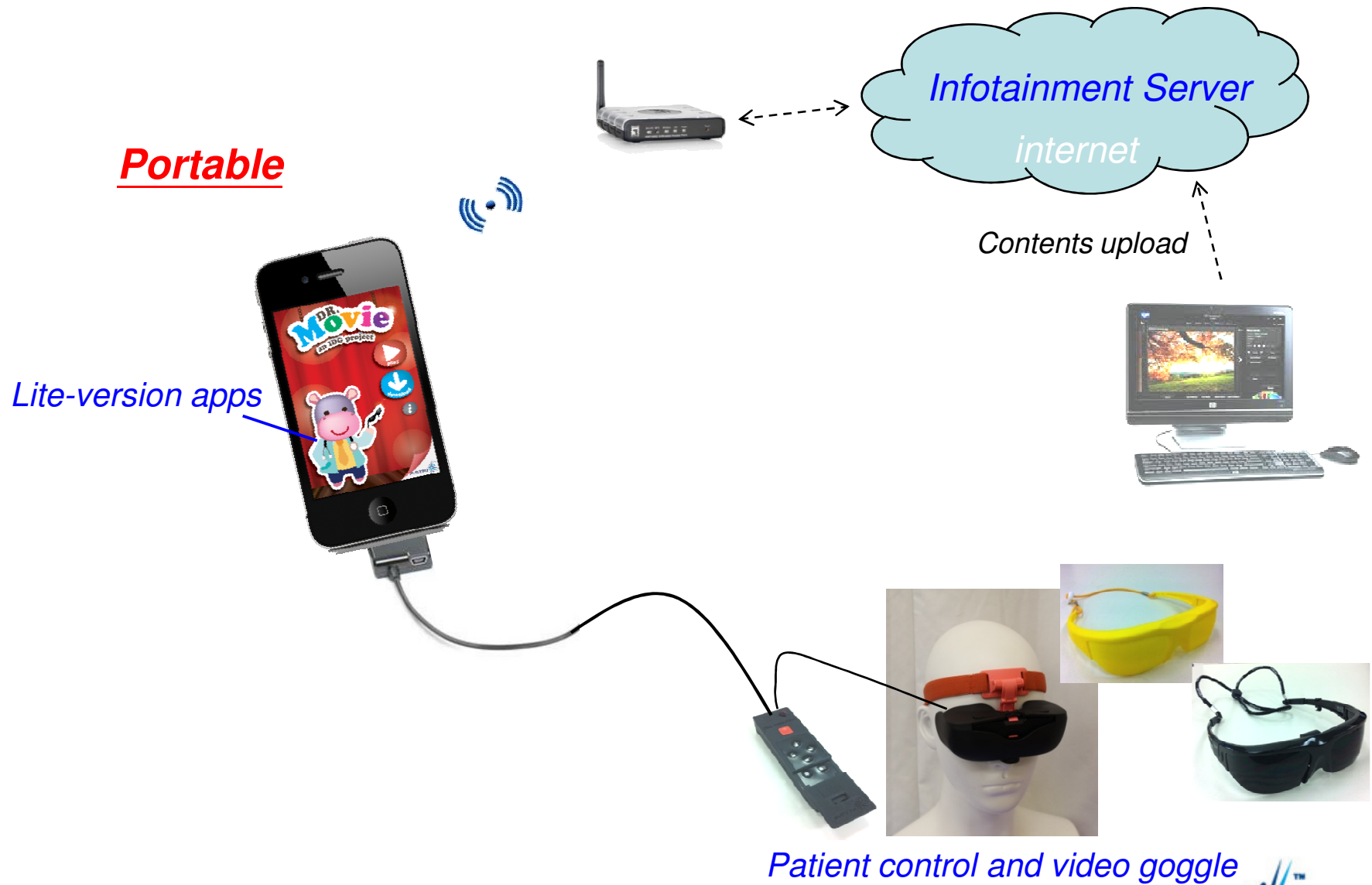


*Contents upload*



*Patient control and video goggle*

# Immersive Distraction Goggle (IDG)



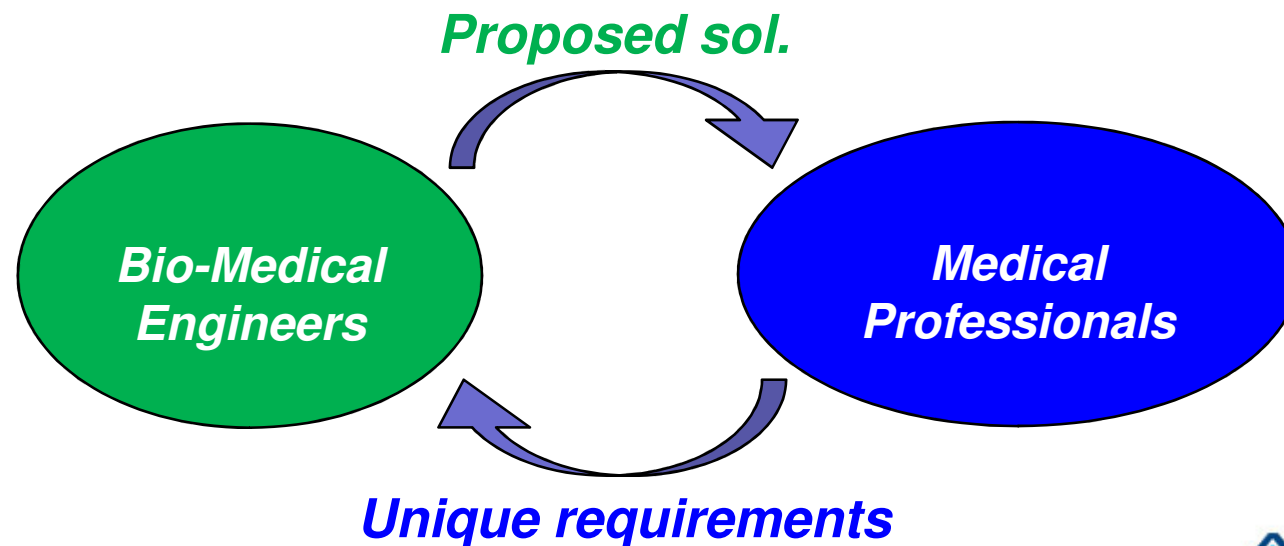
# Immersive Distraction Goggle (IDG)

## **Hardware:**

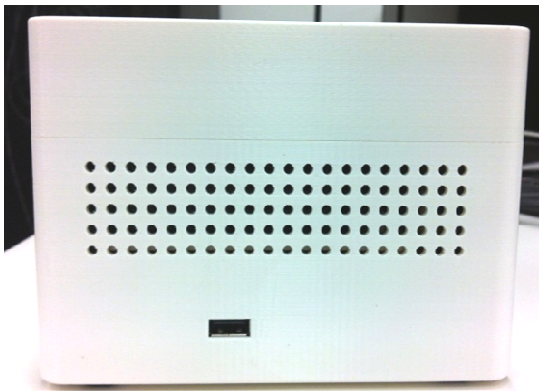
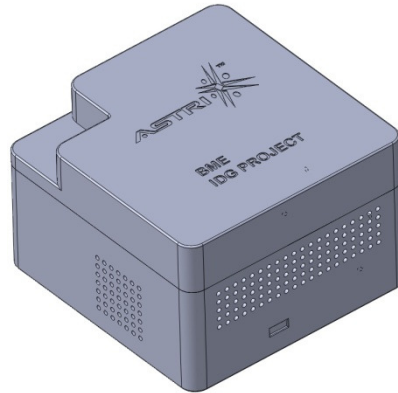
*Key Components Sourcing / Modifications / Engineering Integrations*

## **Software:**

*Infotainment Server Setup / Mobile Apps Development (iOS and Android) / Graphic Designs / Game*



# Immersive Distraction Goggle (IDG)

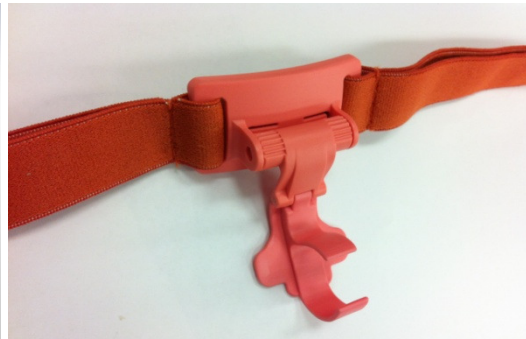
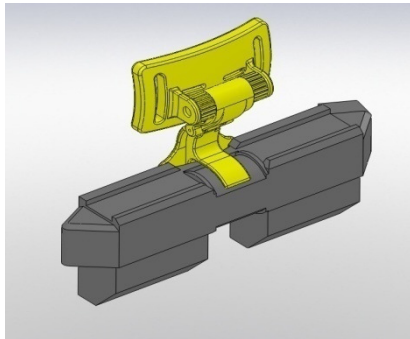


*HDMI ready*

*RCA ready*

*Console*

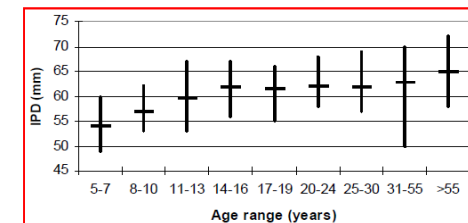
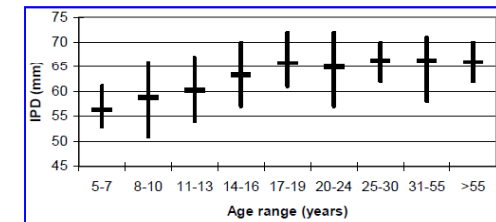
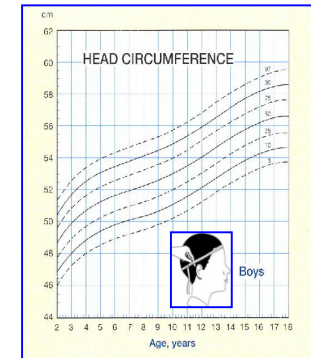
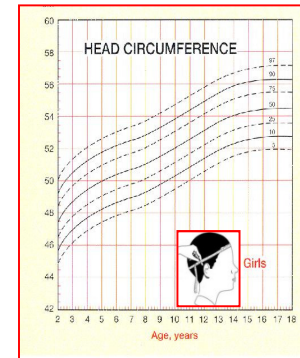
# Immersive Distraction Goggle (IDG)



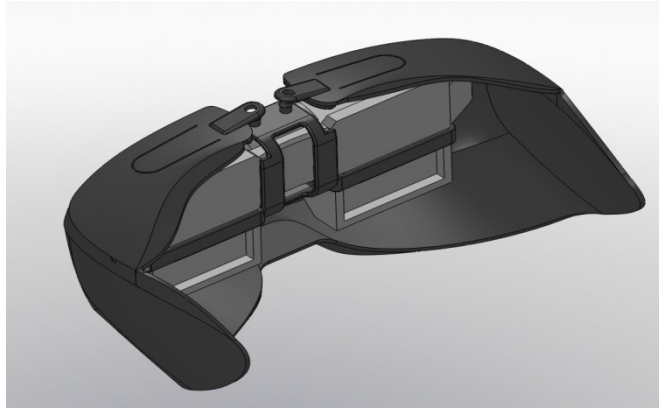
*Different mounting mechanism (fit for all head size)*



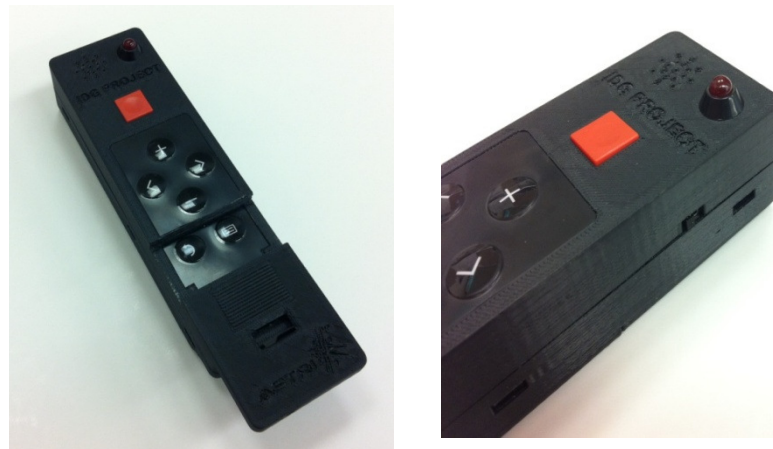
*Diopter and IPD adjustable video eyewear component*



# Immersive Distraction Goggle (IDG)



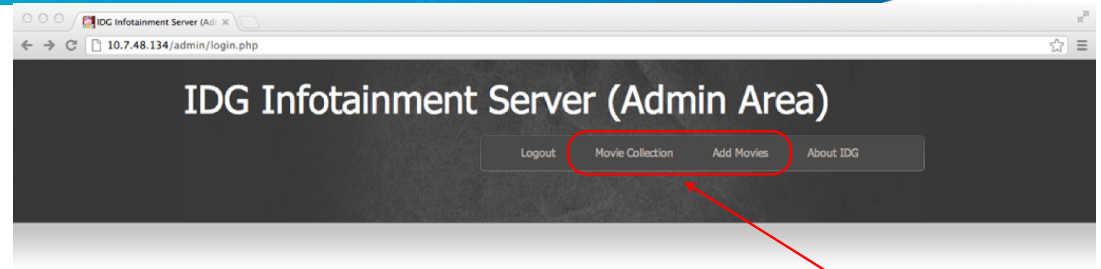
*Immersive Light-shield (L, M, S)*



*Patient Control*

# Immersive Distraction Goggle (IDG)

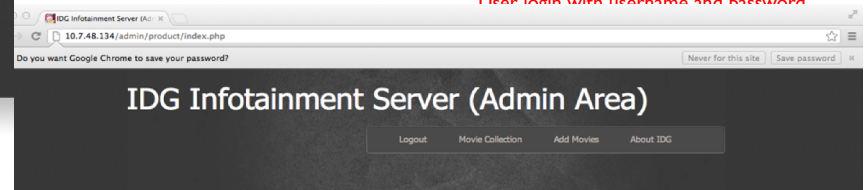
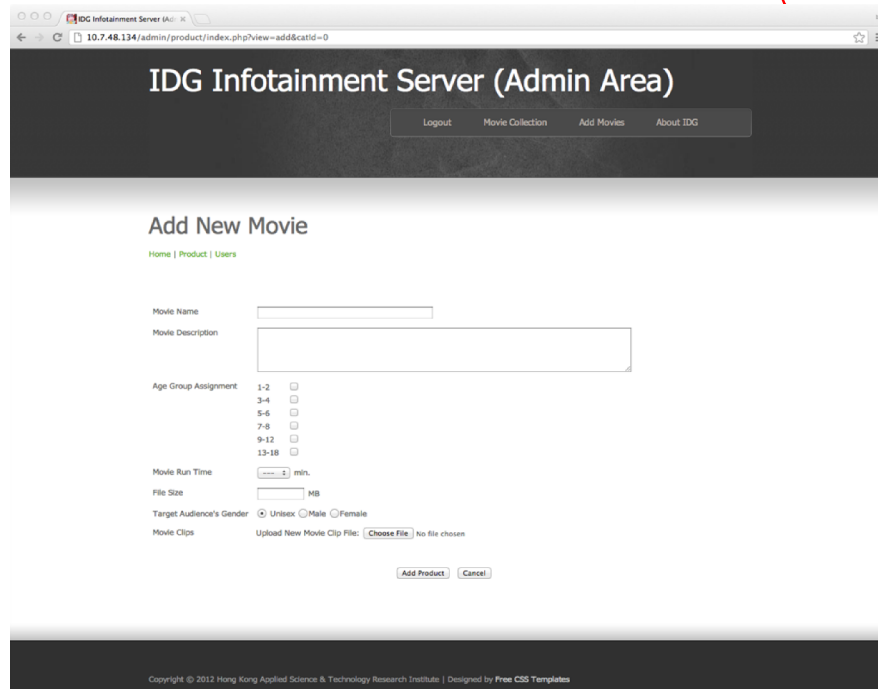
## Infotainment Server



Convenience links to build up media library



I login with username and password



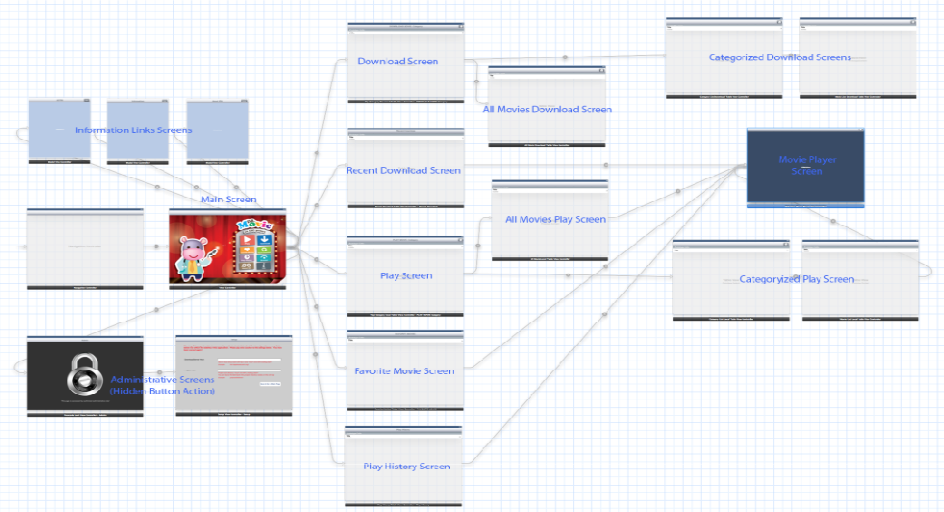
Editing functionality

Movie ID	Movie Name	Run Time	Gender	Age Group	File Size	Modify Delete
10116	Recumbent Biking in Hong Kong (兩輪單車)	5 min.	Unisex	1-2, 3-4, 5-6, 7-8, 9-12, 13-18	8 MB	Modify Delete
10115	New Dimensions of E-living (DinoCarnival 2011)	5 min.	Unisex	1-2, 3-4, 5-6, 7-8, 9-12, 13-18	19 MB	Modify Delete
10114	ASTRI's CEO introduces its latest technologies	5 min.	Unisex	1-2, 3-4, 5-6, 7-8, 9-12, 13-18	14 MB	Modify Delete
10113	ASTRI's Corporate Video	10 min.	Unisex	1-2, 3-4, 5-6, 7-8, 9-12, 13-18	74 MB	Modify Delete
10111	五月天_Finalhome_1_SS	60 min.	Unisex	13-18	260 MB	Modify Delete
10110	多啦A夢_小叮自食其力_7	10 min.	Unisex	5-6, 7-8, 9-12	69 MB	Modify Delete
10109	多啦A夢_室內種植米_7	10 min.	Unisex	5-6, 7-8, 9-12	69 MB	Modify Delete
10108	多啦A夢_模擬駕駛飛機到銀禧_7	10 min.	Unisex	5-6, 7-8, 9-12	69 MB	Modify Delete
10107	多啦A夢_未來世界的商品_7	10 min.	Unisex	5-6, 7-8, 9-12	69 MB	Modify Delete
10106	多啦A夢_玩具兵器_7	10 min.	Unisex	5-6, 7-8, 9-12	68 MB	Modify Delete

Movie collection in a glance

# Immersive Distraction Goggle (IDG)

Apps Development / Graphic Designs



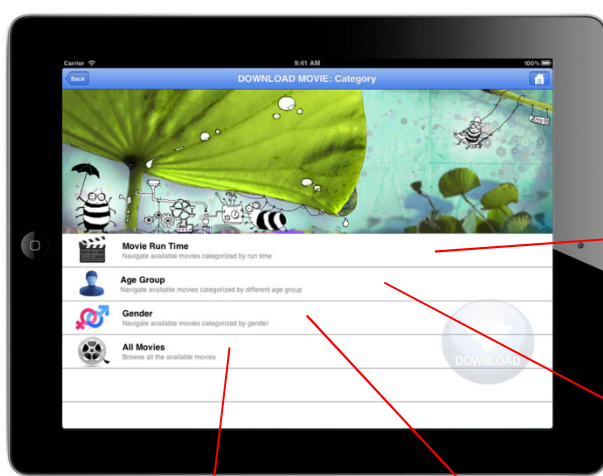
	Actions/Functions	Android Version	iPad Version	iPhone/iPod Touch Version
Main Interface Button Actions	Play	✓	✓	✓
	Download	✓	✓	✓
	Favorite Movies	✓	✓	✗
	Recent Download	✓	✓	✗
	Play History	✓	✓	✗
	Browser	✓	✓	✗
	About IDG	✓	✓	✓
	Info	✓	✓	✓
	ASTRI	✓	✓	✓



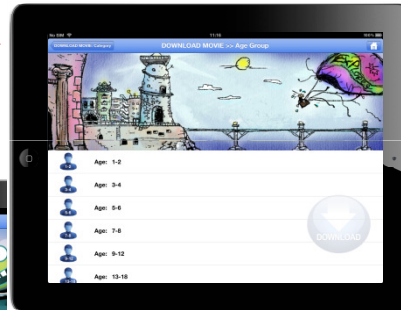
Change of IP address



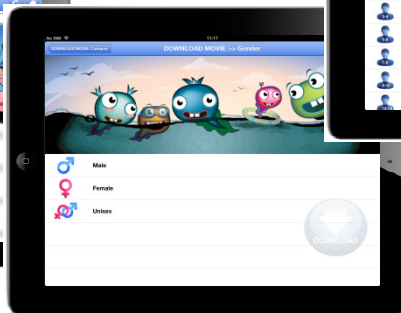
# Immersive Distraction Goggle (IDG)



Run time



Age group



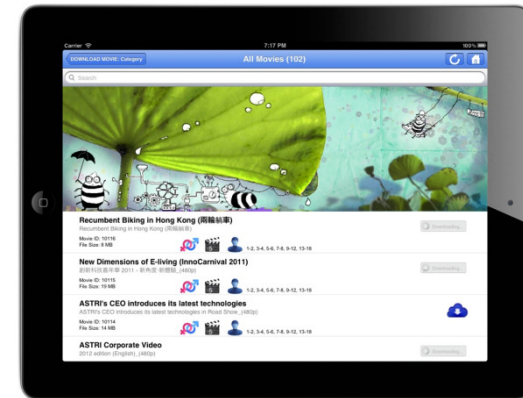
Gender



All movies

## Apps features:

- In-house developed graphics
- Categorized navigation
- Multiple download available
- Favorite
- Recent Download
- Play History
- Contents search
- IDG game
- Concurrent display, etc.
- Offline for play mode



click for download  
same for Play mode

# Immersive Distraction Goggle (IDG)

## Simple Game for Kids



*holding*



*watching*

***No touch-screen on a specific point is needed***



*Road signage (appear once in second)*



*... disappear ...*



*Swing the tablet*

# Immersive Distraction Goggle (IDG)

沉浸式醫療目鏡介紹

Immersive Distraction Goggle for medical use

## Different Contents

- *Pre-edited short video clips (e.g. cartoon)*
- *2D / 3D available*
- *Video Call*
- *Games*
- *eBook, Internet, Youtube, Facebook, etc.*

(01:53)

## Features

- **Apps**: in-house designed, facilitates doctor's requirement
- **Immersive Design**: light-shield and earphone
- **Human Factors**: all-sized head-mount, diopter & IPD adjustable, etc.
- **Controls**: doctor's master control, patient limited control
- **Infotainment server**: contents management
- **Versatile**: Instant contents switching during operation

# Social Impact

## Leading-edge research institutes drive progress and change

Over the past decade a cluster of research institutes has been established in Hong Kong, making of these businesses - ASTRI and responsible for many technologies

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## 戴目鏡睇影片 病童唔怕做手術

### 可加快療程 減用麻醉藥

【本報訊】香港應用科技研究院研發出一款專為小兒病人而設的醫療目鏡，能加快治療時期的進度，減輕痛苦及焦慮，有助加快療程及減少為病童使用的麻醉藥。

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## 戴眼罩睇住卡通做手術 小朋友合作唔扭計

### 小朋友專注力 分散小朋友注意力

【本報訊】香港應用科技研究院研發出一款專為小兒病人而設的醫療目鏡，能加快治療時期的進度，減輕痛苦及焦慮，有助加快療程及減少為病童使用的麻醉藥。

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## 應科院目鏡減痛 分散病人注意力

【本報訊】香港應用科技研究院研發出一款專為小兒病人而設的醫療目鏡，能加快治療時期的進度，減輕痛苦及焦慮，有助加快療程及減少為病童使用的麻醉藥。

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## 醫療目鏡 睇影片 減痛楚

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## 醫療目鏡系統 減病童焦慮痛楚

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## 戴視像鏡減手術恐懼

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# Social Impact



InnoCarnival 2012 (highlighted exhibit)



HK news (news.gov.hk)



HKBN - bbTV



NowTV - Medicine Online (杏林在線)

ASTRI Proprietary

## HKTDC - HK Pavilions 2013

Selected exhibits to be shown in below Expos

第八屆中國中部投資貿易博覽會(中博會) Expo Central China	鄭州 鄭州國際會展中心	2013年5月18日至20日
第二屆中國(北京)國際服務貿易交易會 China (Beijing) International Fair for Trade in Services (Proposed)	北京 國家會議中心	2013年5月28日至6月1日
第三屆中國—亞歐博覽會 China-Eurasia Expo (Proposed)	烏魯木齊 新疆國際會展中心	2013年9月2日至6日
第九屆泛珠三角經貿合作洽談會(泛珠) 9th Pan-PRD Trade Fair (Proposed)	貴陽	2013年9月9日至13日 ( 待定 )
第十屆中國-東盟博覽會(東盟) China-Asean Expo (Proposed)	南寧 南寧國際會展中心	2013年9月20日至24日
第十四屆中國西部博覽會 14th Western China International Fair (Proposed)	成都 成都市世紀城新國際會展中心	2013年10月23至27日



# Deployment in local Hospital



(02:26)

*Undergoing Laser Procedure without Sedation*



*before*



*laser procedure*



*after*

## +ve comments from doctor

- Safe and effective
- Patient awake & in control
- Early discharge
- Less side effect
- Cost effective
- Faster procedure
- Less manpower
- No fasting
- No post-operative vomiting / dizziness
- No post-operative medical care for sedation

# Authorities

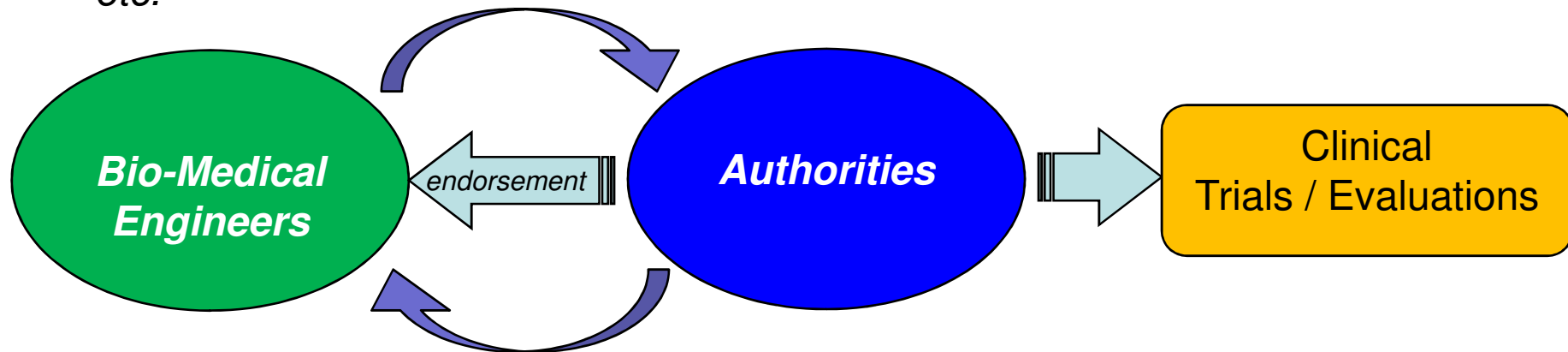
*BME role: Solution Facilitator*

## **Authorities: Medical Professionals**

- *Medical Doctors*
- *Medical Professors*
- *Therapists*
- *Psychologists*
- *Nurses*
- *Patients*
- *etc.*

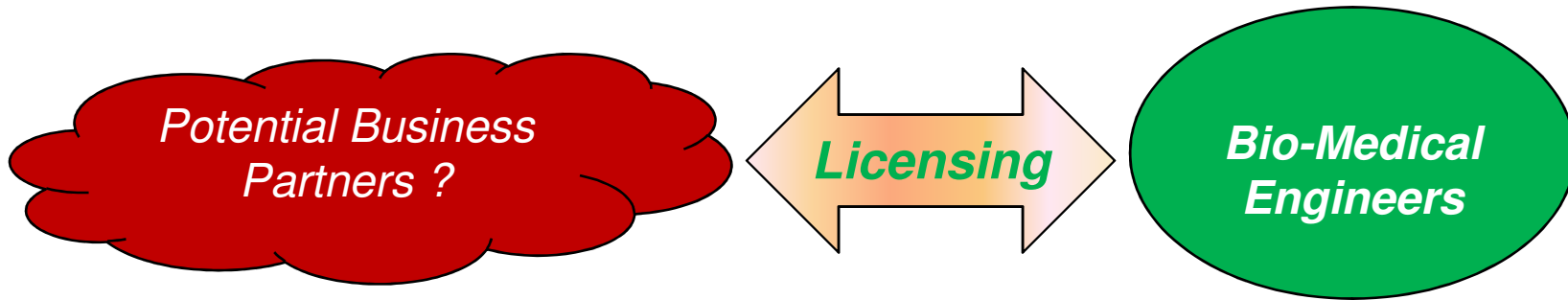
*IDG Project: 5 official visits in 6 months*

*Proposed sol.*

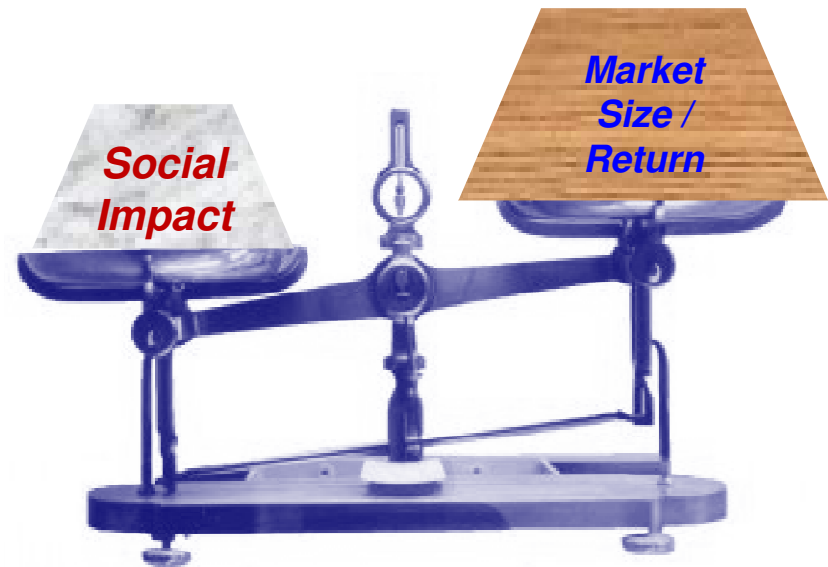


**Unique requirements**

# Commercialization (BME)



- *Market Research (Market Value)*
- *Business Model*
- *Engineering Solutions (Technical Value)*
- **Social Impact**
- **Authority**



**Always True ?**



# Concluding Remarks

*R&D Engineers in BME has somewhat different mentality:*

***“We are not the authority”***

*Development of engineering solutions:*

***Seek for medical professional’s input in regular basis.***