EXHIBIT 2020

IPR2018-01257 / IPR2018-01258

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC, ZTE (USA), INC., SAMSUNG ELECTRONICS CO., LTD.,
LG ELECTRONICS INC., HUAWEI DEVICE USA, INC.,
HUAWEI DEVICE CO. LTD., HUAWEI TECHNOLOGIES CO. LTD.,
HUAWEI DEVICE (DONGGUAN) CO. LTD.,
HUAWEI INVESTMENT & HOLDING CO. LTD.,
HUAWEI TECH. INVESTMENT CO. LTD., and
HUAWEI DEVICE (HONG KONG) CO. LTD.,
Petitioner

v.

CYWEE GROUP LTD.

Patent Owner

Case IPR2018-01257
Case IPR2018-01258

Patent No. 8,552,978
Patent No. 8,441,438

DECLARATION OF SHUN-NAN LIOU

July 31, 2019

1. I am a named-inventor of U.S. Patent Nos. 8,441,438 and 8,552,978, that are owned by and assigned to CyWee Group Ltd. ("CyWee Group") and that are the subject of the above-captioned matters. I am over the age of 21 and competent to make this declaration. I am the CEO of CyweeMotion Group Ltd and am president of CyWee Motion Inc.

2. A true and correct copy of a document entitled "CyWee, Where Technology Entertains 2009.09" is attached as Exhibit 2021. The document's properties show that it was created December 18, 2008 and last modified September 11, 2009.

3. A true and correct copy of a document entitled "JIL Game System Hardware Specification Ver. 1.5" is attached as Exhibit 2022.

4. A true and correct copy of a JIL Phone Bill of Materials, dated May 24, 2010, is attached as Exhibit 2023.

5. True and correct copies of photographs taken of a JIL Phone prototype and the printed circuit board in that device are attached as Exhibit 2024.

6. A true and correct copy of the CyWee Phone API Reference is attached as Exhibit 2025.

7. A true and correct copy of a document entitled "CyWee Motion Fusion Solution" is attached as Exhibit 2026.

8. A true and correct copy of a document entitled "CyWee Where technology entertains Technical Presentation: Motion Technology and Gaming Applications" is attached as Exhibit 2027.

9. A true and correct copy of an email to James Shen at Qualcomm, dated July 29, 2009, is attached as Exhibit 2028. A true and correct copy of an attachment to that email is attached as Exhibit 2029.

10. A true and correct copy of a Mutual Non-Disclosure Agreement between CyWee and Qualcomm Inc. is attached as Exhibit 2030.

11. A computer dedicated to the production of JIL phone, which contained a great deal of information regarding the development process and code for the project, was reformatted after the conclusion of the JIL phone project, making the code difficult to locate. Source code similar to the code that ran on the JIL phone was located in October 2016. Since then, CyWee has continued to search for the original code used in the project. I recently located the original source code for the JIL phone in an internal CyWee email dated March 16, 2010. That email is titled "Latest JIL phone with MR project of IIMR" and includes a file titled IIMR_dll_2010-02-12-1(Qualcomm_MR).rar. The .rar file is a compressed file, which includes a file named Attitude.cpp, which contains CyWee's sensor fusion code for the JIL phone as of February 12, 2010 according to the "date modified" timestamp on the file. A true and correct copy of Attitude.cpp is attached hereto as Exhibit 2031.

12. I worked with my fellow inventors, Zhou Ye and Chin-Lung Li, on developing motion sensing technologies.

13. In the 2008-2010 period, I was involved in research and product development activities related to motion sensing, including a game controller known as the Z controller, and the JIL phone.

14. Before May 22, 2009, CyWee selected hardware for the "JIL Game Phone Project." *See* Exhibit 2021 at 11 (providing project name), Exhibit 2022 at 4, 7 (listing revisions to hardware specification, and describing CyWee's involvement). CyWee was designated as the "Motion HW/SW [Hardware/Software] Solution Provider" for the project. Exhibit 2021 at 11. The hardware selected included a smartphone with an integrated display that could be used as a 3D pointing device for game control. The hardware selected before May 22, 2009 show that the JIL phone

was a smartphone that included 9-axis output. Exhibit 2021 at 9. More specifically, the device included a 3-axis accelerometer, 3-axis rotation output, and a 3-axis magnetometer. *Id*. The JIL Phone hardware specifications were documented on May 22, 2009, then updated on June 22, 2009 and November 7, 2009. Exhibit 2022 at 4. The hardware specifications corresponding to the motion sensors continued to be updated through at least May 24, 2010 as the team refined its selection of sensor hardware components. Exhibit 2023.

15. The inventions claimed in the '438 patent were conceived of on or before May 22, 2009 and diligently reduced to practice by at least as early as July 29, 2009. *See* Exhibit 2028 (referencing JIL phone). Claims 10 and 12 of the '978 patent were conceived of by the end of May 2009 and diligently reduced to practice by at least as early as September 25, 2009. *See* Exhibit 2025 at 2 referencing API software for JIL Phone. Between the date of conception and the actual reduction to practice of each patent, CyWee held weekly research and development meetings for each of the on-going projects, which were attended by a team consisting of the co-inventors of the '438 and '978 Patents and others working at our direction.

16. A JIL Phone prototype is shown below:



Exhibit 2024 at 1. The housing and PCB used in the JIL phone prototype were manufactured by Foxconn.

17. The JIL Phone was revolutionary in several respects. Unlike earlier devices (including earlier Apple mobile devices) the JIL Phone incorporated a gyroscope, accelerometer, and magnetometer, which together were capable of 9-axis output. Exhibit 2025 at 4; *see also* Exhibit 2027 at 22 ("CyWee's motion module supports various types of games, allows for 9-axis motion recognition . . . ."). The JIL Phone performed sensor fusion by using sensor data from the three sensors to reduce errors when determining its orientation or attitude.

18. The JIL Phone shown above included an InvenSense IXZ-650 gyroscope capable of generating 3-axis output, a Yamaha YAS529 magnetometer, and a STMicroelectronics 2935 33DL accelerometer. Alternatively, the accelerometer and magnetometer could be replaced with an Aichi Micro Intelligent Corp. AMI602 6-axis motion sensor module. Exhibit 2023.

19. The team working on JIL Phone motion sensor technologies included my co-inventors on the patents-in-suit, Joe Ye and Chin-Lung Li. The team further included other CyWee personnel working at our direction, including but not limited to programmers.

20. Prior to the JIL Phone, CyWee developed the CyWee Z controller. The Z controller included a 3-axis accelerometer, and a gyroscope capable of outputting 3-axis rotational movement. *See* Exhibit 2021 at 3. A picture of the Z controller is shown below:



The Z controller performed sensor fusion, and was a controller meant to play games on an external display. *Id.* at 3. For example, the Z controller could be used in its stick form to control a racing game, or could pivot and be used as a gun in shooting and combat games. *Id.* at 4. The sensor fusion algorithm used with the CyWee Z controller was an earlier version compared to what is disclosed and claimed in the '438 and '978 patents, and did not yet practice all elements of the sensor fusion method claimed by those patents.

21. It is my understanding that the code for sensor fusion used in the JIL Phone practiced all elements of the sensor fusion method claimed by the '438 and '978 Patents.

22. The team developed at least six versions of JIL Phone software, all of which performed a sensor fusion algorithm practicing claims of the '438 and '978 patents, and were documented between September 25, 2009 and April 16, 2010. Exhibit 2025 at 2. The different versions were tested on the JIL Phone. The later versions of source code, including cwy_sfc_attitude.h and cyweefusionAGC.cpp , practiced the earlier sensor fusion algorithm developed in the Attitude.cpp code.

23. Before July 29, 2009, CyWee actually reduced to practice a solution for the JIL Phone that practiced claims of the '438 patent. *See* Exhibit 2028; Exhibit 2029 at 6, 7. Paragraph 24, below, shows an illustration of this solution. On July 29, 2009, Zhou Ye sent information regarding this solution to James Shen at Qualcomm. *Id.* This information was subject to a non-disclosure agreement between CyWee and Qualcomm. *See* Exhibit 2030. That non-disclosure agreement was entered into on April 23, 2008, for the purpose of developing the JIL Phone. *Id.*

24. The team's JIL Phone motion sensor development and system integrations are illustrated in several documents. For example, Figure 15 of Exhibit 2025 depicts the JIL Phone:

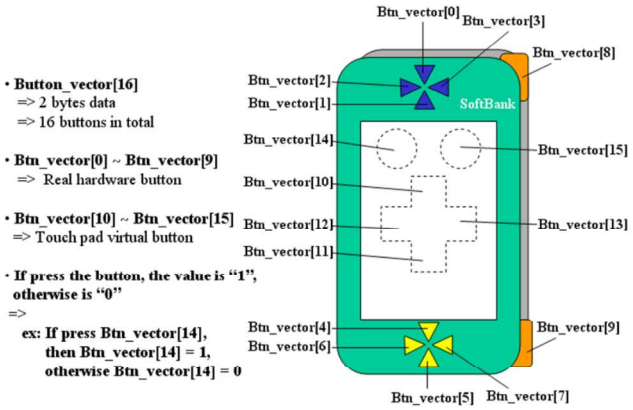


Figure 15: Example of APK of button arrangement for PC game application

And Figures 4 to 6 of the same document illustrate the team's integration of sensor fusion algorithm software with hardware by showing sensor output values as the prototype rotates about three different orthogonal axes:

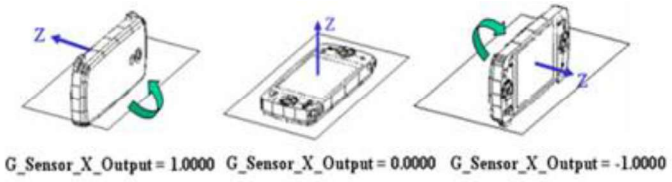


Figure 4: G sensor x output

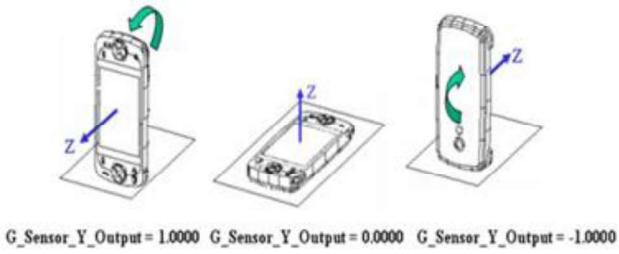


Figure 5: G sensor y output

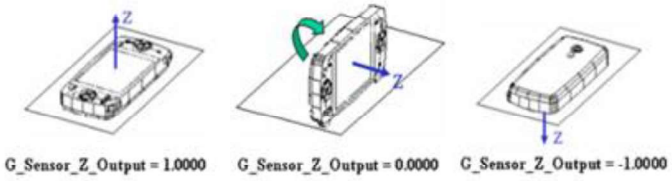


Figure 6: G sensor z output

Figure 3 of Exhibit 2026 shows the same JIL Phone illustration from the prior document, further annotated with axes and axes of rotation corresponding to the team's conventions employed by the JIL Phone's sensor fusion algorithm software.

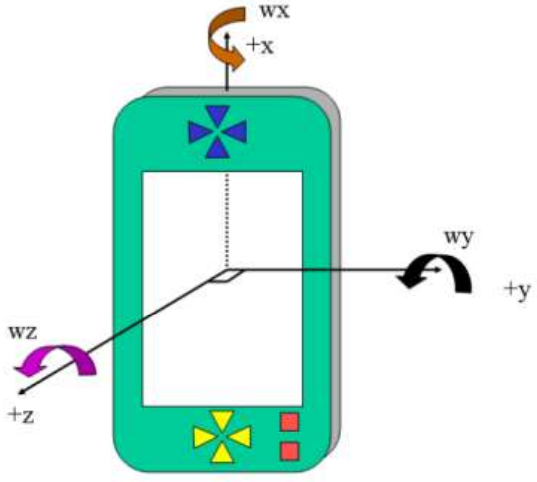


Fig. 3 Coordination of the phone

Date: July 31, 2019

Shun-Nan Liou

Shun-Nan Liou

EXHIBIT 2021

IPR2018-01257 / IPR2018-01258

Where Technology Entertains





CyWee, Where Technology Entertains

2009.09

Company Profile

SBCVC 软银中国创业投资有限公司 SB China Venture Capital

工業技術研究院 Industrial Technology Research Institute

- Founded in August 2007
- Focus on Innovative Entertainment Technologies & Applications
- Location: Taipei (HQ), Beijing, Hangzhou, USA Ohio
- Products
  - CyWee Z: 6-axis Motion Sensing Controller
  - CyWee M: Motion Module for Mobile, Mouse & Remote Control
  - CyWee X: Wireless HD Gateway
  - CyWee Y: Motion Capture System
  - CyWee Q: Innovative User Interface
- Patents: 117 patents filed & 22 approved

CyWee Copyright Reserved

Evolution of CyWee – from Hardware Provider to Entertainment Operator

CyWee Z

6-axis Motion Controller

Gesture Gaming, Air Mouse, Gesture control …





PC Motion Online Gaming

CyWee M

Motion Module

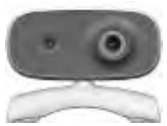
Mobile Motion Application, Mouse Module, Remote control



CyWee Y

Motion Capture System

Body Motion Recognition for Virtual World



CyWee X

Wireless HDMI

Real-time 1080p video stream, from PC to TV



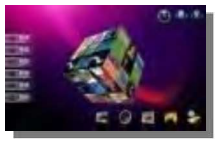


TV Home Entertainment

CyWee Q

Innovative UI

Video Cube, Video magazine, 3D UI





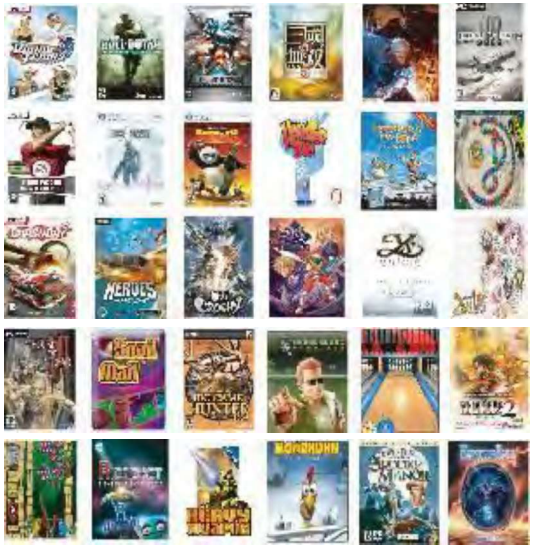
Digital download
Online Gaming
Mobile Application
Virtual World

CyWee Z – Multi-Function Controller

Technology	Ergonomics	Practicality
		
• 3-Axis Accelerometer and 3-Axis Gyroscope in one device • Real-time 3D tracking of user movement provides 1-to-1 match • Patents Awarded in US, Japan, PRC China, Taiwan, South Korea, EU	Multifunctional Five-Mode "Twist" • Stick Mode • Racing Mode • Aviation Mode • Gun Mode • 3D Mouse Mode	No Console, No Clutter. Plug & Play with Any PC

Redefine PC Gaming





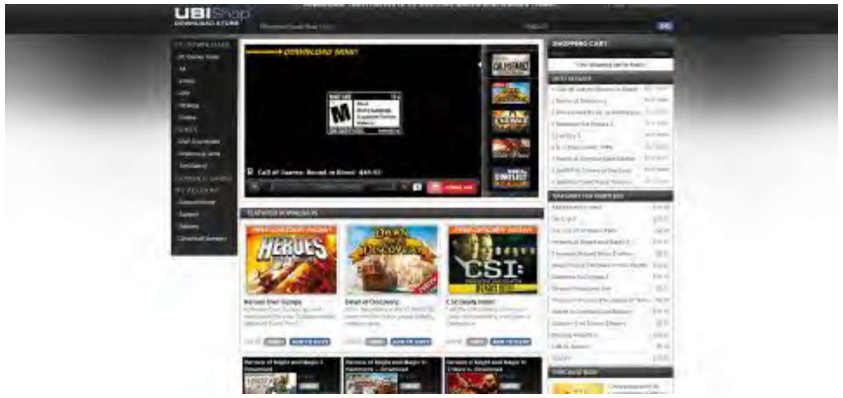
- Any PC Game could be redefined to Gesture Game
- Any body can play games with easy control
- You can even beat Keyboard player in Online Gaming with CyWee Z





Digital Download Platform Hosted by DR





Software download site to offer patched games from publishers such as EA, Activision, and Ubisoft.

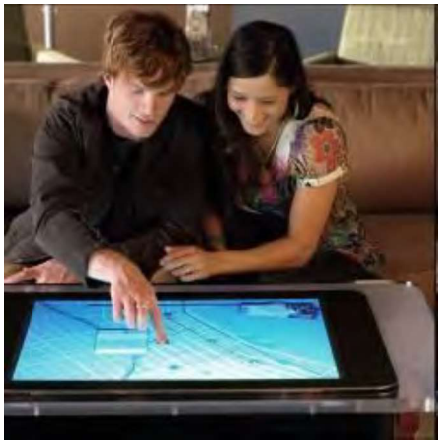
Digital distribution of gesture enabled games bundled to CyWee devices

DR will launch CyWee's online software store with games licensed from our partners and other publishers.

This relationship will lead to a digital distribution store for mobile games in the future.

Touch begins from here





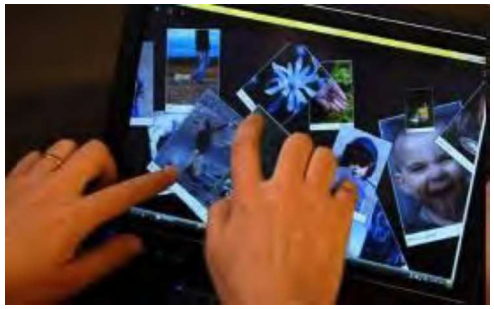




Apple’s tablet

Netbooks and other touch enabled devices continue to surge

CyWee Z – enable Windows 7 on Any Screen



Win 7 enable touch-screen functions of Rotate, Enlarge / Shrink and Sliding

Most of the PCs don't have the touch-screen



Many PCs are moving to the living room for streaming and browsing online videos and content

Air mouse will be required in the living room for Windows 7 features

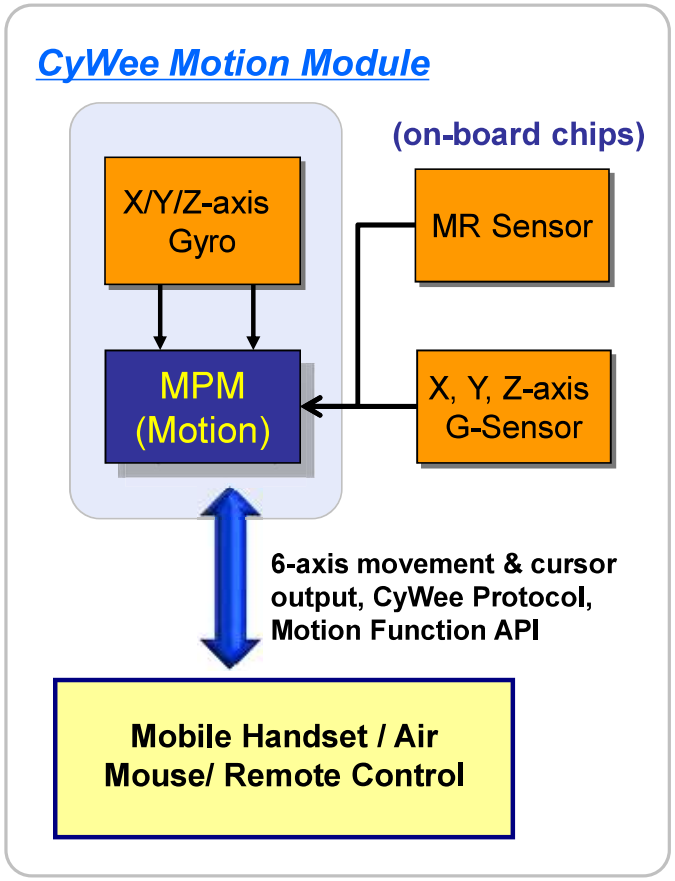
Yet an ordinary 3D mouse will not be able to perform Win 7 features





A 3D mouse solution has finally arrived to enable Windows 7 touch applications with simple gestures…

CyWee M – Motion Module for Mobile, Mouse & Remote Control





- On-Phone Motion Gaming
- Virtual Tour
- GPS/LBS
- Motion Game Pad
- Air Mouse
- Home Media Control



- Air Mouse
- Game Mouse
- Home Media Control

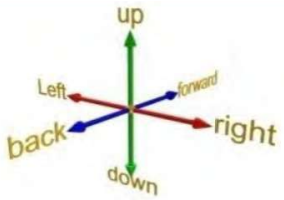


- IPTV/Interactive TV Control
- Air Mouse
- Motion Game Pad

What are the advantages of CyWee M?

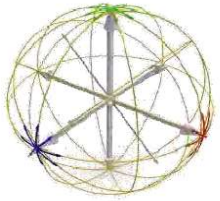
iPhone or GPhone





OPhone (CyWee M embedded)





G Sensor / MR Sensor	G Sensor + MR Sensor + Gyro Sensor
Separated applications for G Sensor (game, UI) and MR Sensor (e-compass)	Patented Advanced Motion Algorithm utilizing the 3 sensors to provide perfect solution
G Sensor – slow response in X, Y angles, no response in Z angle	Accurate 6-axis motion (X, Y, Z accel. & rotation) and absolute position output
MR Sensor - can't operate properly when tilting, easily interfered, slow response	Mouse Cursor & Motion output for controlling PC and Home Media Center
Can't provide accurate/smooth motion detection	Provide accurate/smooth motion detection in any angle and any position

CyWee Copyright Reserved

Invited to JIL Game Phone Project As Motion HW/SW Solution Provider

JIL 2nd Project: Mobile Game Phone

JIL – Joint Innovation Lab

A JV of CMCC, Vodafone, Verizon and Softbank to develop common technology and product



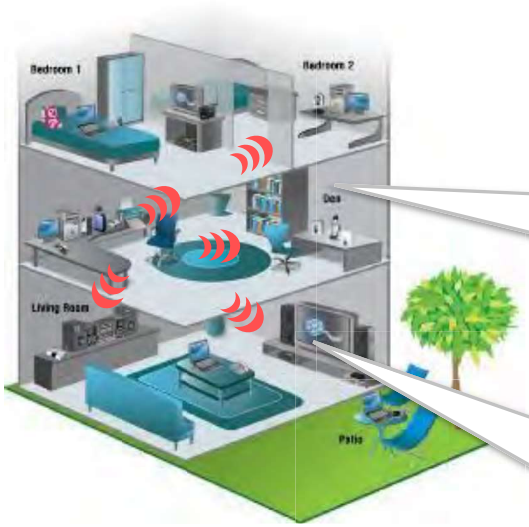


Phones will use Borqs OMS/Android+

CyWee M module embedded in the JIL Game Phone providing Motion Gaming & Remote Control Functions



CyWee X – High Definition Real-time Streaming





Wireless 802.11n



- Supports HD Video (1080P)
- Supports Real-time Streaming of Games
- Supports HDMI, DVI, VGA
- Bi-direction Streaming (PC⇐⇒TV)

The Mobile Console – combined CyWee M & X

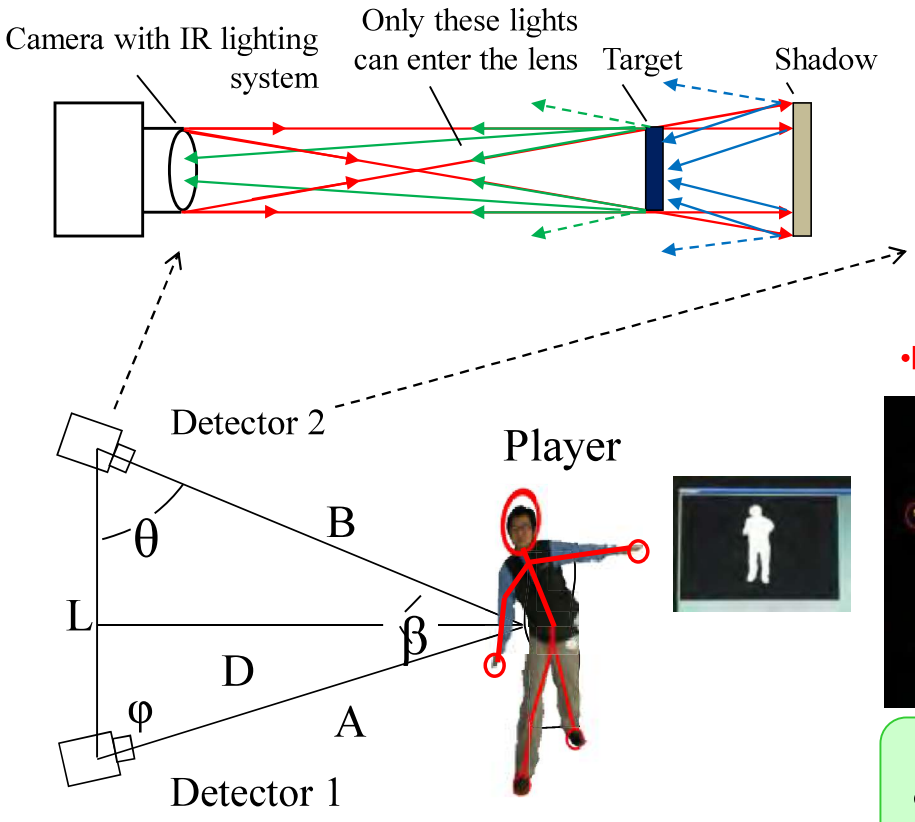
- Mobile as the console for running entertainment applications (Game, Video …)
- Using the 802.11n in your handset to transmit the real-time application image wirelessly to your TV
- Users can use their mobiles to control while watching off the big display



CyWee Copyright Reserved

CyWee Y – Motion Capture System

•Shadowless capture system



•Dual webcam 3D Tech.

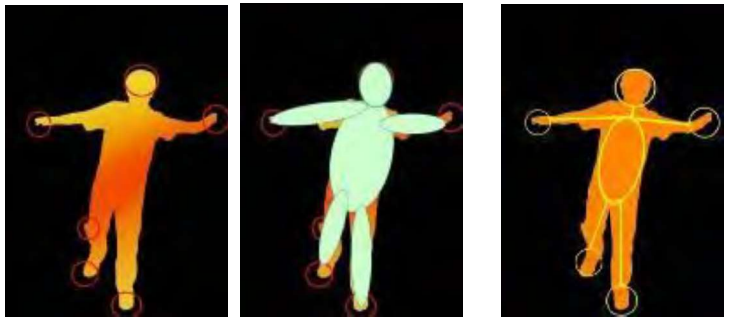
$\beta = 180 - \vartheta - \varphi$

$A / \sin\vartheta = L / \sin\beta$

$D = A \sin\varphi$
$= L \sin\varphi \sin\vartheta / \sin(180 - \vartheta - \varphi)$

The accuracy of depth D depends on the accuracy of L, ϑ, and φ, therefore the player in the 3-D space can be measured on a **pixel-by-pixel basis**

•Motion RecognitionTechnology



Retrieve outline and depth info → **Distinguish hands, legs, and body** → **Recreate 3D avatar pose**

The difference between Traditional Solution & CyWee Y

Traditional solution:
Complicated and Costly



CyWee solution:
High Tech and Low Cost for end-users



Complicated Capturing:
- Multi-cameras
- Special lighting
- Single background
- Mark Sensors/bodysuit
- Motion Analysis through server

Simple Capturing:
- Single capture unit
- Any lighting condition
- Any background
- No mark sensors
- Single DSP solution

CyWee Q – 3D Video Interface

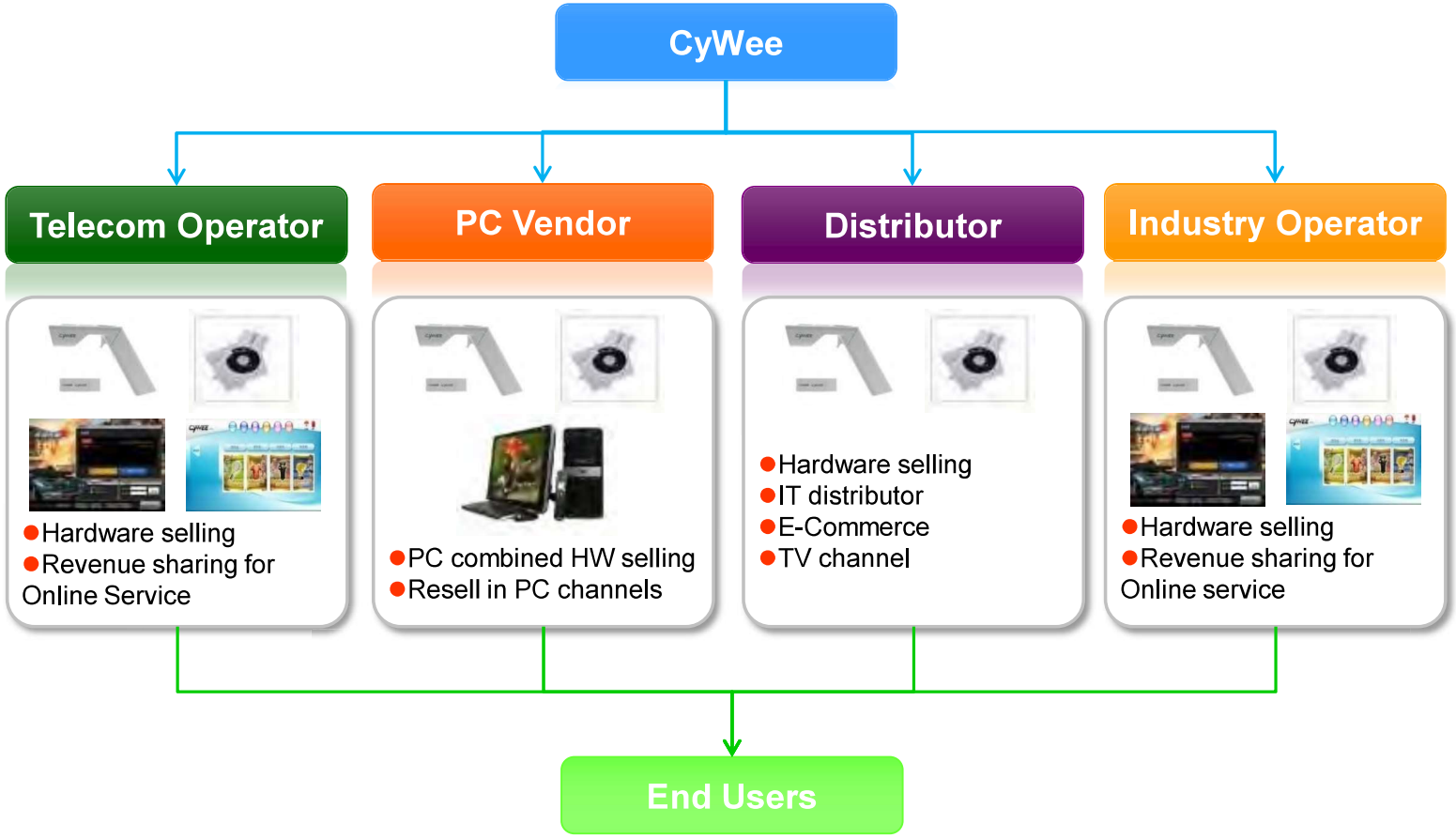




- **Innovative Interface**：streams over 200 videos in cubic or spherical form
- **Applications**：video player, multimedia magazines, games, entertainment, business applications
- **Customization**: customized, personalized content and channel choices
- **User friendly**：drag, turn, slide, rotate, resize (iPhone & Multi-touch gestures)

CyWee Copyright Reserved

Business Model of CyWee



Strategic Alliance with Key Market Players

Contents Partner	Operator	PC，Distributor
SEGA, EA, 腾讯游戏 GAME.QQ.COM, ATARI, NChannel, UBISOFT	China unicom中国联通, EXPO 2010 SHANGHAI CHINA, 中国电信 CHINA TELECOM, 中華電信	acer, 360buy.com 京东商城, hp, Cnwisdom 浙江慧达驿站网络有限公司, FUJITSU, 神州数码 Digital China

Olympics、Beijing EXPO、Taiwan IT Month、CES 2009、Chinajoy







CYWEE

Where Technology Entertains



EXHIBIT 2022

IPR2018-01257 / IPR2018-01258









JIL Game System Requirement Specification

JIL Game System Hardware Specification Ver 1.5

draft

Version: 1.5 Candidate Release

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Revision History

Date of Change	Doc Version	Sections Changed	Description	Change made by
22 May 2009	0.9	All	Basic device selection.	Shigenori Imanaka
22 Jun 2009	1.12	All	All device	Shigenori Imanaka
7 Nov 2009	1.5	All	Description and Explanation	Shigenori Imanaka

draft

1. Introduction

1.1. Purpose

This requirement specification contains functional requirements for JIL's Game system. Since the Game system is an application platform involving multiple parties including end user, independent software vendor (ISV) and operator and service provider (SP), the present document organizes the functional requirements by target audience. The major purpose of this document is to define the hardware specification to help manufacturers to build their handsets to be compliant with JIL specification. Target audiences of this document include product managers, architects and parties with an interest in software development.

This specification was used to be usually submitted by Excel sheet, but sometimes it causes serious misunderstanding because it is a little bit difficult to describe all the features and functions only on text base.

1.2. Executive Summary

To join to JIL as a vendor, or manufacturer is very simple. But to get technical information from JIL member is a little bit difficult. Because JIL holds internal discussion so frequently and the definition is sometimes no longer the definition as it used to be. Concurrent, latest information and requirements from JIL are such ambiguous and hard to keep in touch with. So, JIL will provide the specification and the related information periodically.

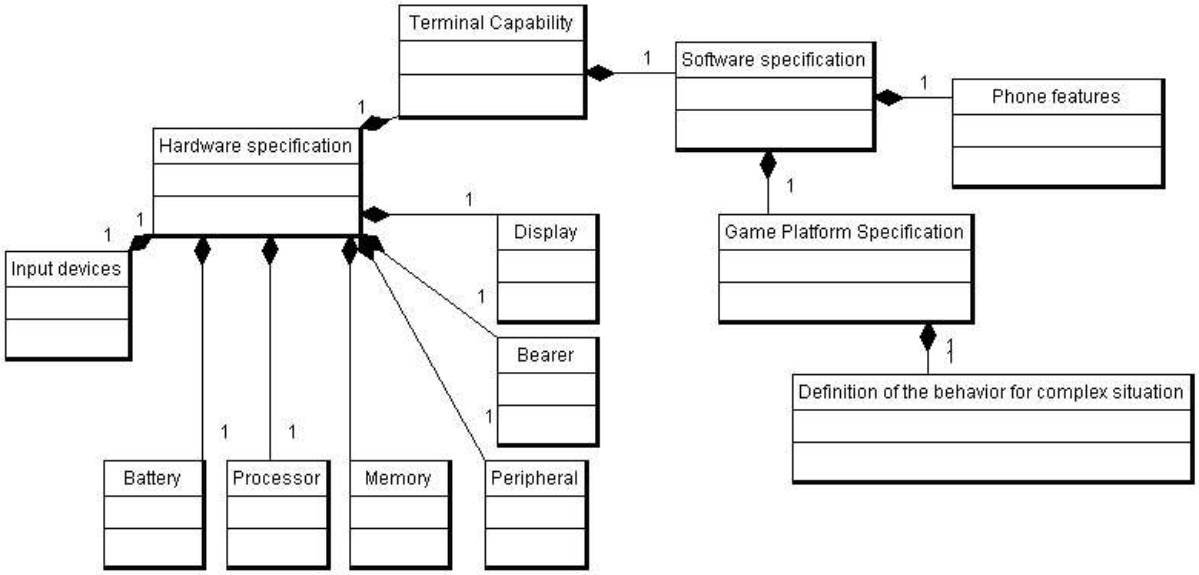
As a part of the JIL Project, China Mobile, Vodafone, Verizon, and SBM will create a common game specification and propose a new environment. The JIL Game platform is divided mainly into the 2 segments of mobile phones exclusively for games with game exclusive features such as a 4-way key, and regular mobile phones with JIL Game functions. JIL will create requirements for both segments.

This specification is described about a requirement of a mobile phone exclusively for [Game Centric model] and a regular mobile phone with JIL Game function [Game Friendly model]. If there is no description of a model in each requirement, it is a requirement to both models.

1.3. Overview

Hardware specification contains the requirements for all devices which are needed by game phone. Hardly JIL does not require manufacturers to equip an certain device like baseband chip. If the device fulfills the specification, manufacturer can choose it for JIL game phone. Of cause there are a few exceptions like analog joy pad device. The reason why JIL compel manufacturer to use the specific devices is to keep the user experience as game developers defined.

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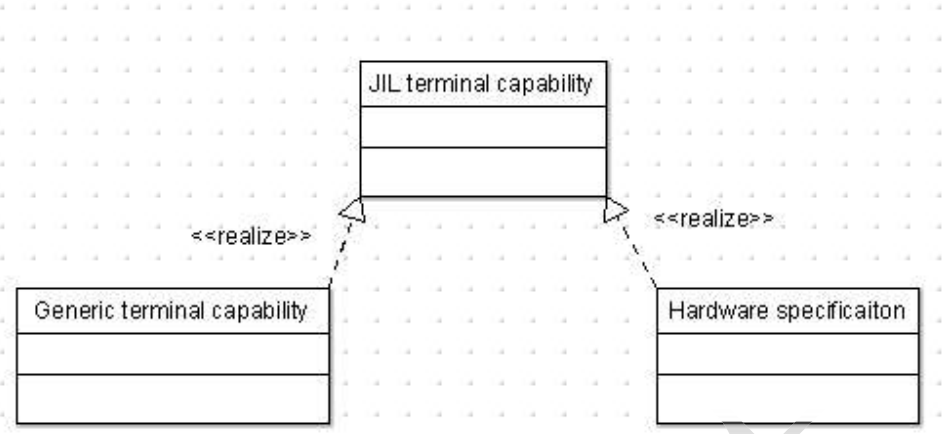
Hardware specification is a part of HLTS (High Level Terminal Specification). JIL member and those who have NDA with JIL can read both document if the disclosing status is enough. Hardware specification is only defining the hardware and device specifications. If the reader wants to know the behavior, or some functions that can be achieved with software combination, the reader should refer to the documents regarding software specification. For example, video codec are usually listed in the semiconductor's specification sheet, so the readers are apt to think that the codec are hardware issues. But usually codec are software issues. Such mathematical processes as iDCT, or entropy coding are usually done by DSP in the SoC. For hardware specification, JIL defines only the benchmark for DSP capabilities.

Hardware specification contains these items.

1. Peripheral
2. Bearer
3. Display
4. Processor
5. Battery
6. Input devices
7. Memory
8. General rules

Hardware specification determines only the specifications that are needed by JIL platform, and JIL game platform. So this document does not define the common specification for generic hardware.

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1.3.1. Choosing devices for handsets

JIL sometimes hire special devices and compel manufacturers to use them. But most part of the device will not be forced to use. JIL requires the solutions of the functions and not force manufacturers to use certain devices without reason. If the manufacturers were accessed by JIL spec manager to use certain devices, please confirm the reason in the higher level meeting or contact to the product manager.

Today, the devices JIL want manufacturers to use are:

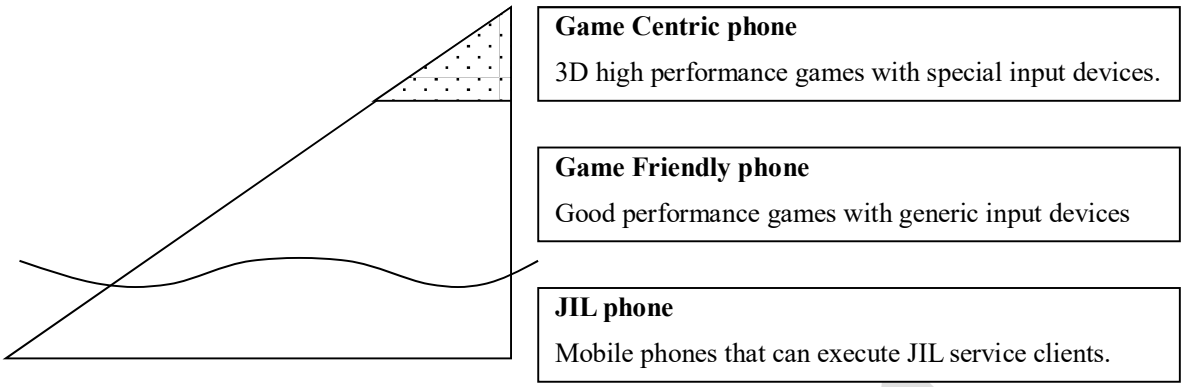
- APPSIDE's analog joystick device.
- Cywee's gyro and accellometer device
- Kinoma UI (software)

1.4. Roadmap

The technologies for mobile handsets are developing every day. This hardware definition will be changed to be suitable for the market standard in the future. Device workstream in JIL is in charge of maintenance of platform definition and the workstream will publish the roadmap every year. If the manufacturer or technical vendor requires the information, they have to have NDA for it.

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1.5. Platform overview



JIL will handle 2 or 3 business platforms shown in above figure.

1) Game Centric phone

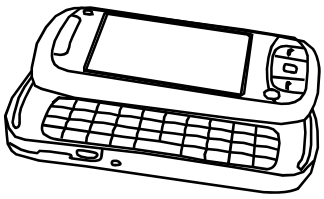
Mobile terminal in this category has at least 2 home screens. One is for generic phone use, and another is for game operation. Mobile terminals in this category also have special input devices to be able to act as game console devices. The manufacturers must have all the sensors and input devices in the Game Centric phone they will develop. JIL will have a strict certification program to find whether the handset is compliant with the specification or not. The input devices which are needed for the devices in this category are shown in the later chapter.

Other specification regarding game play is also provided in this document. The bottom performance must be strictly kept by manufacturers. From the view point of content providers, the handset in this category shall have only one specification that their contents will run on each device without any optimization.

2) Game Friendly phone

Today, the mobile chipsets and associate chips became stronger and faster enough to be used for game console. They have strong processing power to calculate vector and colors, to playback encoded movie files, to play 3D sounds. Not only Game Centric phones, but also Smartphones based on OpenOS such as Windows Mobile, SymbianOS, Android or Linux came to use those powerful chipsets.

They have wide screen, with capacitive touch sensor and some devices to detect motion, location, temperature, lights, and proximities. From the view point of processing power and input devices, they are capable enough to execute high performance games. Only the difference is that these handsets don't have the dedicated input devices that Game Centric phones have.



Almost all the smartphones launched in 2009-2010 will be regarded as Game Friendly phone.

3) JIL phone

The dividing line between Game Friendly phone and JIL phone is quite ambiguous today. JIL is planning to

launch more new services other than Game distribution and the target phones will include wider zone. JIL phone's bottom line is to have ARM11 or competitive.

Profile	FPU	VFPU	Chipsets	bottom Frequency
ARM1136 JZ-S	No	Yes	MSM7200, OMAP2430	400MHz
ARM1176 JS-F	Yes	Yes	Unifier 4MBB, Medity-2	330MHz
Xscale	No	No	PXA270, PXA910	850MHz

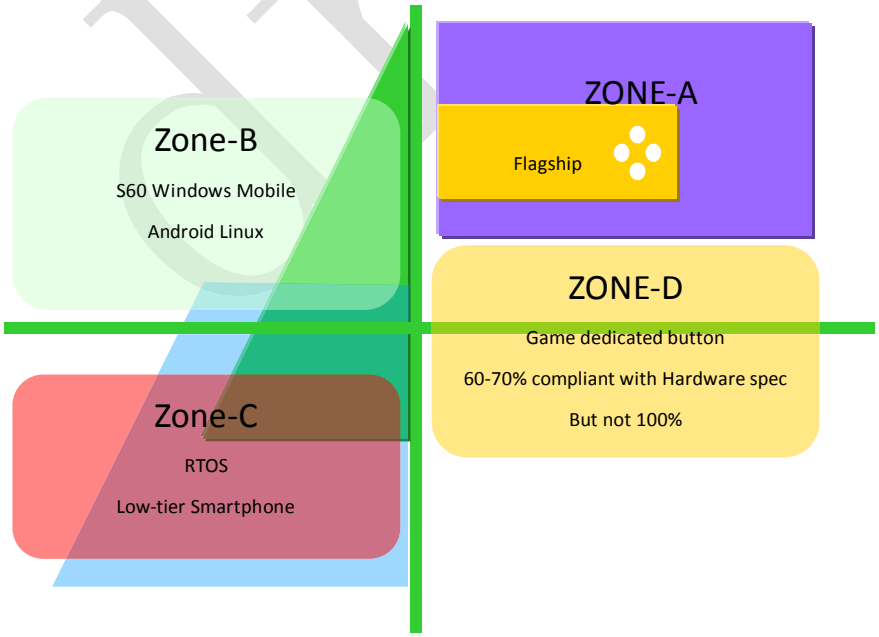
Of course, these frequency or simple benchmark specification does not guarantee high performance. JIL will also provide a mark specification for the dividing line.

1.6. "One binary" and hardware specification

The body of game package JIL will distribute is ARM based binary. The differentiating point from other platform is

1) The game binary can run on several OS. JIL Game execution environment will buffer the difference. Game developers build their games only once.
2) ARM binary can run faster than other platform that has virtual machine solution.
3) JIL game platform is sensitive with CPU architecture to keep the compatibility.
4) To keep the compatibility, some hardware features are strictly defined.

1.7. Handset Zone



In the figure above, Zone-A is "Game Centric". Zone-B is "Game Friendly". Zone-C is "JIL phone". So, what

is Zone-D?

There is a possibility that there will appear a handset that has joypad and shooting key, LR button and analog joystick, but not powerful/compliant enough to run JIL Game contents. For example, suppose that the handset does not have ARMv6 full instruction. Or, the GPU is not powerful enough. The number of polyphonic sound was a little bit small and the music was not played sufficiently. They are in Zone-D.

The worst point of Zone-D is the possibility to mislead our customers. Our customers don't have enough information or knowledge whether the handset is compliant with the platform definition or not. Actually, JIL will going to have a certification program and will show whether the handset is compliant or not. But it does not help our customers that are about to buy new handsets in the shop.

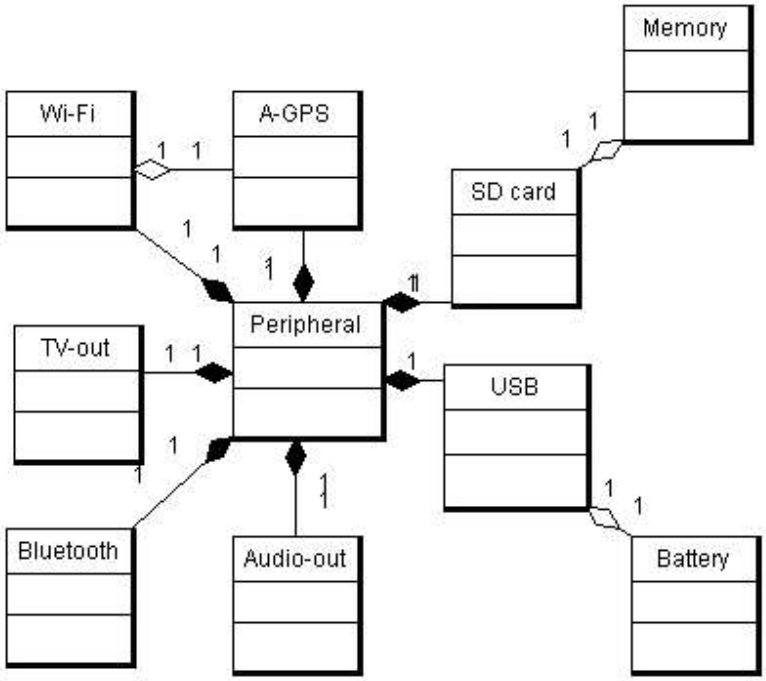
So, Zone-D handset shall not be developed for a while until our customers become able to distinguish whether the handset is Zone-A or D. If some manufacturer came to JIL and explained their plan to develop Zone-D products, JIL member have to explain the difficulty to launch that kind of handsets in our market.

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2. Specifications

2.1. Peripherals

For the peripheral, JIL does not require so special features for handsets. In this chapter we show the generic interface and peripherals that are required by JIL game platform shown as below.



2.1.1. A-GPS

GPS function is required. This function is not only used for map application but also used by games in the future. To provide correct mapping/location information to users, the GPS needs assistance by another service provider. JIL requires OMA-SUPL for A-GPS services. This is mandatory requirement.

2.1.2. USB interface

USB 2.0 hardware that can use Highspeed profile needed. This is mandatory requirement. JIL requires the hardware to equip both host and slave function for additional peripheral that will be launched in the future / will be attached by user's favorites. The drivers for the peripherals shall be provided by peripheral developers, and handset manufacturer does not have to guarantee anything regarding the peripherals that will be launched by another developers. The use case for the USB interface JIL is considering is

- Digital TV tuner (ISDBT-H / DBV-H)
- External keyboard

- Game controller
- Outer speaker
- Battery charger

For USB interface, micro USB interface is strongly recommended and the interface shall also be used for battery charger. Some of JIL operating companies has strict requirement regarding this point.

2.1.3. Bluetooth

2.1.3.1. Hardware device

To have Bluetooth 2.1 device is mandatory. If there appeared a new version Bluetooth and that is compatible with 2.1, so it shall be equipped for the game device. As Bluetooth communication consumes battery so much, the device shall be chosen by manufacturer carefully.

2.1.3.2. Profile

The profile for Bluetooth will be provided by Software requirements. For example, JIL flagship model has these profiles. Manufacturer can add the profile to be suit for its own product strategy.

1) SDP
2) GAP
3) HSP
4) HFP
5) A2DP
6) AVRCP
7) OPP

2.1.4. Wireless LAN

2.1.4.1. IPSec decode

The decoding process of WEP, WPA, WPA2 takes higher processing power, JIL recommends to have IPSec decoder by hardware. The hardware shall be equipped in the wireless LAN chip or DSP around application processor. This requirement is optional. If you have any trouble with finding the vendor, JIL recommends you to have a contact to Marvell.

2.1.4.2. Protocols

The protocol shall be compliant with 802.11b/g. Logically speaking, 802.11n is compatible with 802.11b/g, so 802.11n is also acceptable. As 802.11n is at rather higher speed and takes high processing resource to decode encrypted packet, the terminal shall have enough processing power not to cause serious performance down when connecting to wireless LAN.

802.11n or 802.11a has legal restriction in some countries. The manufacturer must have a communication with OpCos regarding the legal status of 802.11a/b/g/n.

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2.1.5. TV-OUT

It is desirable for mobile handset to have TV-out function. Considering that the dimension of the handset cannot be so large, to implement the TV-out connector is a little bit complicated issue. So TV-out is just an optional requirement.

2.1.5.1. TV-out target function

Mobile terminal shall have functions not only to playback streaming contents via TV but also to show the game screen with minimum latency. Less than 17msec is desirable for the cost of transferring the image to TV-set.

2.1.5.2. Target TV-set

Mobile terminal shall have function to transferring image to those TV-formats. The format for respective market shall be considered by manufacturer.

- NTSC
- PAL
- SECAM
- HDMI

2.1.5.3. Expanding image

As the basic resolution is HVGA (480x320 / 4:3), mobile terminal shall have the function to expand the image to be fit with the TV-screen. Not to cause the latency or serious performance down because of the cost to process image expansion, the terminal shall have hardware image controller.

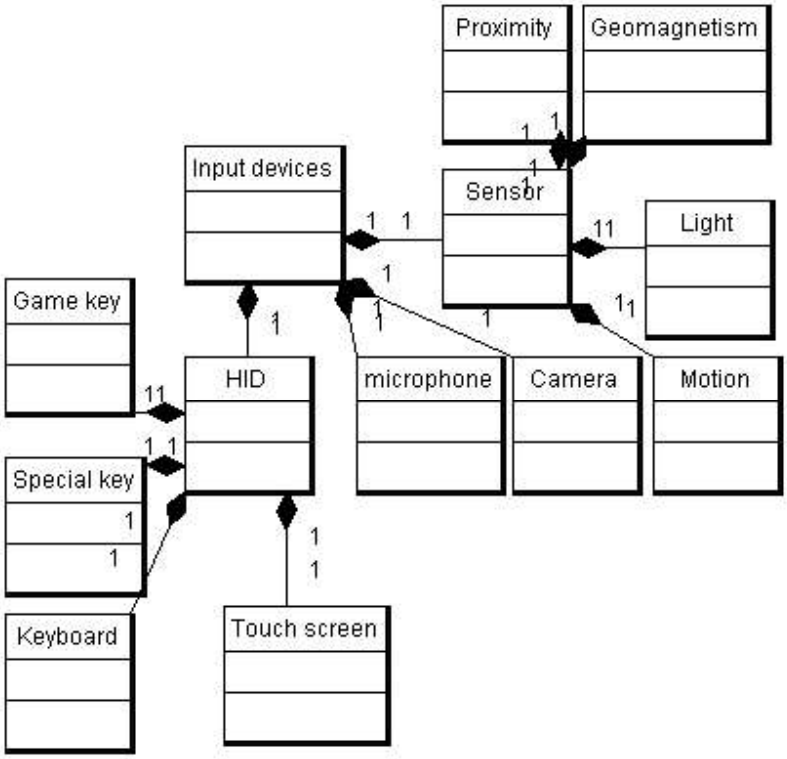
For 16:9 display such as HDMI TV-set, the expansion method shall be taken care not to synthesize the image too much to harm game play.

2.1.6. Audio output

For audio output, the handset shall have stereo speakers and 3.5mm stereo headphone jack.

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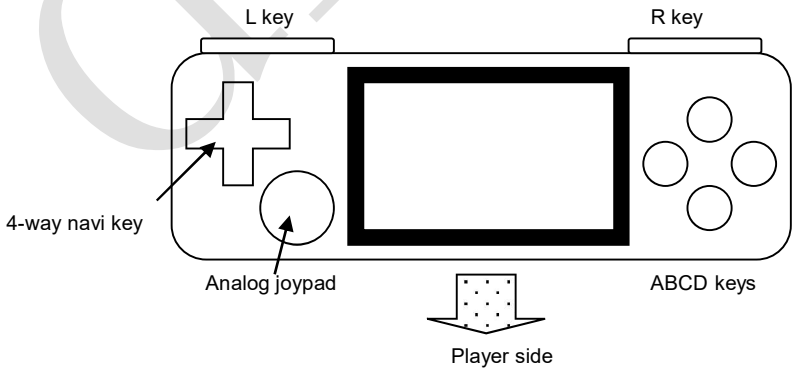
2.2. Input devices



Input device Overview

2.2.1. Game button

The Game Centric phone must have those keys



2.2.1.1. Extend (LR) key

The extend key, usually called as LR key, shall be on the shoulder of the terminal drawn in the figure above.

2.2.1.2. ABCD Key

ABCD key is usually called as shooting key, determining key, ○×△□ key and so on. Those name are used in other game platforms in the past. The Game Centric phone shall have 4 buttons on the right side of the screen.

2.2.1.3. Analog Joystick

Analog joystick or joypad shall be equipped. The joypad shall detect the distance from center, 360 degree direction with the sensitivity of less than 3msec. Tentatively, JIL recommends APPSIDE's solution to keep the operating feel same.

Detail of APPSIDE spec is;

- Solution name: AppsPad
- IC: CD202C (Appside has only IP, Appside has contractor in Taiwan, Korea, and Japan)
- Data sampling rate: 3msec
- Data bit length: 10bit for x, y, z.

The access to APPSIDE is as follows:

http://www.appside.com/

This device shall be equipped close to the 4-way key. The implementation, like location, device, responding speed shall be considered with ID manager and UI manager.

2.2.1.4. 4-way (navi) key

The terminal shall have 4-way key. The location shall be set in the left side. The sensitivity shall be less than 17msec. And the terminal shall abandon the detected value when the detection made twice or more when drawing a frame. Only the first detected value shall be provided.

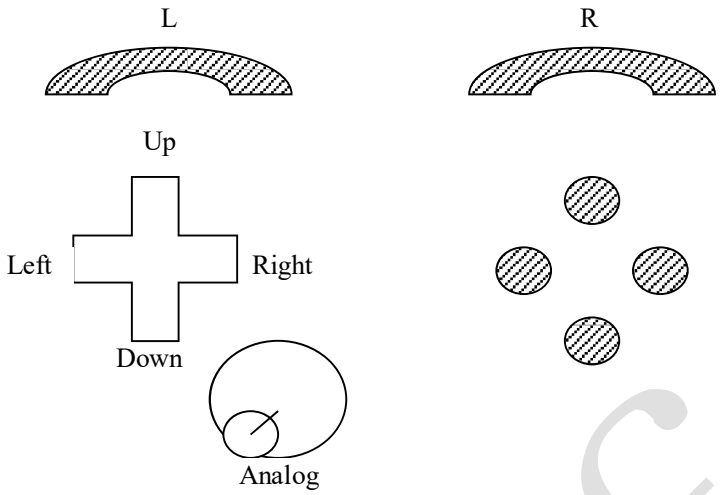
2.2.1.5. Key detection

When pushing key together, all the pushed keys shall be detected at once.

In the figure below, the system shall not detect the simultaneous key down of Up+Down, or Left+Right.

But Right+(Up, Down), Left+(Up, Down) simultaneous key down shall be detected.

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The game keys status shall be provided within 3msec. The LR key and ABCD key and 4-navi keys shall be detected whether respective keys are pushed or not.

2.2.2. Sensors

The engineers and product manager will take care about the requirements regarding sensors whether JIL has strong recommendation to hire certain devices or not. Then, they will need the cost information or whether the drivers for the sensors are provided by sensor vendors.

The sensitivity for each sensor is provided in the document "JIL_Extension_API.pdf", p22-.

2.2.2.1. Proximity sensor

JIL is trying to implement the middleware function to use proximity sensor though there cannot be found any use cases by October.2009. Except for the gaming use, this sensor shall be provided to the handset. So this sensor is thought to be mandatory to equip by JIL.

2.2.2.2. Geomagnetism sensor

JIL is trying to implement the middleware function to use geomagnetism sensor though there cannot be found any use cases by October.2009. Except for the gaming use, this sensor shall be provided to the handset. So this sensor is thought to be mandatory to equip by JIL.

For JIL's first Game Centric model which was developed by Foxconn /LG Electronics, this solution is using YAMAHA's geomagnetism sensor. If manufacturers want to use the function without any trouble, is may be better to choose the same chip. JIL can provide the contact point for YAMAHA semiconductor division.

2.2.2.3. Motion sensor

"Motion sensor" is just a casual name. Technically it is defined as 6-mode acceleration meters. The 6-mode are described as

- X acceleration
- Y acceleration
- Z acceleration
- Roll degree
- Yaw degree

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- Pitch degree

To implement this functions and sensors are mandatory. The resolution and time quantum desirable for game middleware shall be provided by JIL and Acrodea.

2.2.2.4. Light sensor

JIL has no plan to develop middleware for this sensor. But this sensor shall be provided to the handset. So this sensor is thought to be mandatory for JIL Game Centric phone.

2.2.3. Camera

Generally speaking, a camera is mandatory device for mobile handset. JIL is planning to use mobile camera as an input device for games. From this view point, a camera which has too large resolution has some problem. For example, it needs huge memory area for image buffer. And, to process such a huge image data needs heavy load on processors if the game provides a recognizing function on the image. That will harm to the real-time feeling of the game. And for such usage, the image shall be remained in the image buffer as a raw data. There are so many solutions that compress the image right after it was captured. But considering the gaming usage, such kind of solutions shall not be hired by manufactures.

2.2.3.1. Main camera

At most 5M pixel camera shall be supported. Manufacturer shall contact to JIL team when choosing the device. Decision by marketing section shall be respected. Auto focus is also desirable.

2.2.3.2. Sub camera

Sub camera is recommended. Today, such new technologies as AR, gesture detection, image recognition for small device became feasible. To help such implementations, the existence of sub camera is desirable.

2.2.4. Microphone

Microphone for talking shall be supported. This requirement is for telephony function. JIL does not think that our handset is just a game device which has 3G/LTE/GSM modem. JIL handset shall have full telephony functions, so microphone is mandatory.

2.2.4.1. Additional microphone

Additional microphone shall be used for noise reduction. If there is another way for noise reduction, manufacturer may choose it. Providing the explanation of the implementation is desirable.

2.2.5. Volume control

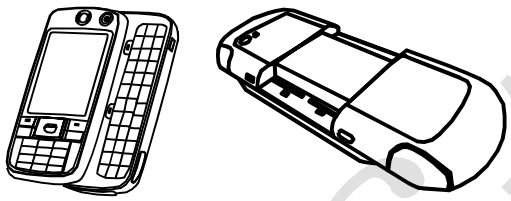
2.2.5.1. Hardware key or slider

2-key or slider switch for volume control shall be provided. Using generic key combined with game keys is also acceptable.

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2.2.6. Body switch

If the handset had a form factor to transform the figure, like Tilt-Slide, Dual Slide, Single Slide, the handset shall have the sensor to detect the status as “Open” and “Close”. The detected status shall be used for executing game home screen, or pausing games, resuming games.



Single and Dual Slide

2.2.7. Keyboard

2.2.7.1. 12 digit keypad

2.2.7.2. QWERTY key (Hard key)

2.2.7.3. Virtual keyboard

2.2.8. Touch Screen

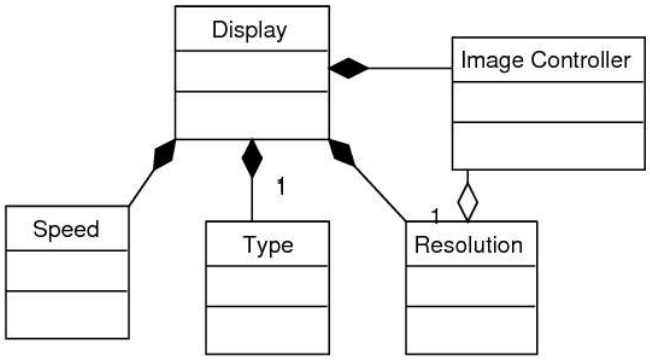
The handset shall have a capasitive touch screen. The touch screen shall have multi finger mode. Dual touch is enough.

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2.3. Display

Today, there are so many handsets which have not only main display but sub display on its back. And, there are so many types of display like LCD, ASV LCD, OLED. Manufacturer shall put it into consideration when choosing display devices that the display the display needs the quality to save power, the responding speed, and clear visibilities.

JIL requires handsets to equip capacitive touch sensor as a input device. Because of the implementation of touch sensor, the transparency will be down around 15 to 20%. To keep the visibilities, back light will need more power. Manufacturer shall put it into consideration when choosing the device.



2.3.1. Display type

3.5inch LCD, or ASV (Advanced Super View / Trademark by SHARP) LCD are recommended. OLED (Organic Light-Emitting Diode) display module is also recommended if the responding speed is fast enough. If the manufacturer wants to use bigger display than 3.5inch, 3D display, or Dual view module, the planner shall contact to JIL officers whether that concept will suit to JIL's game platform. Generally speaking, 3D display needs specialized contents to show the maximum performance. And, an anomalous display sometimes causes a incident on user's health. Manufacturer shall not be so impatient about launching their new technologies.

2.3.2. Image controller

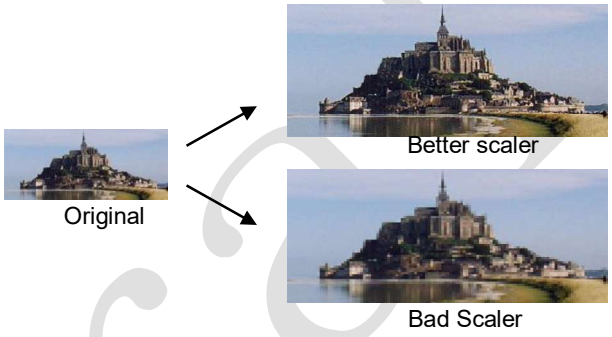
The implementation of the functions to expand/rotate images is mandatory. But the hiring image controller as a special device is another issue. Only on the case 2.3.3, manufacture shall implement the image controller outside the GPU. If there appears the manufacture who want to implement the image controller outside GPU only for rotating phone's home screen or movie player, JIL does not forbid it. But from the viewpoint of cost, JIL would suggest that function can easily be achieved by using GPU libraries.

2.3.3. Resolution

Basic resolution for games is HVGA (480x320). And 24bppp (RGB 8:8:8) is mandatory. Games for JIL Game Centric will be designed and developed for this specification.

Manufacturers that want to equip higher resolution display, even though games are developed on HVGA, they also take care of these restrictions.

1) Game shall be played in, what we call, “Full screen mode”. Therefore, if the handset has a VGA screen, the game screen shall be displayed with being expanded twice.
2) On the case of 1）, the system will expand the final image of game screen for every frame. For the expansion, no harmful influence on the game play shall be allowed like timing delay, or quality down of the image. The harmful influence is described as follows:
    ① Frame rate down.
    ② Big change on aspect rate of pixels.
    ③ The damage on artistic work because of puerile video scaler’s work.
    ④ The damage on visibility for icon/characters because of puerile video scaler’s work.
    ⑤ Mosquito noise because of JPEG expansion
3) System shall not trap and overwrite the primitive packet for GPU
4) Even if the handset has an excessive display, like very long horizontal length compare to vertical length, the game screen shall take 70% of the screen.



2.3.4. Responding Speed

For Responding speed, 17msec or around is desirable. JIL would like to have the game platform that enables 60fps games.

2.3.5. Visibility

These visibilities shall be considered when choosing device.

1) The screen shall show the clear image under the sunshine.
2) The screen shall provide wide angle visibility
3) The screen shall have anti-fingerprint peculiarity.

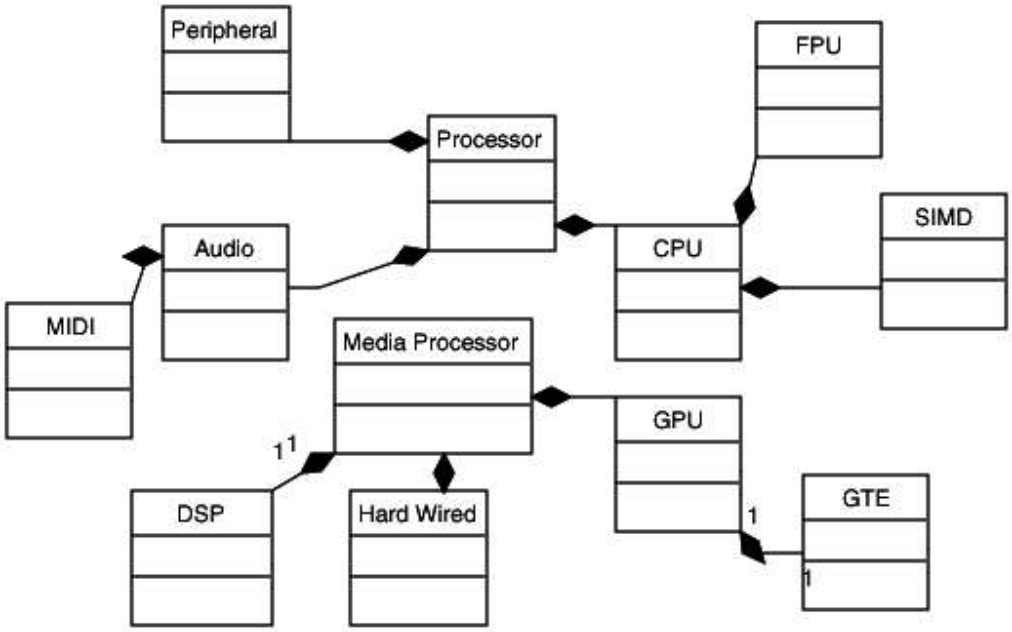
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2.4. Processor

The important factors for main processor and associate processors are as follows:

1) Availability to keep binary compatibility which is basic and essential concept for JIL Game platform.
2) Good architecture to achieve high performance for 2D/3D graphic.
3) Excellent processing power that can handle multiple threads and tasks without serious performance down.
4) Special processors that works to help main processor not to cause serious performance down when a complex case appeared to the handset.
5) Well-matured power management system that helps the battery duration.

The figure below is the structure of processor's association. Here the peripheral controller chips are left out from the dialog.



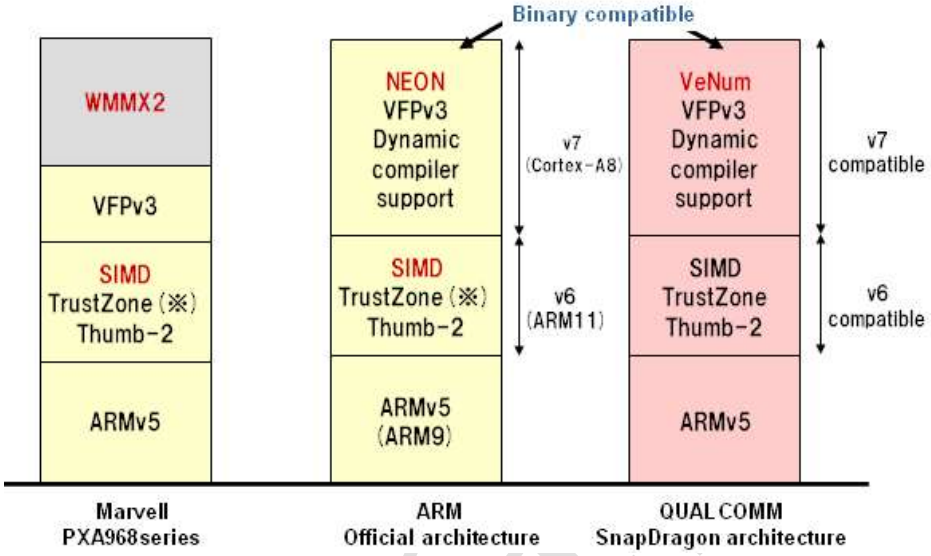
2.4.1. CPU

2.4.1.1. CPU architecture

For Game Centric phone, CPU architecture shall be compatible with ARMv6/v7. As v6, JIL assumes that ARM1136JZ-S and ARM1176JF-S are v6. And, JIL also assume that Cortex-A8, A9, A5 and some Xscale processor are regarded as v7.

As of November 2009, there is only a proto-type handsets using Xscale while any manufactures have not proposed game exclusive handsets with ARM11 or Xscale to JIL. Tanking this into account, CPU architecture is going to be transferred to full-compatible ARMv7 unless we have a proposal of ARM11 and Xscale until releasing new models for the season of spring 2011. In this way, we will be able to support all v7 instructions, which may lead to the significant improvement of an operating performance.

There are 2 different types for ARM application processor. One can use full ARM instruction set and another can partially use that instruction. The later type semiconductor is mainly developed by Marvel. Marvel Xscale processor has WMMX or WMMX2 instruction set instead of ARM SIMD/NEON instruction. The latest product by Marvel has SIMD instruction. Other party in the world usually uses ARM instruction and fully compatible.



PowerPC, MIPS, SH, SPARC, I64, Intel x86 and their compatible architectures are out of scope.

2.4.1.2. Target frequency

Minimum frequency example:

- ARM1176 - 800MHz
- ARM11MP (single) 800MHz
- ARM11MP (dual) 650MHz
- Cortex-A8 650MHz
- Cortex-A9 (single) 800MHz
- Cortex-A9 (dual) 600MHz
- Cortex-A9 (Quad) 550MHz

Manufacturer shall contact to JIL HW team if there is a possibility not to be compliant.

2.4.2. FPU implementation and profile

JIL is considering about FPU that, not only VFPU that is usually equipped by ARMv6/v7 architectures as default functions, but IEEE-defined FPU that can process the transcendental functions. For implementation, high-speed connection to CPU is desirable like to be regarded as co-processor with instruction set support by CPU. I/O connection style shall not be chosen by manufacturers.

To fulfill this requirement, even though ARMv6 based, such chipsets as ARM1136JZ-S which was launched in the early stage of ARM11 market cannot be chosen. The typical example is MSM7000/7000A series by QUALCOMM. JIL will not accept the handset that is using these chipsets as a main processor of JIL Game Centric phone. For Game Friendly, or JIL phone, it is welcome or even desirable to have.

For manufacturers, it is not enough to hire those chipset that has FPU and VFPU. Things and our requirements are not so simple. Manufacturers shall construct the libraries which use FPU and VFPU, and use it for its Operating System, then disclose the API specification documents to the developers. When developing the software platform for both the handset and games, the implementation of the FPU shall be recognized by the engineers to use it. When building the system up, the engineers shall use the compiling switch to use FPU and VFPU.

As of November 2009, programs for game application have been developed for instruction sets up to v6, however, a software platform for mobile handsets are free from v6 regulation. On top of that, JIL expects improving of overall performance by frequent usage of v7 and WMMX2. On the other hand, JIL will require the agreement with the manufacturer in advance not to use those instruction sets for the handset due to the restriction of existing platform. For example, the platform builder and software development kit for Windows Mobile with WinCE5 are officially applicable up to only v4, ARM7 equivalent . In such cases, any high-speed processor will not work enough (just ARM7 with large cash memory and high frequency), so JIL desires manufactures to explain ideas how to avoid these situations.

In any case, JIL will not accept the software platforms, in which game binaries can not implement v6 and v7 requirements due to the restriction of software platform.

2.4.3. Media processor

Media processor is needed for such functions as encoding and decoding movie and picture data. Frequent transactions of complex but simple calculation such as Motion Compensation, Discrete Cosine Transform, Integral transform, VLC and BAC are poised for a function of media processor. Media libraries for these functions should be provided by OS or chipsets venders.

2.4.3.1. Dedicated Processor

Handsets, which use only MMX or SIMD instructions to decode media files and do not carry the exclusive media processor, will not be accepted. The reason for this is to keep the total performance high in the case of using movie and JPEG as texture data for game applications and the avoidance of low performance of mobile handsets while playing movie files.

2.4.3.2. VIDEO codec

Video Codec will be explained in the software implementation part.

H.263, H.264/AVC, MPEG4 (AS),VC-1,On2V6/V7 are fine if software implementation are provided.

On2V6/V7 is usually used by Web movie services like nicovideo, YouTube, YourFileHost. So, if the region marketing does not have strong requirement for respective codec, the Codec shall be cut off.

Media processor shall be equipped / chosen on the supposition that these CODECs would be required by software requirements.

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2.4.3.3. Target resolution and performance for movie

In the subject of 2.4.3.2, though saying that this will be explained in the software implementation part, the transaction speed of H.264 (ISO/IEC 14496-10, MPEG-4 Part 10 Advanced Video Coding) will be shown here to explain the required DSP performance. Since H.264 does not use DCT, which has been used for Codec in many ways, and does not examine the performance of DCT, other benchmarks should be applied. JIL will explain the performance of DCT as much as possible in the future.

For a while, the target performance is defined as 30fps@720p by H.264. DSP or hardware assist shall be powerful enough to support this performance.

2.4.4. Audio processor

2ch stereo output is default.

2.4.4.1. Audio codec

Video Codec will be explained in the software implementation part.

MP3, AAC, AAC+, AMR, ADPCM, WMA, are fine if software implementation are provided.

2.4.4.2. Surrounding effects

3D sound field effects shall be supported by DSP

2.4.4.3. MIDI

96/128 poly is recommended. 72 (by wavetable) is minimum.

2.4.5. Graphic processor

Dedicated processor shall be implemented

2.4.5.1. GPU

GPU shall be connected to either Main BUS or faster BUS in the SoC.

128bit x 128MHz or faster BUS speed is needed. Manufacturer or semiconductor supplier shall explain the concrete block diagram and bus configuration to JIL hardware team. JIL also requires the capabilities to be compliant with OpenGL ES1.2 and 2.0 for Game Centric phone.

2.4.5.2. Target 2D drawing performance

60fps, 24bpp, 480x320, 15 times redraw at a frame is the ideal performance.

133M pixel/sec or more is the target fill rate. This number is just a peak spec and to be a threshold to choose the SoC.

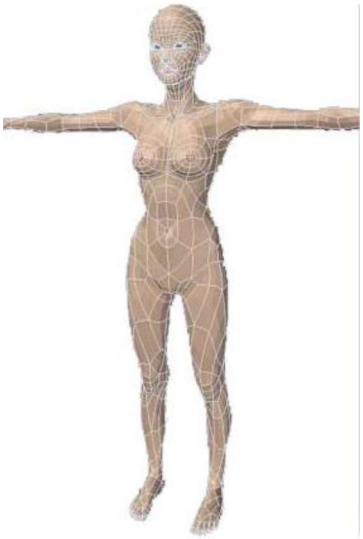
Such kind of number is usually calculated with BUS speed, Clock frequency, and the processing time.

Considering the actual number, 60fps, 16bpp, 480x320, 9 times redraw with fully textured polygons.

Assume that 2500poly/1 human character, 5 players, 4500 polygon big boss, and 7000 polygon landscape are drawn in 1/60 sec with 30 times interruption for keys and collision calculation, and all they are moving and fighting in the screen. That is the bottom line for GPU specification in actual.

The figure in the next page is the example of 2500 polygon's human body. In general, for 60int, human body costs 1000-1500 polygons and 2500 polygons for 30int. For bust up or face zooming, the model takes 1500-200 polygons only for the face, with the hair moving.

draft



2500 polygon character

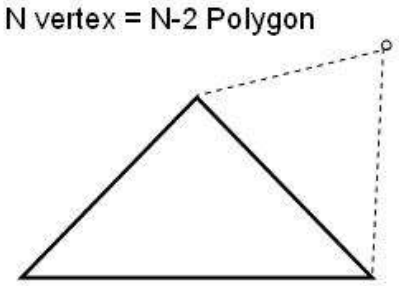
2.4.5.3. GTE

GTE (Geometry transfer engine) shall be implemented independently. But it is OK if GPU has the same function inside. SIMD, MMX, and other DSP shall not be used for geometry transferring to avoid serious performance down when multiple function are being used.

2.4.5.4. Target geometry transferring performance

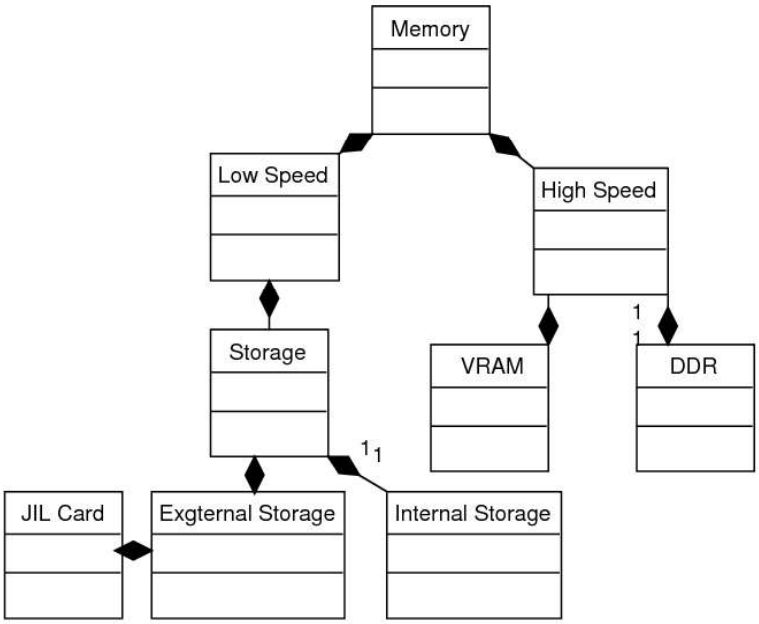
20M tri/sec or more is desirable. In the typical case that is shown in 2.4.5.2, the game needs (2500x5 + 4500x+ 7000) x 60 = 1.44M polygons/sec. So there is a big difference between 20M and 1.44M. Readers have to be aware that later number comes from game playing case.

There is a very cunning and silly idea to count polygons. See the figure below.



This figure shows that to calculate N vertex is almost N polygon if N is big enough. So, sometimes GPU vendor or semiconductor vendor explains the GTE can calculate N polygon though the GTE only can calculate N/3 polygons. JIL denies this idea thoroughly. N polygon needs 3-vertex calculation. And this is the definition.

2.5. Memory System



2.5.1. High speed memory

2.5.1.1. Amount of main memory

256MB (Min) , Target 512MB (Depend on the cost) DDR/DDR2/LP-DDR shall be supported.

For multitask OS, 512MB is desirable. Contact to JIL team to explain the memory structures.

This memory system is supposed to be shared with VRAM.

2.5.1.2. Desirable amount of VRAM area

8MB (2MB texture buffer mandatory) VRAM or equivalent is required. (12MB or more is recommended for HD decode.) VRAM shall be connected to either the main BUS or faster BUS, or GPU directly. Tentatively, JIL assumes that 16MB VRAM is desirable.

If GPU has an internal VRAM system and the VRAM is connected to faster BUS, that is ultimately desirable. In this case the amount of VRAM shall be referred.

2.5.2. Low speed memory

2.5.2.1. Capacity of internal storage

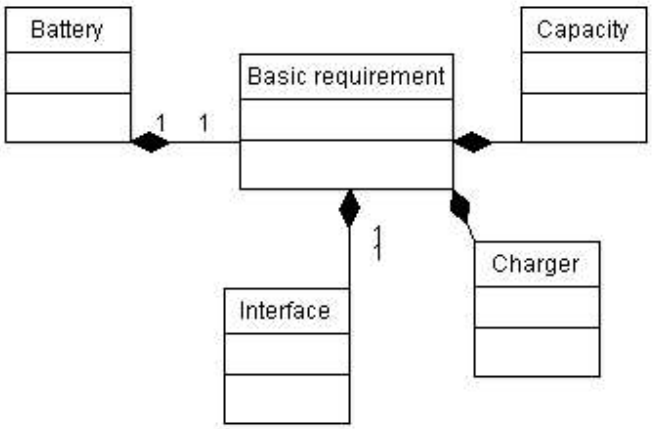
2.5.2.2. Capacity of external storage

2.5.2.3. Implementation of Virtual memory system

2.5.3. JIL card conformance

draft

2.6. Battery



2.6.1. Capacity

2.6.1.1. Playing time

4 hours offline game play with no RF and Wi-Fi + 30min talktime + emergency call shall be supported. JIL will provide a benchmark test for the playtime measurement. (suppose typical 3D action game like Doom3, Metalgear soild)

2.6.1.2. Rider

For emergency call, battery capacity for 5 minutes call shall be reserved.

2.6.2. Interface

2.6.2.1. Extra battery interface

2.6.2.2. Charging interface

The interface for battery charger shall be micro USB connector.

2.6.3. Charger

draft

2.7. Radio

2.7.1. General Rules

2.7.1.1. Profile to be supported

One of SKU1-SKU5 shall be suppoted. It is desirable that the motherboard designing is uniformed. JIL does not mention whether the solution is done by one-chip or separated.

- SKU1: UMTS/EDGE
- SKU2: CDMA/EVDOrA
- SKU3: TD-SCDMA/EDGE
- SKU4: UMTS/EDGE/EVDOrA
- SKU5: UMTS/EDGE/TDS-CDMA/EVDOrA

2.7.1.2. Getting specification for each Opco

The RF format is different between all JIL operator companies's.

Contact to the specificatoin manager to get each of RF specification with refering the contact list on the Cover sheet.

draft

EXHIBIT 2023

IPR2018-01257 / IPR2018-01258

Bill of Material for B-01-C01 (Invensense gyro) 20100518.PCB
On 2010/5/24 at 上午 11:25:08

Components	Pattern	Quantity	Comment	Cost	Remark
IXZ500/650	QFN2428_5X4S	1	U5	**2.5**	Gyro
AMI602	AMI602S	1	U2	**1.5**	MR/G
C8051F902/F912	QFN24_4X4S	1	U4	**1.5**	MCU
104	RC0402	2	C5,C13		
105	RC0402	3	C2,C8,C15		
106	RC0603	2	C4,C11		
106	RC3216	1	C10		
1K	RC0402	1	R1		
224	RC0402	1	C16		
471	RC0402	2	C3,C9		
47uF	RC3528	1	C1		
AIC	SOT-23-5S	1	U3		
C/103/0402	RC0402	1	C14		
C/104/0402	RC0402	4	C12,C17,C18,C20	**1.5**	
C/104/25V	RC0603	1	C7		
C/224/X7R/0402	RC0402	2	C6,C19		
Header 10	S_SIP10	2	P2,P3		
L/1uH/0402	RC0402	1	L2		
MIC5205_2.7V	SOT-23-5S	1	U1		
NC/105	RC0402	1	C21		
R/1K/5%/0402	RC0402	1	R2		
R/3.3K/0402/5%	RC0402	2	R5,R40		
R/750/1%/0402	RC0402	4	R3,R4.R6,R7		
Total				7	

Cost 10pcs		
	Invensense	Epson
Component	7	5.5
Layout+SMT	95.156	95.156
Total	102.156	100.656

Cost 350pcs		
	Invensense	Epson
Component	7	5.5
Layout+SMT	6.188	6.188
Total	13.188	11.688

EXHIBIT 2024

IPR2018-01257 / IPR2018-01258

FRONT



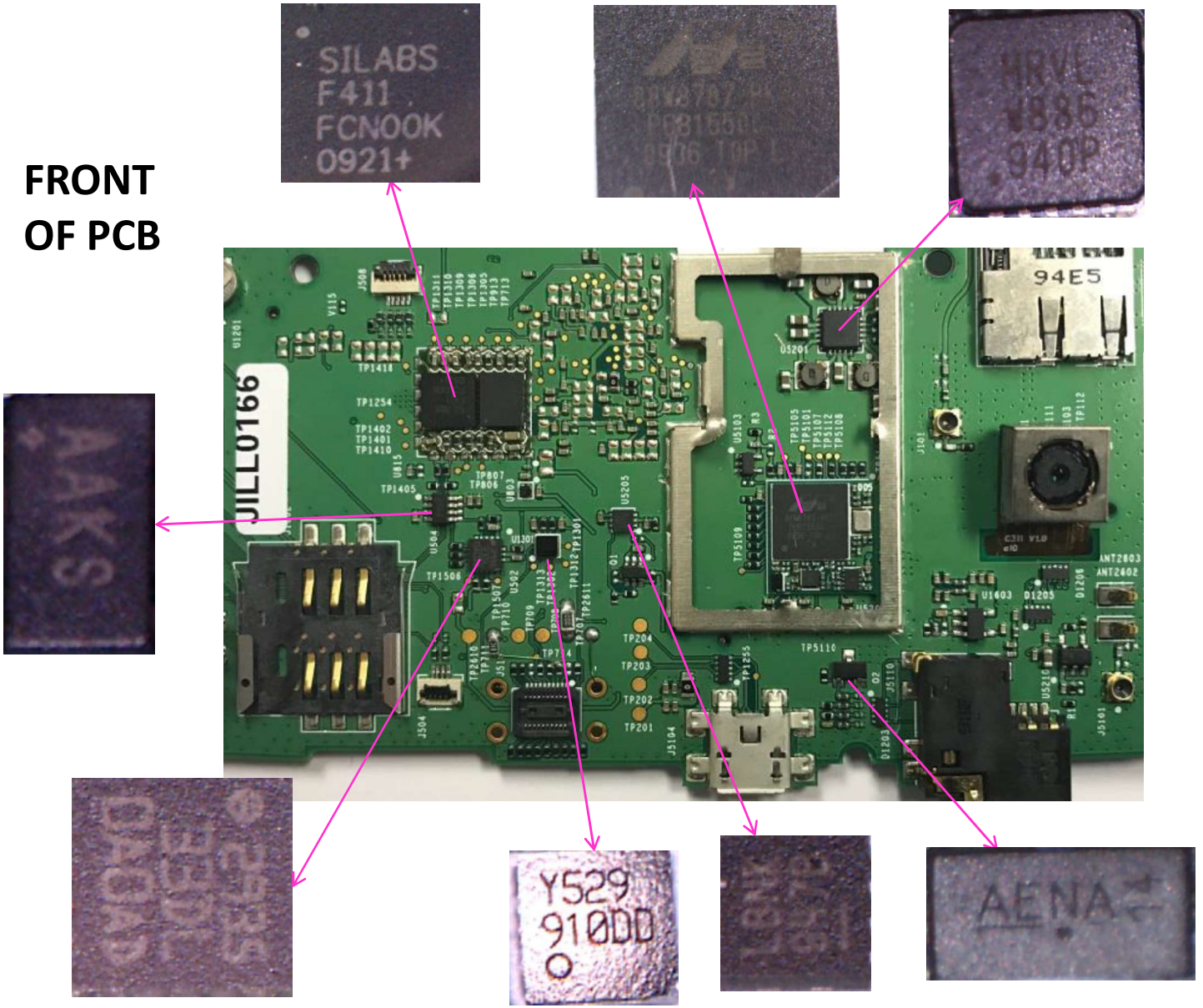
BACK



BACK WITH BACK COVER REMOVED



FRONT OF PCB



BACK OF PCB

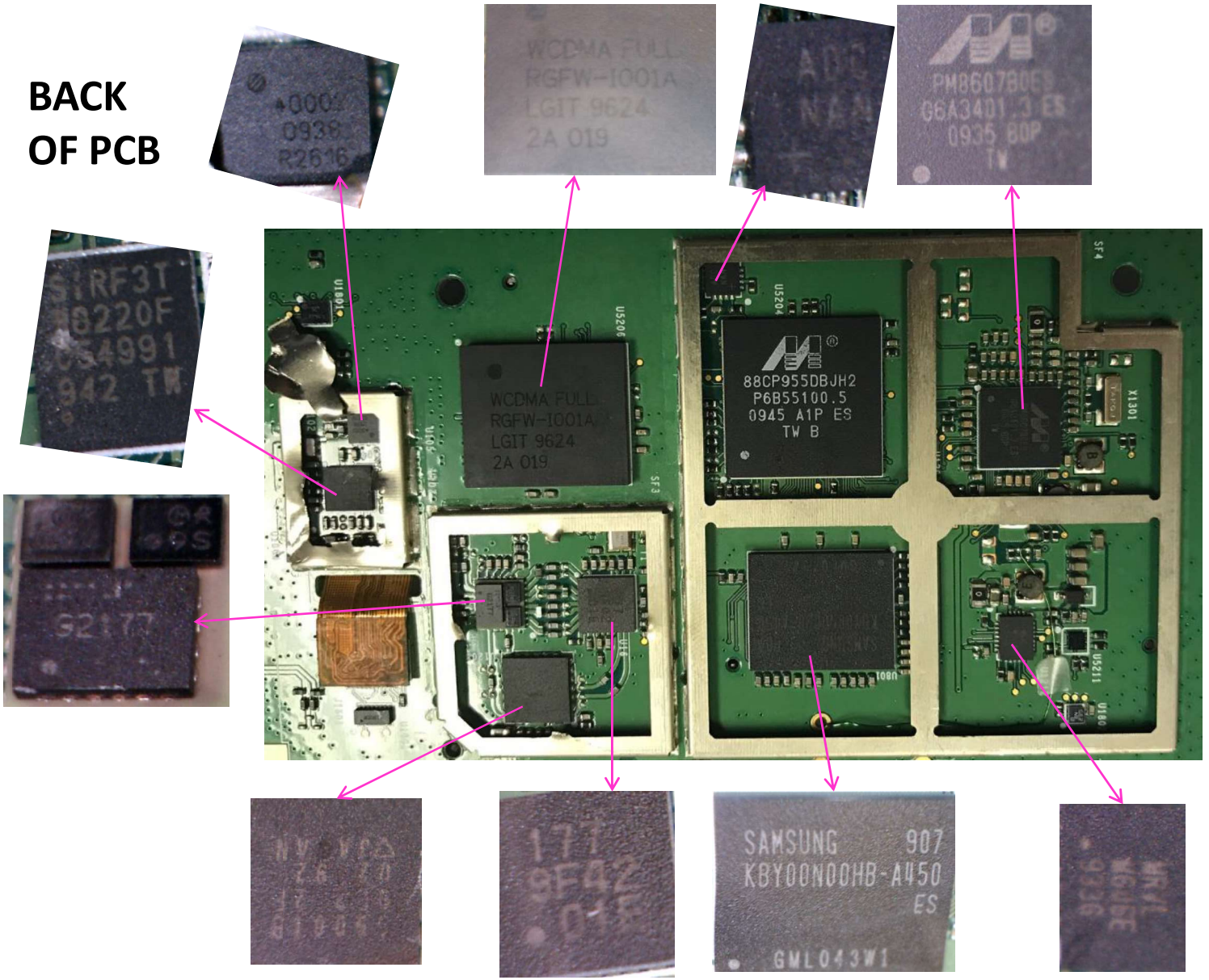

WCDMA FULL
RGFW-1001A
LGIT 9624
2A 019
88CP955DBJH2
P6B55100.5
0945 A1P ES
TW B
SAMSUNG 907
KBY00N00HB-A450
ES
GWL043W1

EXHIBIT 2025

IPR2018-01257 / IPR2018-01258

CyWee Phone API Reference

☐ **Confidential (Internal Use Only)**

☒ **Limited Release**

☐ **Normal**

Revision History

Version	Description	Author	Date
1.0	* First Version	Henry, Tigran	2009/9/25
1.1	* Modify some data type of structure cywee_data_t, * Fix Figure notation error * MR sensor Figure error	Henry	2009/9/29
1.2	* Modify API definition to fit CyWee Spec * Reserve some API for future release * Modify API to JNI style	Henry, Tigran	2009/12/22
1.3	* Add PC game application API	Henry, Tigran	2009/12/25
1.4	* Change API interface * Change motion API output	Henry, Tigran	2010/4/7
1.5	* Separated **JNI** and **Middleware API** descriptions. * **Added new APIs for** JNI :setMotionThresholdValueFactor, setShakeMotionThresholdValueFactor and getLibVersion. ***Added new API for middleware:** CYWEE_Control_set_motion_threshold_value_factor, CYWEE_Control_set_shake_motion_threshold_value_factor.	Henry, Tigran	2010/04/16

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Introduction

1.1 CyWee Motion Recognition Tech.

1.1.1 Usage

The CyWee motion recognition technology can provide the motion recognition result and 9-axis sensor rawdata output (3-axis accelerometer + 3-axis gyroscope + 3-axis magnetic sensor) by using a 3-axis accelerometer (Ax, Ay, Az), a 2-axis gyroscope (Gwx, Gwz) and a 3-axis (Mx, My, Mz) magnetic sensor. The phone coordinate is shown in figure below:

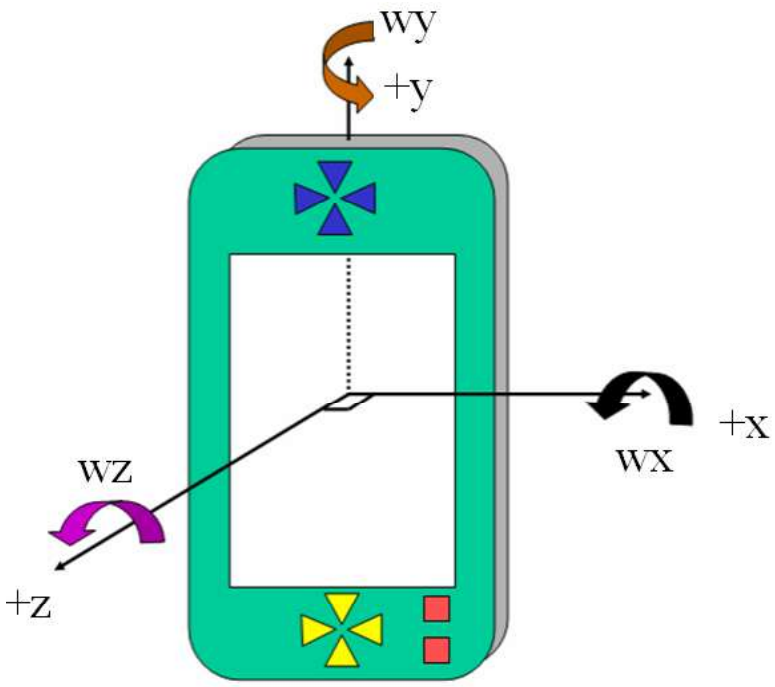


Figure 1

3-axis accelerometer (Ax, Ay, Az) contains Ax, Ay and Az sensing axes. Each sensing axis aligns to the phone coordinate. The Ax's "x" means aligning to phone coordinate +x. The Ay's "y" means aligning to phone coordinate +y. The Az's "z" means aligning to phone coordinate +z. The gyroscope's Gwx means aligning to phone coordinate +wx. Gwy means aligning to phone coordinate +wy. Gwz means aligning to phone coordinate +wz. The magnetic sensor's Mx means aligning to phone coordinate +x. My means aligning to phone coordinate +y and Mz means aligning to phone coordinate +z.

1.1.2 Protocol

All sensors' rawdata can be got from the CyWee library. These data format maybe become different from the original rawdata got directly from each sensor through I2C interface.

1.2 CyWee API introduction

CyWee provides the API library to access the CyWee sensors data from *middleware* and *Java applications* as well. The library name is **libcywee_sensorapi_vX.Y.so**, where X and Y are the major and minor versions of the library. Library can be linked as a shared library to the middleware application development and also can be use as JIN library for Java APK developers. For Java APK developers CyWee also provides additional helper Java package **cywee.sensor.api** to manage the sensors data.

API is classified into several modes. They are ***Rawdata mode***, ***Motion mode***, ***Orientation mode*** and ***PC application mode***.

1.2.1 Raw mode

This API provides all the sensors rawdata. It contains 3-axis accelerometer, 3-axis gyroscope and 3-axis magnetic rawdata.

1.2.2 Motion mode

This API provides the motion recognition results due to the motion of waving the phone in several directions. The motion can be as Figure 2_1~Figure 2_3 showing:

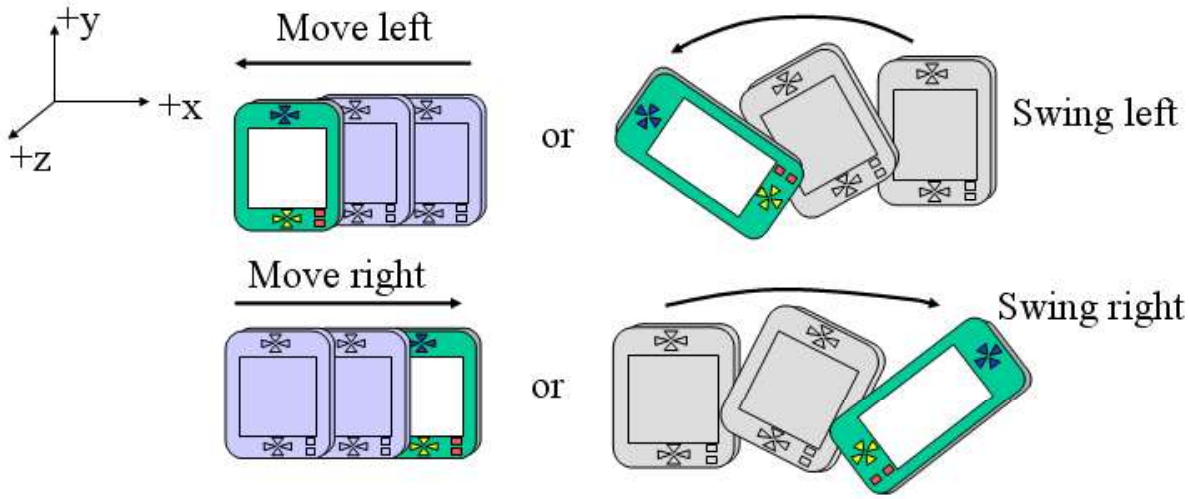


Figure 2_1: X-direction motion output

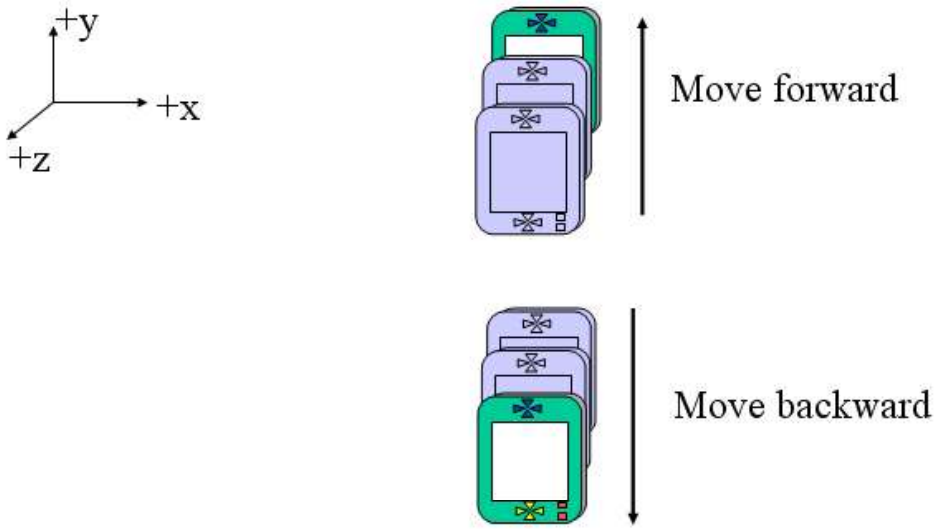


Figure 2_2: Y-direction motion output

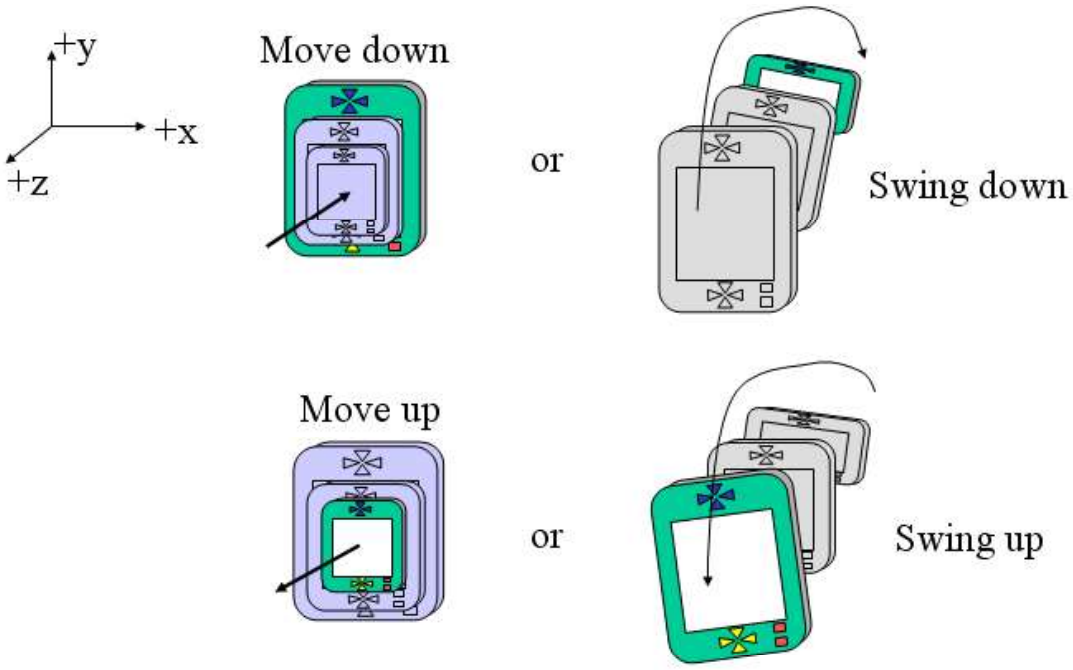


Figure 2_3: Z-direction motion output

If just shake the cell phone with any direction, it will generate shaking signal output. As Figure 2_4 showing:

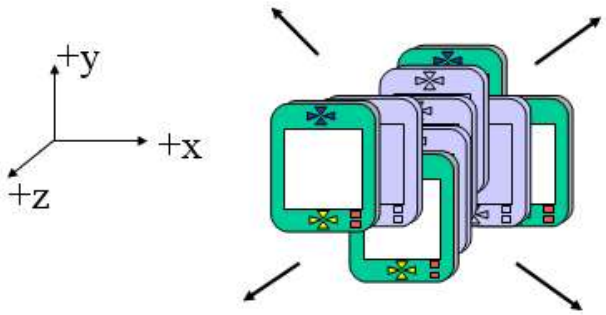


Figure 2_4: Shaking motion output

It also can provide with the cell phone posture of "Turnover". As Figure_2_5 showing:

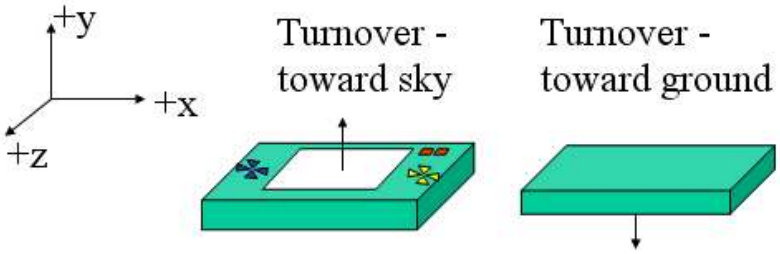


Figure 2_5: Shaking motion output

1.2.3 Orientation mode

This API provides with Roll, Pitch and Yaw three absolutely angles. The orientation definition is defined by CyWee specifications. As Figure 3 showing:

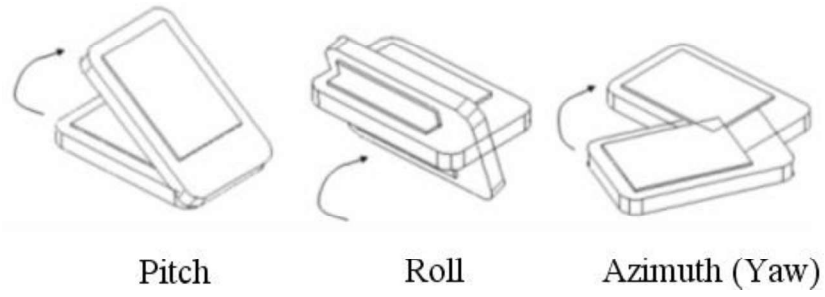


Figure 3: Orientation definition

1.2.4 PC application mode

In this mode, CyWee will prepare for all sensors' information to the buffer of this API, and content developer can send it to the PC side through WiFi or Bluetooth. Sensor's rawdata is sent for PC motion game development. Air mouse's displacement dx and dy on the screen are used for air mouse pointing function.

2 CyWee API description for Java developers

CyWee API library exports the corresponding API methods to JNI for Java APK developers. CyWee also provide additional helper Java package **cywee.sensor.api** to manage the sensors data.

2.1 cywee.sensor.api package

cywee.sensor.api is the helper package to convert the sensors data byte array to the corresponding structures in Java application. It contains four public classes `CyWeeMotionData`, `CyweeOrientationData`, `CyweeRawData` and `CyWeeUIData` for corresponding sensor data types.

2.2 openSensor

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Opens the CyWee interface to the Sensor Fusion Manager.

2.3 closeSensor

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Closes the CyWee interface to the Sensor Fusion Manager.

2.4 activateSensorAccelerometer

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Activate accelerometer sensor polling in the Sensor Fusion Manager

2.5 deactivateSensorAccelerometer

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Deactivate accelerometer sensor polling in the Sensor Fusion Manager

2.6 activateSensorMagnetic

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Activate magnetic sensor polling in the Sensor Fusion Manager

2.7 deactivateSensorMagnetic

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Deactivate magnetic sensor polling in the Sensor Fusion Manager

2.8 activateSensorOrientation

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Activate orientation sensor polling in the Sensor Fusion Manager

2.9 deactivateSensorOrientation

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Deactivate Orientation sensor polling in the Sensor Fusion Manager

2.10 activateSensorGyroscope

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Activate Gyroscope sensor polling in the Sensor Fusion Manager

2.11 deactivateSensorGyroscope

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Deactivate gyroscope sensor polling in the Sensor Fusion Manager

2.12 getAllSensorValue

Parameters

No parameters

Return Value

If the function succeeds, returns all sensors value of the phone as an array of the bytes. The `CyWeeUIData` class from **`cywee.sensor.api`** helper package must be used to convert the sensors data byte array to the corresponding structure.

Remarks

Read all sensors values from sensor Fusion Manager.

2.13 getRawSensorValue

Parameters

No parameters

Return Value

If the function succeeds, returns sensors raw data values as an array of the bytes. The `CyweeRawData` class from **`cywee.sensor.api`** helper package must be used to convert the sensors data byte array to the corresponding structure.

Remarks

Read raw data values from sensor Fusion Manager.

2.14 getOrientationSensorValue

Parameters

No parameters

Return Value

Returns orientation data values as an array of the bytes. The `CyweeOrientationData` class from **`cywee.sensor.api`** helper package must be used to convert the sensors data byte array to the corresponding structure.

Remarks

Read orientation data values from Sensor Fusion Manager.

2.15 getMotionValues

Parameters

No parameters

Return Value

Returns motion data values as an array of the bytes. The `CyWeeMotionData` class from **`cywee.sensor.api`** helper package must be used to convert the sensors data byte array to the corresponding structure.

Remarks

Read motion data values from Sensor Fusion Manager.

2.16 setMotionThresholdValueFactor

Parameters

The integer value from the range [10: 50]

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Set the motion threshold value factor. CyWee defines the default force threshold for motion output. When doing the motion, how much force can generate the motion output is defined by CyWee internal library. If it is too easy to generate the motion output, it can be set to this threshold factor larger than 1 to let this motion output need more force to generate it. For example, Set 20, it means it needs (20/10 = 2) twice force to generate the motion output from CyWee's library. Set 15, it means it needs (15/10 = 1.5) 1.5 times force to generate the motion output from CyWee's library.

2.17 setShakeMotionThresholdValueFactor

Parameters

The integer value from the range [10: 50]

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Set the motion shake threshold value factor. CyWee defines the default force threshold for motion output. When doing the motion, how much force can generate the motion output is defined by CyWee internal library. If it is too easy to generate the motion output, it can be set to this threshold factor larger than 1 to let this motion output need more force to generate it. For example, Set 20, it means it needs (20/10 = 2) twice force to generate the motion output from CyWee's library. Set 15, it means it needs (15/10 = 1.5) 1.5 times force to generate the motion output from CyWee's library.

2.18 resetGyrocalibrationTable

Parameters

No parameters

Return Value

If the function succeeds, the return value is **non zero** value. If the function fails, the return value is **0**.

Remarks

Reset gyroscope calibration value. This should be set when gyro's value is in static state, its value still not 0. This function should be called.

2.19 getLibVersion

Parameters

No parameters

Return Value

If the function succeeds, the return value is byte array of ASCII characters that represent the version of the JNI library.

Remarks

Return the current version of the JNI library.

3 Middleware API Description

CyWee provides the API library to access the CyWee sensors data from middleware. Library can be linked as a shared library to the middleware program. The "**CyweeSensorApi.h"** header file declares the prototypes of APIs. **"CyweeDataType.h"** header file declared the corresponding data structures which are used by APIs.

int CYWEE_Data_data_open(void)

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

It opens the CyWee interface to the Sensor Fusion Manager. This is the first API that must be called before any other API can be called.

int CYWEE_Data_data_close (void)

Parameters

No parameters

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

It closes the interface to the Sensor Fusion Manager. This is the last API that must be called.

int CYWEE_Control_activate(int *handle*, int *enabled*)

Parameters

handle specifies sensor to enable or disable. It can be one if the following values:

SENSOR_TYPE_ACCELEROMETER 1

SENSOR_TYPE_MAGNETIC_FIELD 2

SENSOR_TYPE_GYROSCOPE 3

SENSOR_TYPE_ORIENTATION 4

enabled the flag which specifies to enable or disable the specified sensor. It can be one of the following values:

ENABLE 1

DISABLE 2

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

It enables or disables the specified sensor polling in the Sensor Fusion Manager.

int CYWEE_Data_poll_data_sensor_raw(tCyWeeSensorRawData* *data*)

Parameters

data Pointer to sensors raw data structure. On return this structure contains the sensors raw data.

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Get the sensors raw data value from Sensor Fusion Manager.

int CYWEE_Data_poll_data_orientation_angle(tCyWeeOrientationAngleData* *data*)

Parameters

data Pointer to orientation angle data structure. On return this structure contains the orientation angle data.

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Get the orientation angle data from Sensor Fusion Manager.

int CYWEE_Data_poll_data_motion(tCyWeeMotionData* *data*)

Parameters

data Pointer to motion data structure. On return this structure contains the motion data.

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Get the motion data from Sensor Fusion Manager.

int CYWEE_Data_poll_data_ui(tCyWeeUIData* *data*)

Parameters

data Pointer to Cywee UI data structure. On return this structure contains the Cywee UI data.

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Get the CyWee UI data from Sensor Fusion Manager.

NOTE: It is recommended to call this function and send the all sensors to PC side to combine with PC application or games through WiFi/Bluetooth.

int CYWEE_Control_set_motion_threshold_value_factor (int *value*)

Parameters

value motion threshold factor value. The integer value is from the range [10: 50].

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Set the motion API threshold value factor. CyWee defines the default force threshold for motion output. When doing the motion, how much force can generate the motion output is defined by CyWee internal library. If it is too easy to generate the motion output, it can be set to this threshold factor larger than 1 to let this motion output need more force to generate it. For example, Set 20, it means it needs (20/10 = 2) twice force to generate the motion output from CyWee's library. Set 15, it means it needs (15/10 = 1.5) 1.5 times force to generate the motion output from CyWee's library.

int CYWEE_Control_set_shake_motion_threshold_value_factor (int *value*)

Parameters

value shake motion threshold factor value. The integer value is from the range [10: 50].

Return Value

If the function succeeds, the return value is **nonzero** value. If the function fails, the return value is **0**.

Remarks

Set the motion API shake threshold value factor. CyWee defines the default force threshold for motion output. When doing the motion, how much force can generate the motion output is defined by CyWee internal library. If it is too easy to generate the motion output, it can be set to this threshold factor larger than 1 to let this motion output need more force to generate it. For example, Set 20, it means it needs (20/10 = 2) twice force to generate the motion output from CyWee's library. Set 15, it means it needs (15/10 = 1.5) 1.5 times force to generate the motion output from CyWee's library.

const char* CYWEE_GetVersion (void)

Return Value

If the function succeeds, the return value is zero terminated string that contains the version.

Remarks

Return the version of the library.

3.1 Middleware API data structures

3.1.1 tCyWeeSensorRawData

```
typedef struct _CyWeeSensorRawData
{
unsigned short      G_Sensor_X;
unsigned short      G_Sensor_Y;
unsigned short      G_Sensor_Z;

short               E_Comp_MX;
short               E_Comp_MY;
short               E_Comp_MZ;

unsigned short      W_X;
unsigned short      W_Y;
unsigned short      W_Z;

} tCyWeeSensorRawData;
```

Members

G sensor: ADI ADI345

G_Sensor_X: Accelerometer rawdata toward x-axis. Data range: 0 ~ 4096, 2048 is the 0G output. ***For CyWee phone's spec, you must transfer your data (G_Sensor_X_Output) by using this formula:***

G_Sensor_X_Output = ((float)G_Sensor_X – (float) 2048) / (float) 256.0

Uint: G => compared with gravity

Then you'll see the G_Sensor_X_Output will be like this in "CySensorDataTest" APK:

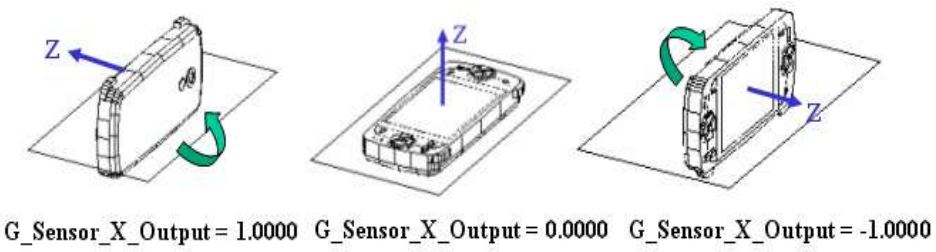


Figure 4: G sensor x output

G_Sensor_Y: Accelerometer rawdata toward y-axis. Data range: 0 ~ 4096, 2048 is the 0G output. ***For CyWee phone's spec, you must transfer your data (G_Sensor_Y_Output) by using this formula:***

G_Sensor_Y_Output = ((float)G_Sensor_Y – (float) 2048) / (float) 256.0

Uint: G => compared with gravity

Then you'll see the G_Sensor_Y_Output will be like this in "CySensorDataTest" APK

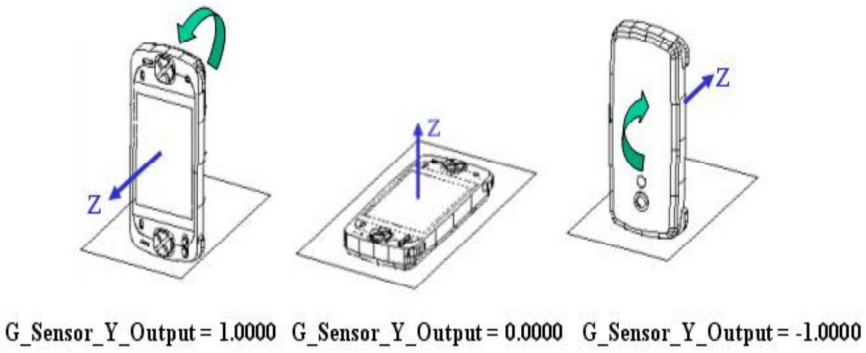


Figure 5: G sensor y output

G_Sensor_Z: Accelerometer rawdata toward z-axis. Data range: 0 ~ 4096, 2048 is the 0G output. ***For CyWee phone's spec, you must transfer your data(G_Sensor_Z_Output) by using this formula:***

G_Sensor_Z_Output = ((float)G_Sensor_Z – (float) 2048) / (float) 256.0

Uint: G => compared with gravity

Then you'll see the G_Sensor_Z_Output will be like this in "CySensorDataTest" APK

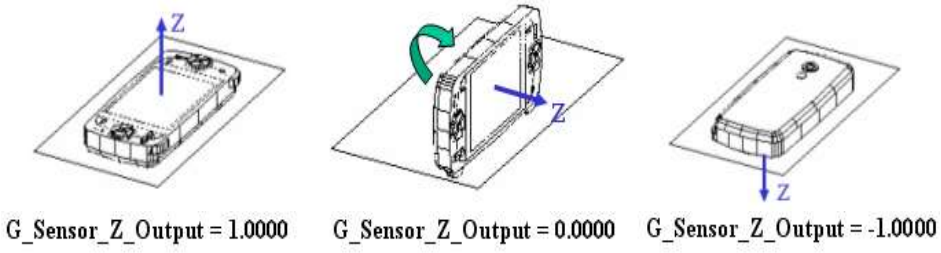


Figure 6: G sensor z output

Magnetic sensor: YAMAHA YAS529

E_comp_MX: Magnetic sensor's rawdata toward x-axis. The magnetic sensor data is calibrated. ***For CyWee phone's spec, you must transfer your data(E_Comp_MX_Output) by using this formula:***

E_Comp_MX_Output = E_Comp_MX / 10000

Uint: Gauss

Remark:

Before using this value, make sure that the magnetic sensor calibration is Done

E_comp_MY: Magnetic sensor's rawdata toward y-axis. The magnetic sensor data is calibrated. ***For CyWee phone's spec, you must transfer your data(E_Comp_MY_Output) by using this formula:***

E_Comp_MY_Output = E_Comp_MY / 10000

Uint: Gauss

Remark:

Before using this value, make sure that the magnetic sensor calibration is done

E_comp_MZ: Magnetic sensor's rawdata toward z-axis. The magnetic sensor data is calibrated. ***For CyWee phone's spec, you must transfer your data(E_Comp_MZ_Output) by using this formula:***

E_Comp_MZ_Output = E_Comp_MZ / 10000

Uint: Gauss

Remark:

Before using this value, make sure that the magnetic sensor calibration is Done

Gyro: Invensense IXZ650

W_X: Gyroscope's rawdata toward wx-axis. 0 is the static output without any rotation motion. ***For CyWee phone's spec, you must transfer your data (W_X_Output) by using this formula:***

W_X_Output = W_X * 3.141592 / 180

Uint: radian / second

W_Y: Gyroscope's rawdata toward wy-axis. 0 is the static output without any rotation motion. ***For CyWee phone's spec, you must transfer your data (W_Y_Output) by using this formula:***

W_Y_Output = W_Y * 3.141592 / 180

Uint: radian / second

W_Z: Gyroscope's rawdata toward wz-axis. 0 is the static output without any rotation motion. ***For CyWee phone's spec, you must transfer your data (W_Z_Output) by using this formula:***

W_Z_Output = W_Z * 3.141592 / 180

Uint: radian / second

3.1.2 tCyWeeOrientationAngleData

```
typedef struct _CyWeeOrientationAngleData
{
   short          Roll;
   short          Pitch;
   short          Azimuth;

   short          Roll_fast;
   short          Pitch_fast;
   short          Azimuth_fast;
} tCyWeeOrientationAngleData;
```

CyWee's spec orientation definition

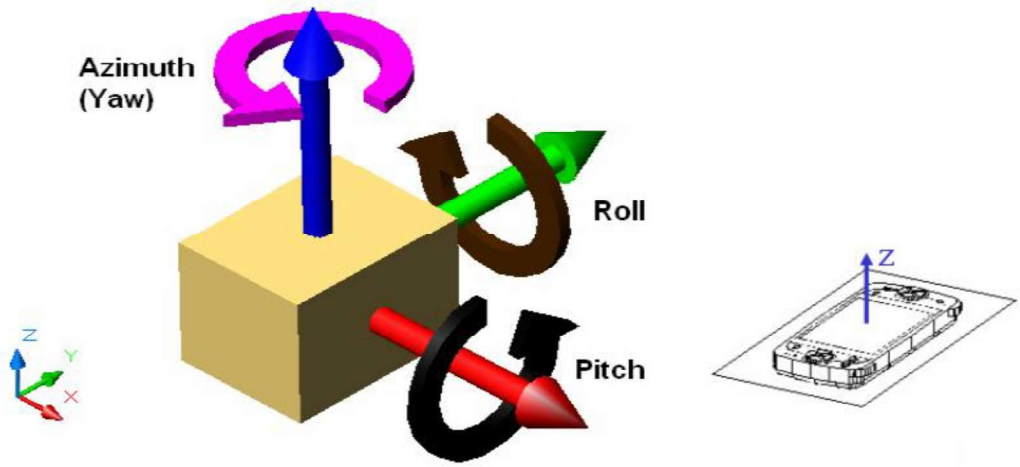


Figure 7: CyWee's spec of orientation

Members

Azimuth: The absolute angle output range is from 0 ~ 360. This output is used for low angular velocity rotation motion for Azimuth(Yaw) angle rotation.

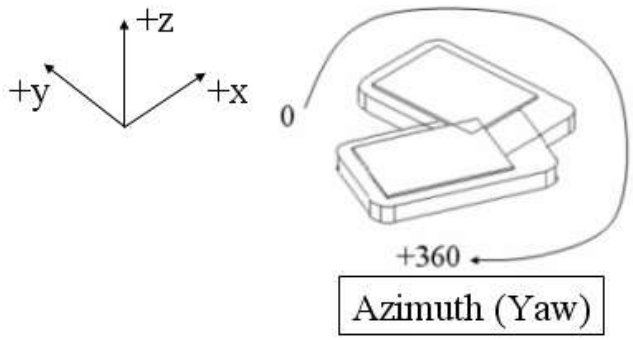


Figure 8: Azimuth (Yaw) absolute angle output

Pitch: The absolute angle output range is from -180 ~ 180. This output is used for low angular velocity rotation motion for Pitch angle rotation.

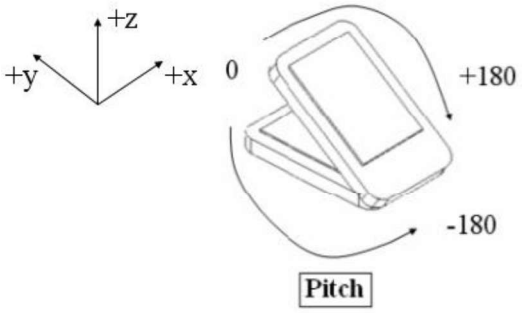


Figure 9: Pitch absolute angle output

Roll: The absolute angle output range is from -90 ~ 90. This output is used for low angular velocity rotation motion for Roll angle rotation.

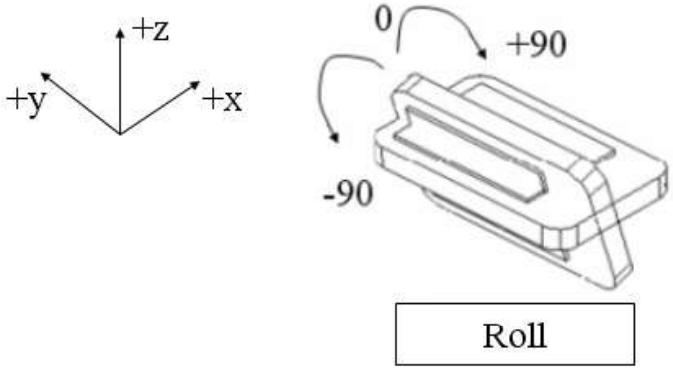


Figure 10: Roll absolute angle output

Azimuth_fast: The absolute angle output range is from -180 ~ 180. This output is

used for high angular velocity rotation motion for Azimuth angle rotation. **Make sure that the magnetic sensor has been calibrated. Otherwise, this value will become inaccurate.**

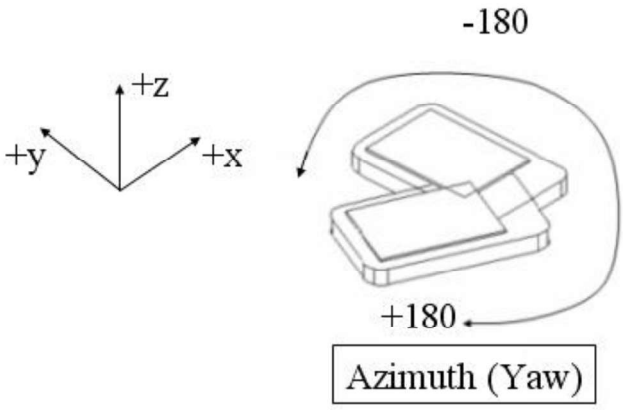


Figure 11: Azimuth_fast absolute angle output

Pitch_fast: The absolute angle output range is from -90 ~ 90. This output is used for high angular velocity rotation motion for Pitch angle rotation. **Make sure that the magnetic sensor has been calibrated. Otherwise, this value will become inaccurate.**

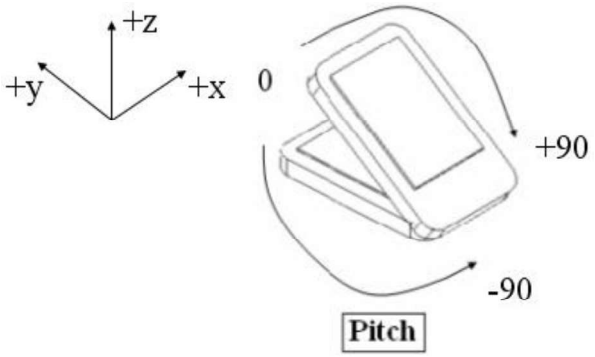


Figure 12: Pitch_fast absolute angle output

Roll_fast: The absolute angle output range is from -180 ~ +180. This output is used for high angular velocity rotation motion for Roll angle rotation. **Make sure that the magnetic sensor has been calibrated. Otherwise, this value will become inaccurate.**

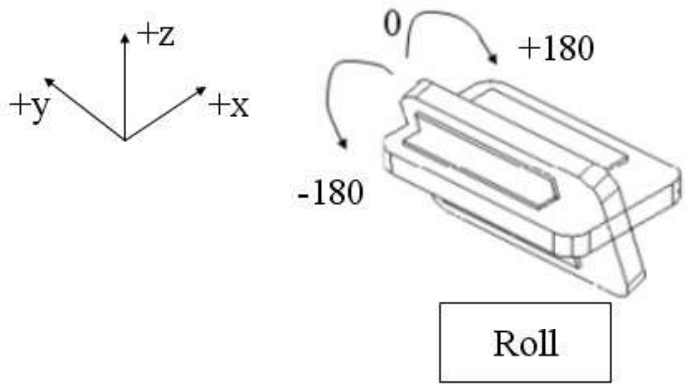


Figure 13: Roll_fast absolute angle output

3.1.3 tCyWeeMotionData

```
typedef struct _CyWeeMotionData
{
int     X_axis_out;
int     Y_axis_out;
int     Z_axis_out;
int     Force;
int     Shake;
int     Turnover;

} tCyWeeMotionData;
```

Members

X_axis_out: According to the picture below, when you wave the phone toward X direction, it will generate the motion output. Toward the +x direction, X_axis_out = 1. Toward -x direction, X_axis_out = -1.
When the X_axis_out is set to 1 or -1, this value will last around 300ms, and then goes to 0.

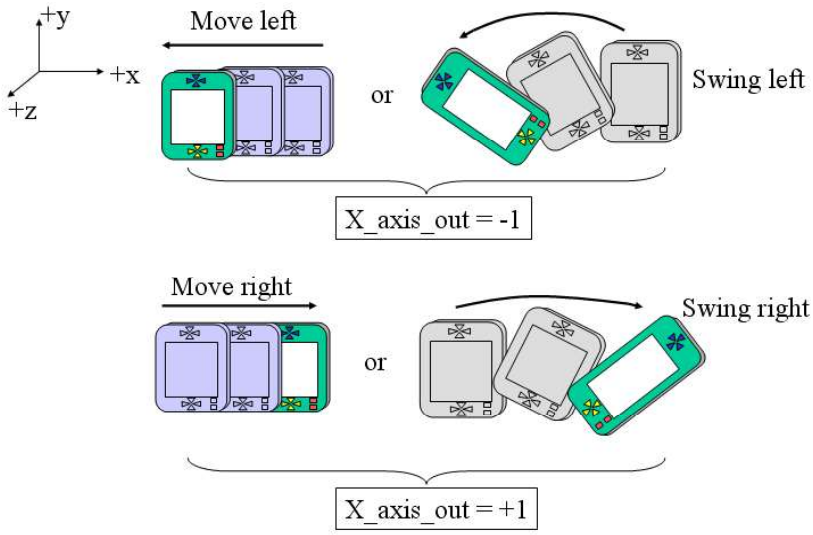


Figure 14_1: X-direction motion output

Y_axis_out: According to the picture below, when you wave the phone toward Y direction, it will generate the motion output. Toward the +y direction, Y_axis_out = 1. Toward -y direction, Y_axis_out = -1.

When the Y_axis_out is set to 1 or -1, this value will last around 300ms, and then goes to 0.

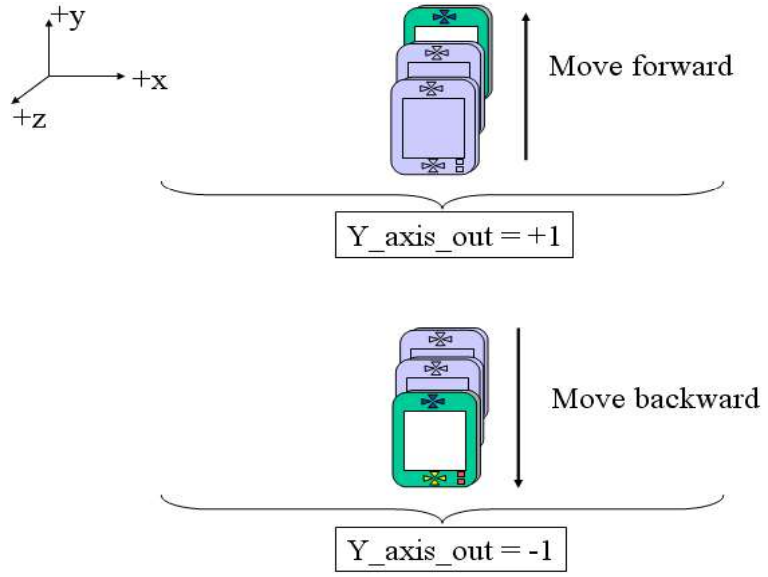


Figure 14_2: Y-direction motion output

Z_axis_out: According to the picture below**,** when you wave the phone toward Z direction, it will generate the motion output. Toward the +z direction, Z_axis_out = 1. Toward -z direction, Z_axis_out = -1.

When the Z_axis_out is set to 1 or -1, this value will last around 300ms,

and then goes to 0.

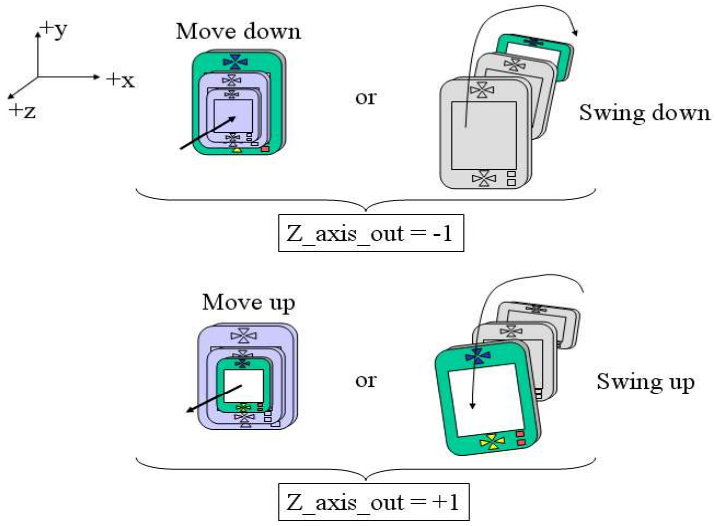


Figure 14_3: Z-direction motion output

Force: When each of motion occurs toward x, y or z directions, this parameter can provide with the magnitude of each motion.

Maximun value is 100. Minimun is 0.

Shake: If just shake the cell phone with any direction, it will generate shaking signal output. As Figure 11_4 showing:

If shaking, Shake = 1, otherwise, Shake = 0. This value will last around 300ms, and then goes to 0.

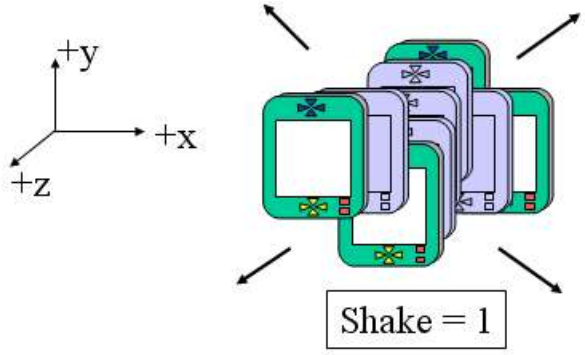


Figure 14_4: Shaking motion output

Turnover It also can provide with the cell phone posture of “Turnover”. According to the picture below

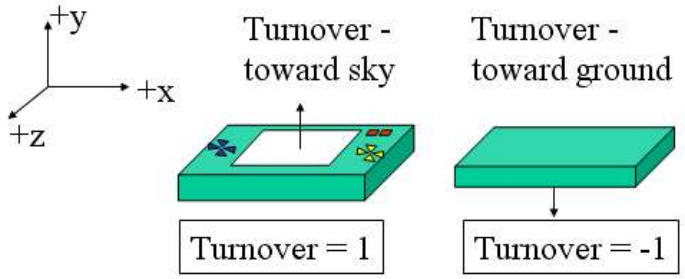


Figure 14_5: Turnover motion output

3.1.4 tCyWeeUIData

```
typedef struct _CyWeeUIData
{
 unsigned short      G_Sensor_X;
 unsigned short      G_Sensor_Y;
 unsigned short      G_Sensor_Z;

 unsigned short      Gyro_W_X;
 unsigned short      Gyro_W_Y;
 unsigned short      Gyro_W_Z;

 short               E_Comp_MX;
 short               E_Comp_MY;
 short               E_Comp_MZ;

 short               Compass_Temerature;

 char                Mouse_X;
 char                Mouse_Y;

unsigned short       Gyro_W_X_High;
 unsigned short      Gyro_W_Y_High;
 unsigned short      Gyro_W_Z_High;

 short               Roll;
 short               Pitch;
 short               Azimuth;
```

unsigned short *ButtonVector;*
} tCyWeeUIData;

Members

G_Sensor_X Accelerometer's rawdata output toward x-axis. The sensing range is from 0 ~ 4096. The 0G output is 2048

G_Sensor_Y Accelerometer's rawdata output toward y-axis. The sensing range is from 0 ~ 4096. The 0G output is 2048

G_Sensor_Z Accelerometer's rawdata output toward z-axis. The sensing range is from 0 ~ 4096. The 0G output is 2048

Gyro_W_X Gyroscope's ADC data output toward wx-axis for 440 deg/sec resolutions. The sensing range is from 0 ~ 4096. The static value without any rotating motion is 2048

Gyro_W_Y This value is always zero

Gyro_W_Z Gyroscope's ADC data output toward wz-axis for 440 deg/sec resolutions. The sensing range is from 0 ~ 4096. The static value without any rotating motion is 2048

E_Comp_MX Magnetic sensor's rawdata output toward x-axis. This data is calibrated.

E_Comp_MY Magnetic sensor's rawdata output toward y-axis. This data is calibrated.

E_Comp_MZ Magnetic sensor's rawdata output toward z-axis. This data is calibrated.

Comapss_Temperature Magnetic sensor's temperature output. This value is used as the parameter to calibrate the magnetic sensor.

Mouse_X Horizontal displacement of air mouse used on PC side. If the hands movement is toward the right direction, it becomes positive value. If left, it becomes negative value. The unit is the screen pixel

Mouse_Y Vertical displacement of air mouse used on PC side. If the hands movement is toward the up direction, it becomes positive value. If going down, it becomes negative value. The unit is the screen pixel

Gyro_W_X_High Gyroscope's ADC data output toward wx-axis for 2000 deg/sec resolutions. The sensing range is from 0 ~ 4096. The static value without any rotating motion is 2048

Gyro_W_Y_High This value is always zero

Gyro_W_Z_High Gyroscope's ADC data output toward wz-axis for 2000 deg/sec resolutions. The sensing range is from 0 ~ 4096. The static value without any rotating motion is 2048

Roll The absolute Roll angle for fast Roll angle motion

Pitch The absolute Pitch angle for fast Pitch angle motion

Azimuth The absolute Yaw angle for fast Azimuth angle motion

Button_Vector The button status vector of hardware and virtual button on touch panel on phone. If the button is pressed, the corresponding vector element is "1". If released, is "0". The definition of button is shown below

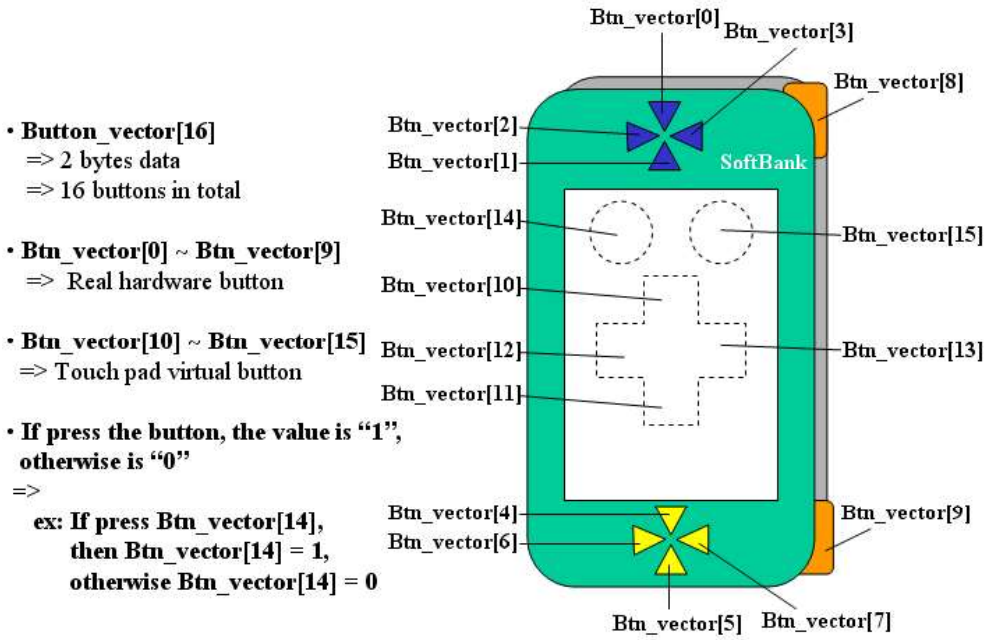


Figure 15: Example of APK of button arrangement for PC game application

4 Architecture Block Diagram

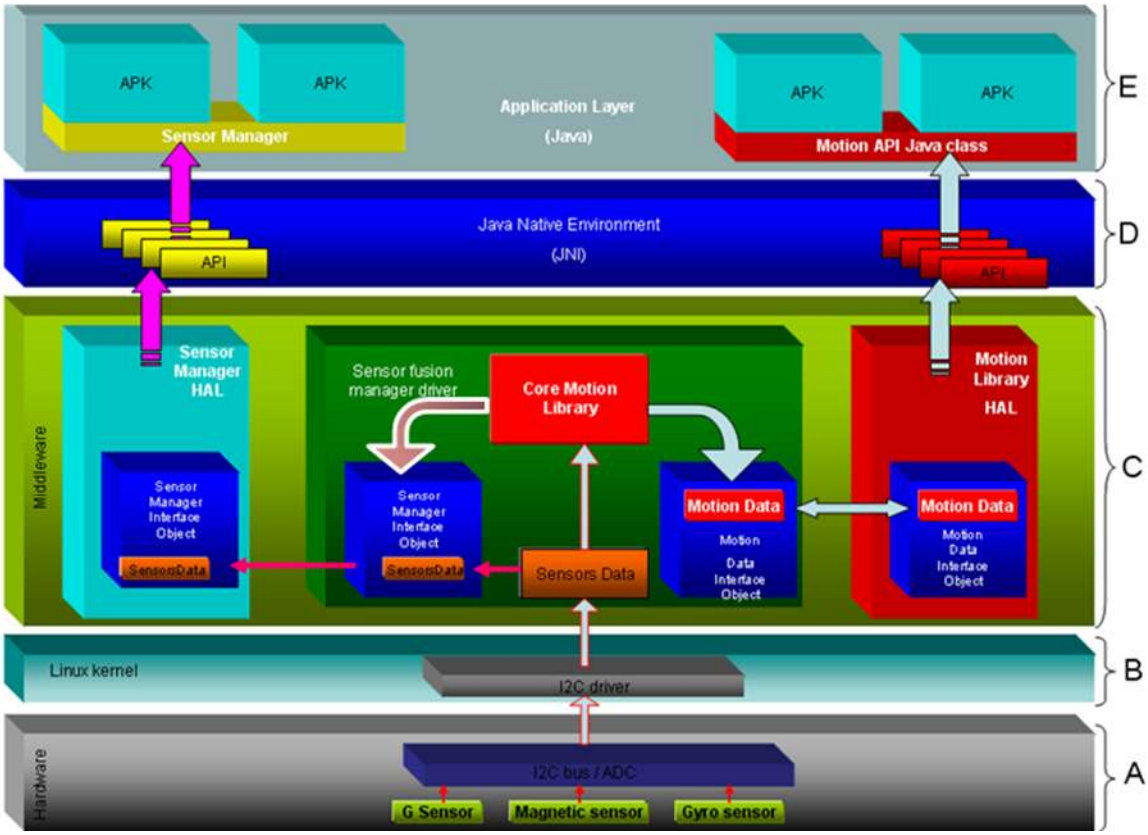


Figure 16: System architecture of CyWee sensor fusion manager

EXHIBIT 2026

IPR2018-01257 / IPR2018-01258

CyWee Motion Fusion Solution

(Middleware only)

☐ **Confidential (Internal Use Only)**

☒ **Limited Release**

☐ **Normal**

CyWee Handset Total Solution

- **CyWee motion middleware supporting Gyro, Accelerometer and magnetic sensors**
- **CyWee patented inclined gyro to simulate from 2-axis to 3-axis gyro output**
- **Provide sensor fusion motion library and API**
- **Other content provided by CyWee**
  - **CyWee games(console, online game)**
  - **Any existing PC game's motion mapping**
  - **Any existing cell phone's games motion mapping**
  - **New user interface on handset**
  - **Mobile console and mobile dongle for real time video transmission from the handset to TV**

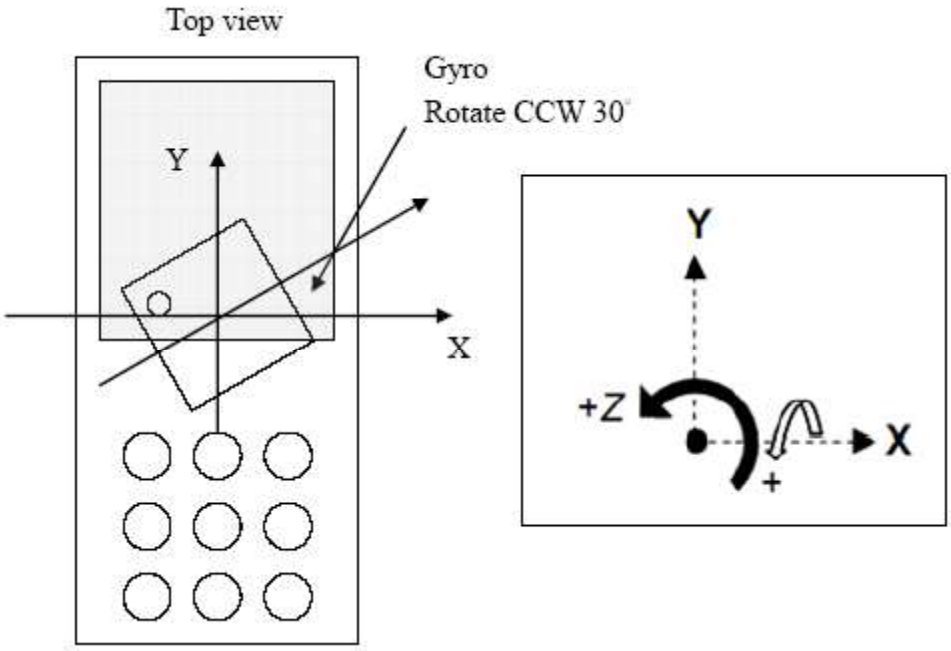


Fig. 1 Block diagram on handset

Easy for Software Integration

- **CyWee library for handset solution is O.S independent**
- **All pure C/C++ code**
- **Easily to integrate with other sensors: ex: G sensor, Gyro and MR sensor…etc. through I^2C bus**
- **Customized motion recognition API for specific application on handset**

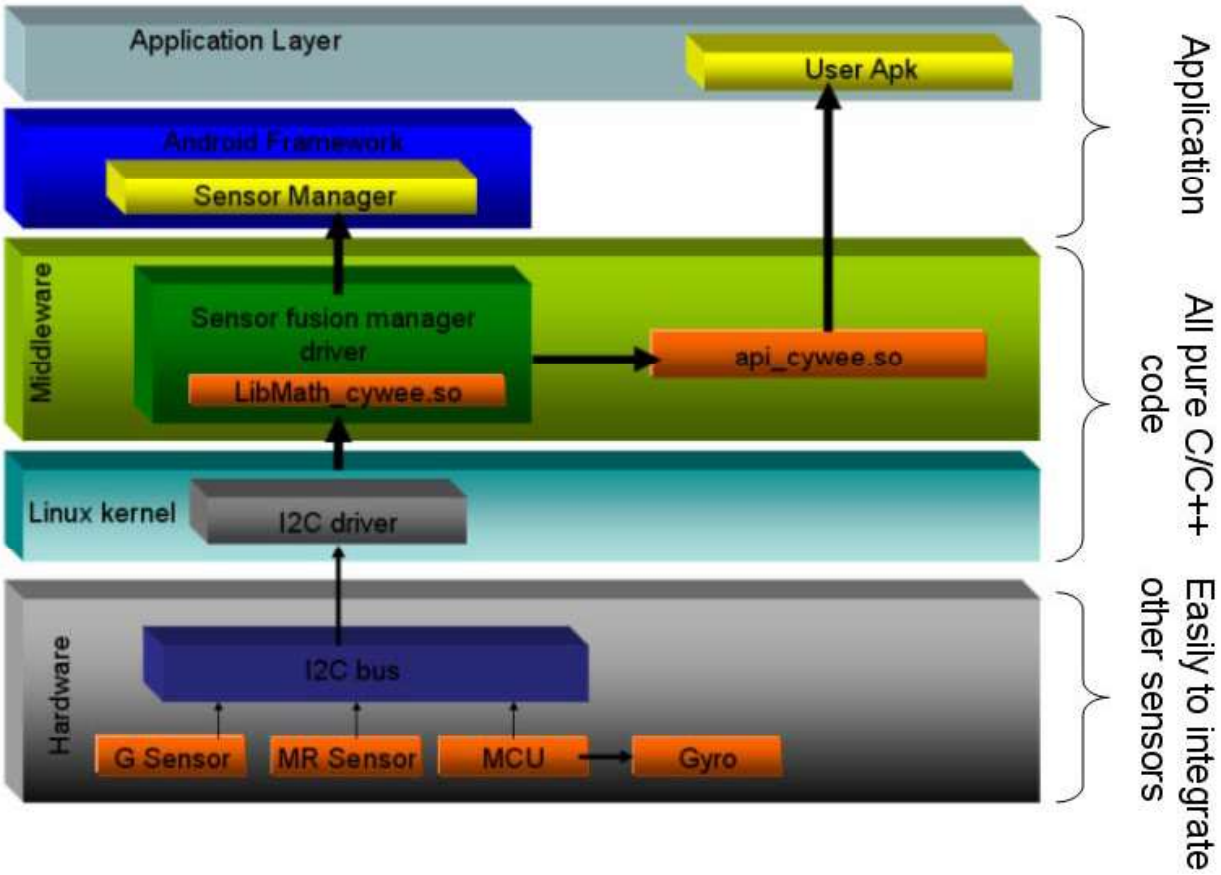


Fig. 2 Example: CyWee sensor fusion total solution on Android platform

CyWee Motion Recognition Tech.

- **Usage**

The CyWee motion recognition technology can provide the motion recognition result by using a 3-axis accelerometer (Ax, Ay, Az), a 2-axis gyroscope (Gwy, Gwz) and a 3-axis (Mx, My, Mz) magnetic sensor. The phone coordinate is shown in Figure 1:

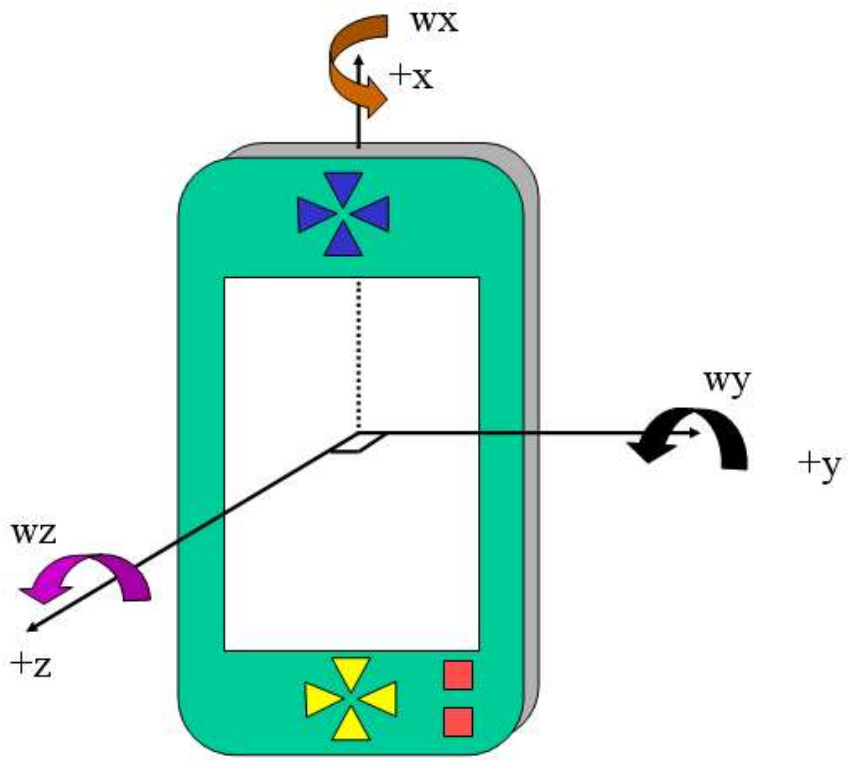


Fig. 3 Coordination of the phone

3-axis accelerometer (Ax, Ay, Az) contains Ax, Ay and Az sensing axes. Each sensing axis aligns to the phone coordinate. The Ax's "x" means aligning to phone coordinate +x. The Ay's "y" means aligning to phone coordinate +y. The Az's "z" means aligning to phone coordinate +z. The gyroscope's
Gwy means aligning to phone coordinate +wy. Gwz means aligning to phone coordinate +wz. The magnetic sensor's Mx means aligning to phone coordinate +x. My means aligning to phone coordinate +y and Mz means aligning to phone coordinate +z.

● Protocol

All sensors' rawdata can be got from the CyWee library. These data's format maybe become different from the original rawdata got directly from each sensor through I2C interface.

The rule of usage can be found as blow:

1. CyweeDataTypes.h
2. CyweeApi.h

CyweeDataTypes.h contains the parameters used in the program and the CyweeApi.h contains the functions definition of all the algorithms.

● API introduction

CyWee library is a library of algorithm to detect the human motion and recognize it as a special status to interact with games. By this library, you can connect to the API with games on phone. You can also send the sensor data to PC side to use the phone as an air mouse and as a game controller to play the PC game.

This API of CyWee library is in support of the usage of five modes. They are *Rawdata mode*, *Sports mode*, *flying mode*, *racing mode* and *PC application mode*.

Rawdata mode:

In this kind of API, CyWee will provide the API with all the sensors rawdata. It contains accelerometer, gyroscope and magnetic rawdata.

Sports mode:

In this kind of API, CyWee will provide the motion recognition results due to the motion of waving the phone in several directions. The motion can be as Figure 2 showing:

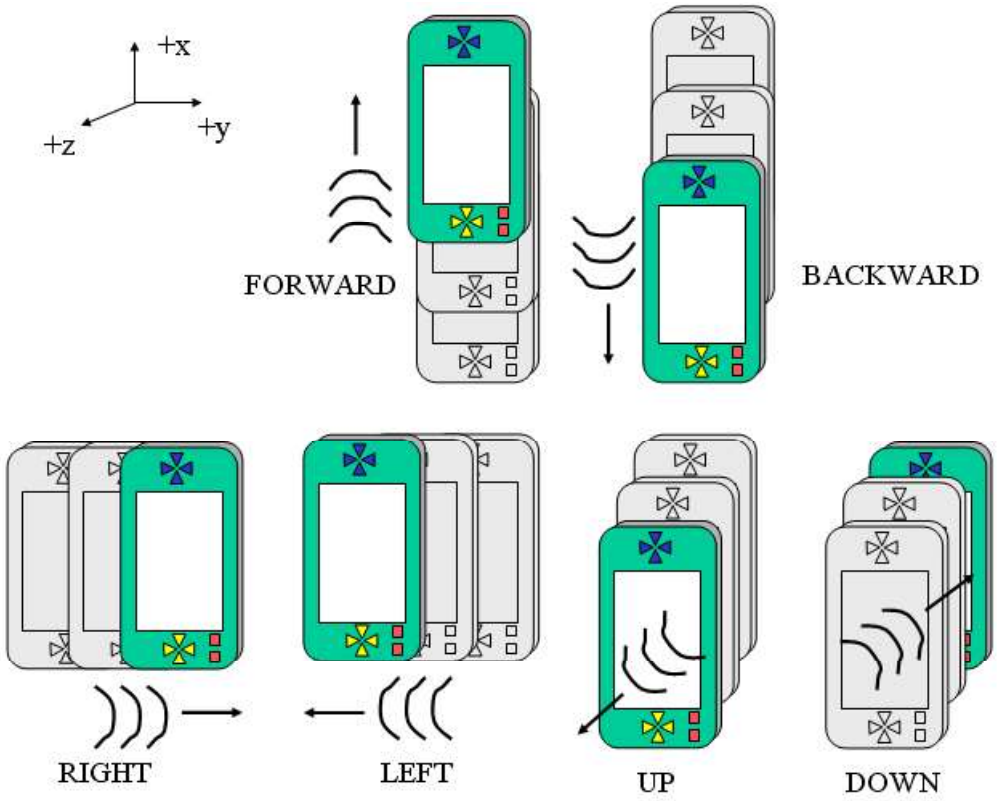


Fig. 4 Sport mode

Flying mode:

In this mode, CyWee will provide with Roll, Pitch and Yaw three absolutely angle and relative Yaw and

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relative Pitch angle calculated by gyroscope. As Figure 3 showing:

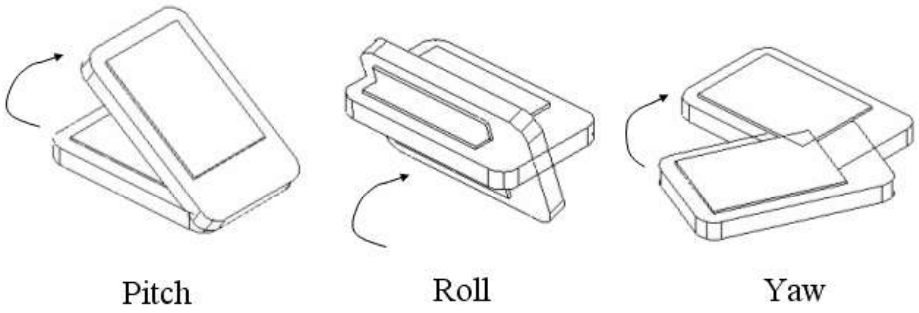


Fig. 5 Flying mode

Racing mode:

In this mode CyWee will provide racing steering motion to send moving forward, moving backward, turning left and turning right four motion output. As Figure 4 showing:

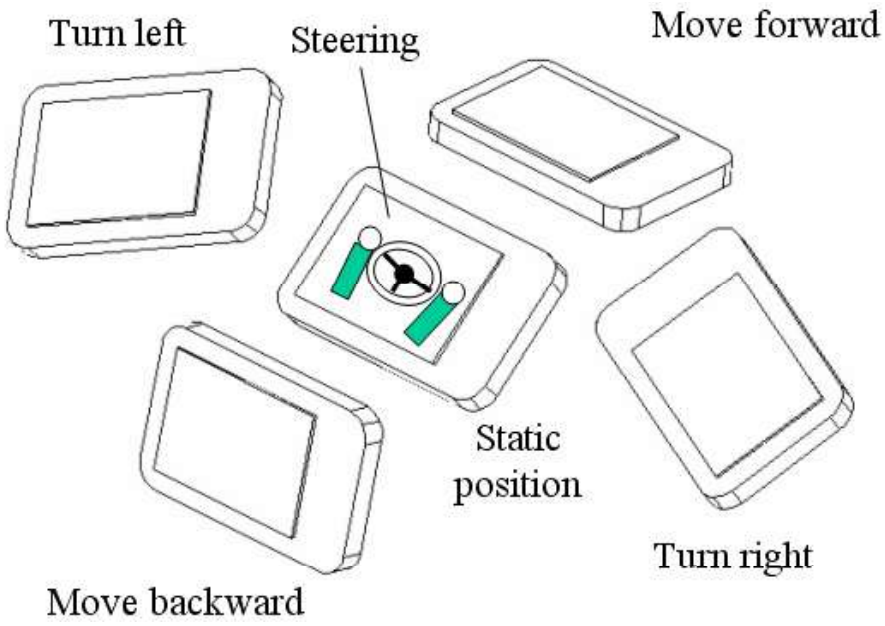


Fig. 6 Racing mode

PC application mode:

In this mode, CyWee will prepare for all sensors' information to the buffer of this API, and content developer can send to the PC side through WiFi or Bluetooth. Sensor's rawdata is sent for PC motion game development. Air mouse's displacement dx and dy on the screen are used for air mouse pointing function.

- **API functions：**

#include "cyweeapi.h"

1. int CywGetAllSensorRawdata(unsigned short* p_ushGsensor, unsigned short* p_ushGyroSensor, double* p_dbMSensor);
2. int CywGetSportStatus(char* p_chSportStatus);
3. int CywGetFlyingStatus(unsigned short* p_ushFlyingStatus);
4. int CywGetRacingStatus(char* p_chRacingStatus);
5. int CywGetPCAppStatus(cywee_data_t*);

- **API function calling flow chat：**

Cywee API library intended to export all necessary data and status information for user APK in the corresponding format.

Cywee API library mechanism implemented as a shared library which can be used by any Android APK or middleware processes.

The name of the library in Android system is *api_cwee.so*.

The library can provide different types of data such as continues stream of raw data or single variable data such as status.

For example to get the continuous raw data stream, the APK can call CywGetAllSensorRawdata API periodically or APK can call CywGetSportStatus to get the game status if it's necessary. Refer Fig. 2 in detail.

More Fun on Handset for UI Control and Gaming

- **Intuitive and easy <u>gesture based</u> UI control interface.**
- **<u>Six degree of freedom and no angle limitation</u> motion game experience.**
  - ***Sensor fusion Rawdata mode***
  - ***Sports mode***
  - ***Flying mode***
  - ***Racing mode***

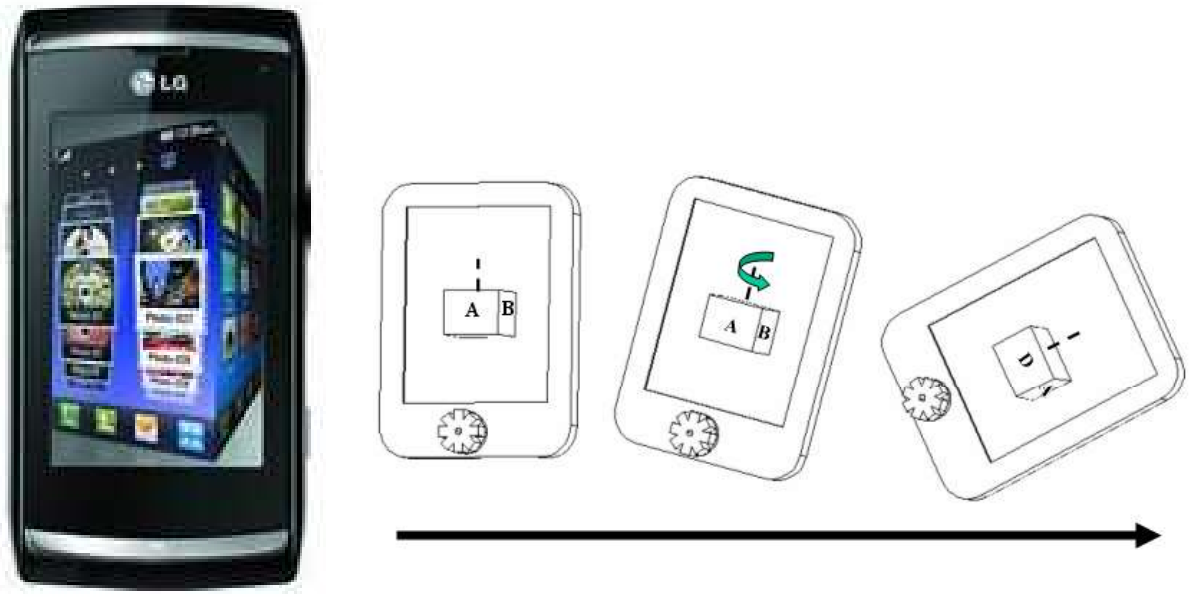


Fig 7 CyWee gesture-based UI control with sensor fusion Tech



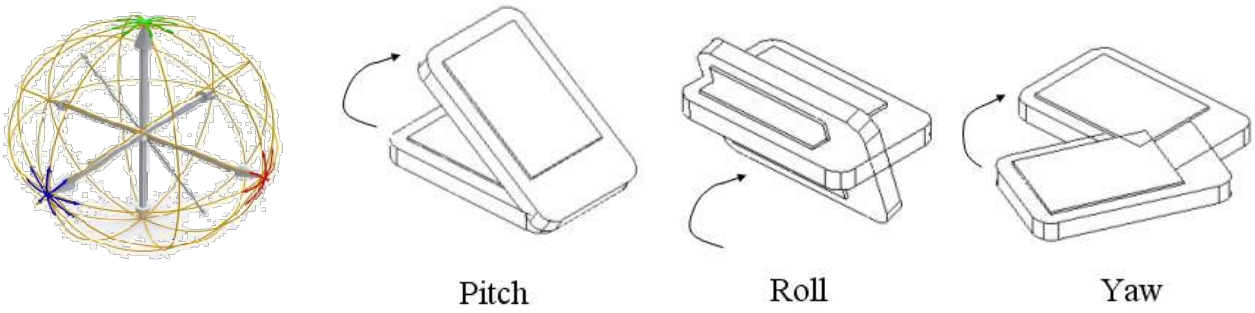


Fig 8 Six degree of freedom no angle limitation motion game experience

Link the Handset to TV for Air Mouse and PC Motion Gaming

- **Using handset to be as an air mouse.**
- **The air mouse can support Window 7 multi-touch function.**
- **Using the handset to play PC motion game on TV.**



Fig 9 Using the handset to be as an air mouse



Fig 10 Using the handset to support Window 7 multi-touch function



Fig 11 Using the handset to play PC motion game on TV

EXHIBIT 2027

IPR2018-01257 / IPR2018-01258



Where technology entertains

Technical Presentation:
Motion Technology and Gaming Applications

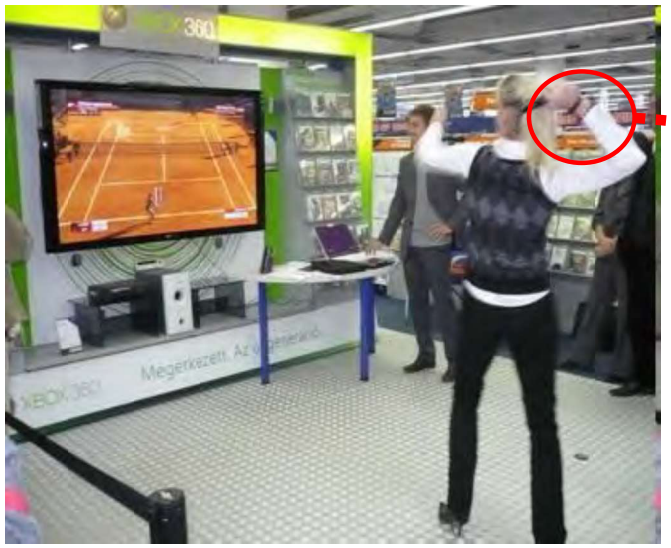
September 2010

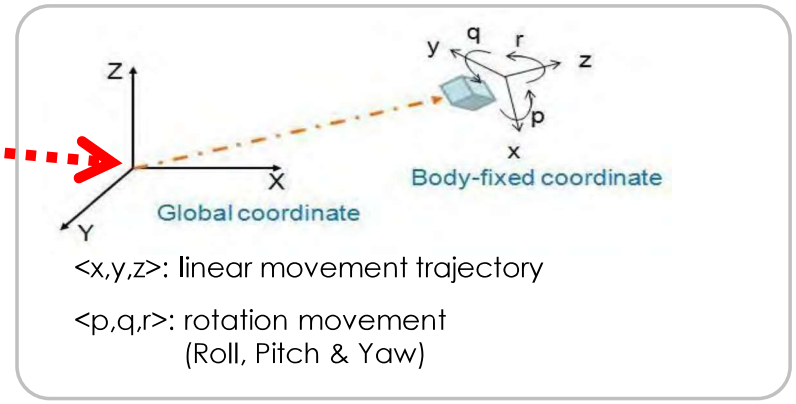
Overview

- What is motion gaming?
- Motion Gaming Evolution.
- Popular motion gaming solutions.
- How to use SDK for motion game development.

Motion Gaming Introduction

Motion Gaming Introduction





Movement : 1:1 real-time motion tracking

These are translated into motions for gaming.

"Motion Gaming" captures human body movements (translation + rotation) through a variety of sensors -- enabling 1:1 game play with real-time motion response.

Motion Gaming Types

Non-motion Gaming



Use buttons to steer car



Use buttons to shoot

Motion Gaming



Use motion to steer



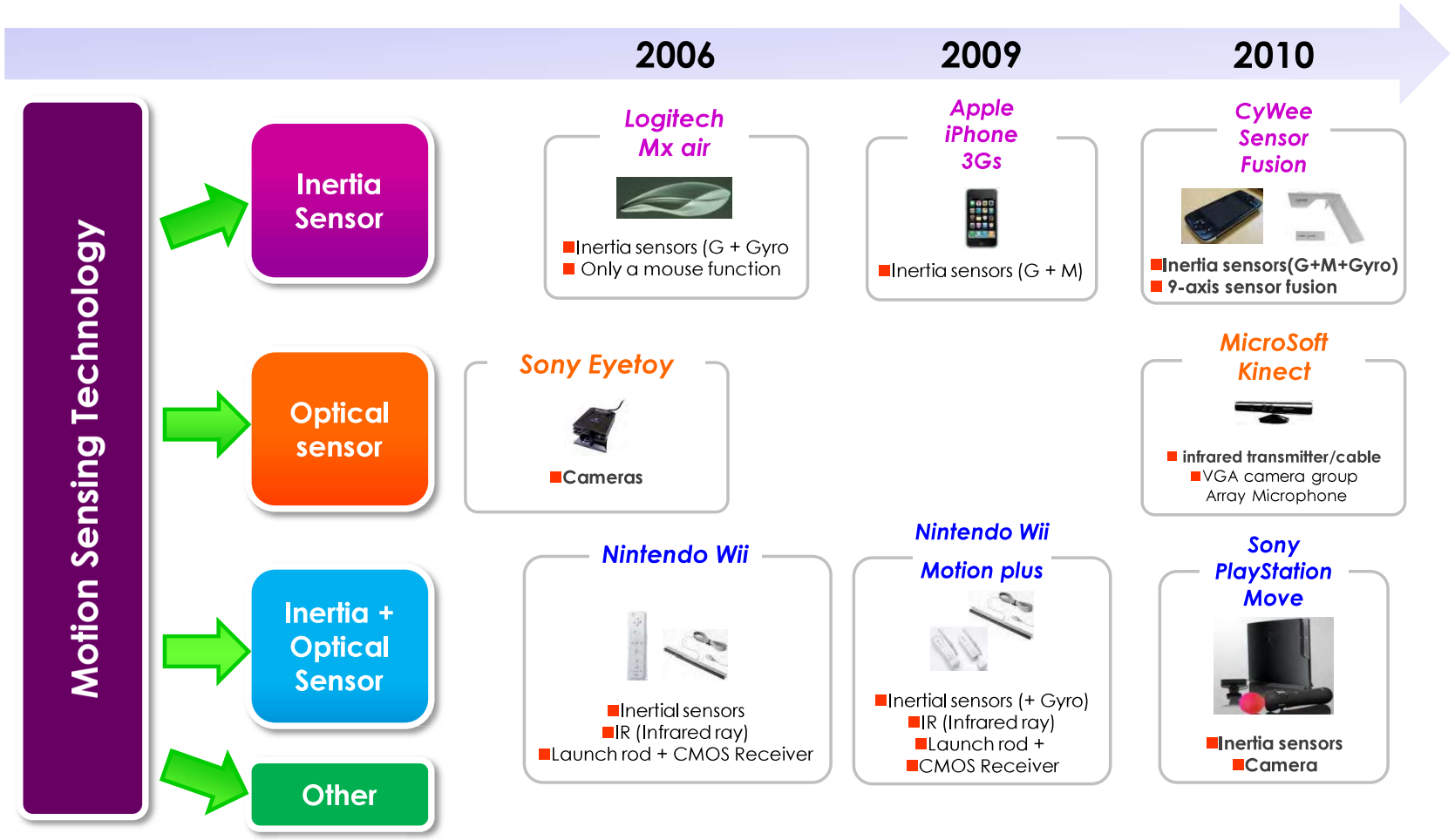
Use motion to shoot

Motion gaming types:

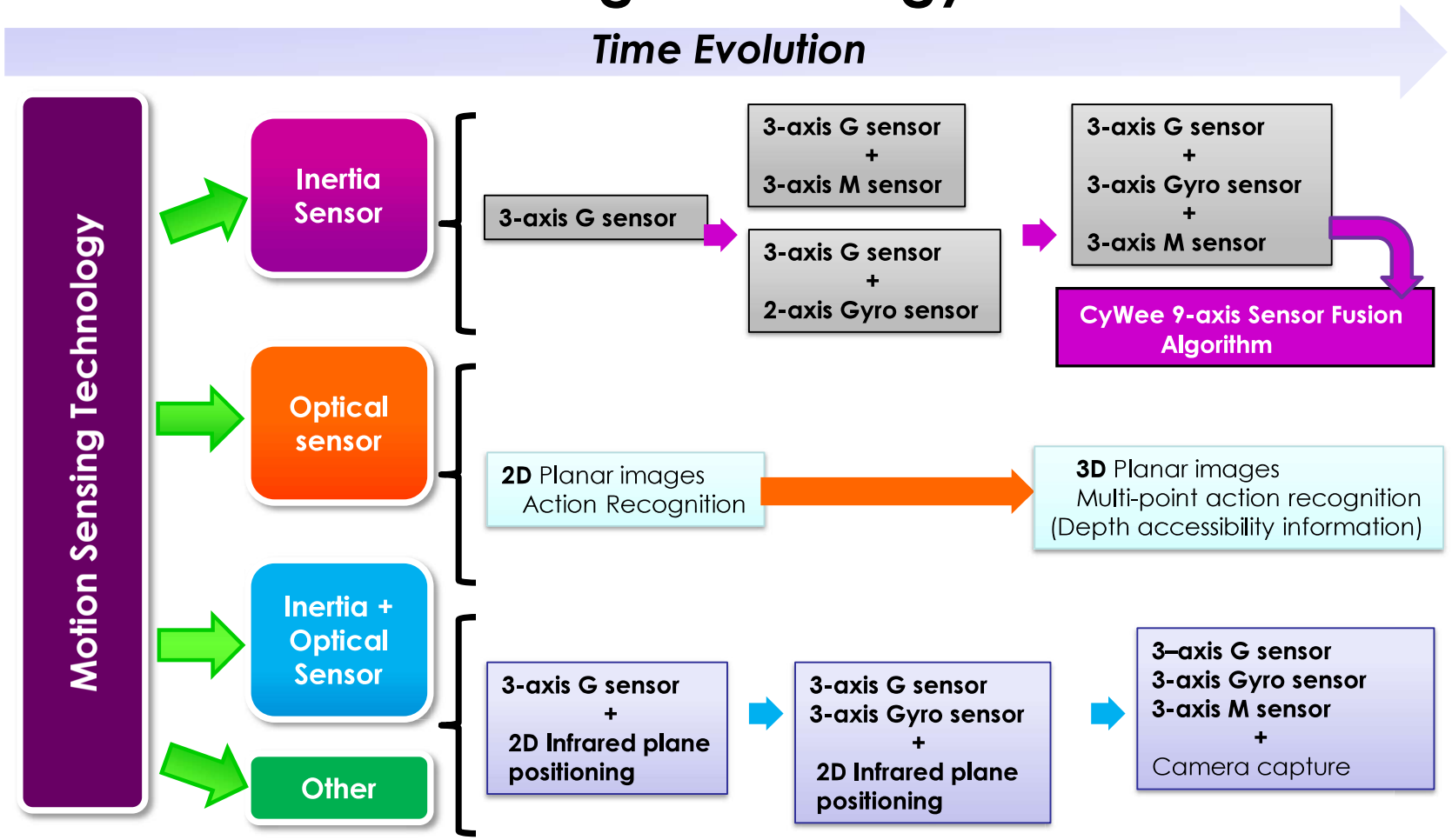
- Racing (3D racing, motorcycle racing, etc.)
- Flying (airplane shooting, flight simulation, etc.)
- Sporting (tennis, baseball, bowling, table tennis, etc.)
- Action (fishing, cooking, etc.)
- Shooting (first person shooting games, etc.)

Motion Gaming Evolution

Motion Sensing Gaming Evolution



Motion Sensing Technology Evolution



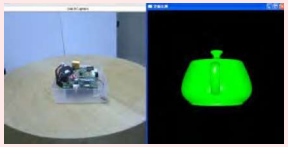
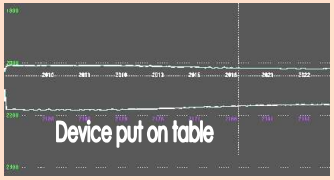
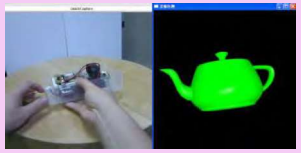
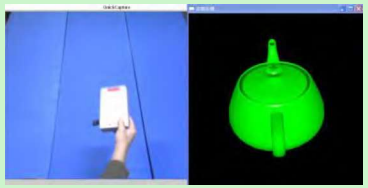
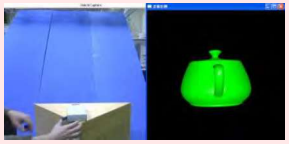
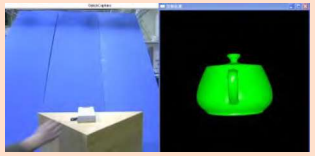
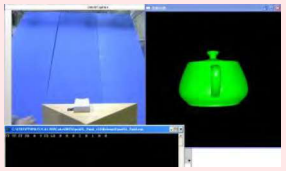
9-Axis Motion Module on Mobile Phones



9-Axis Key Benefits:

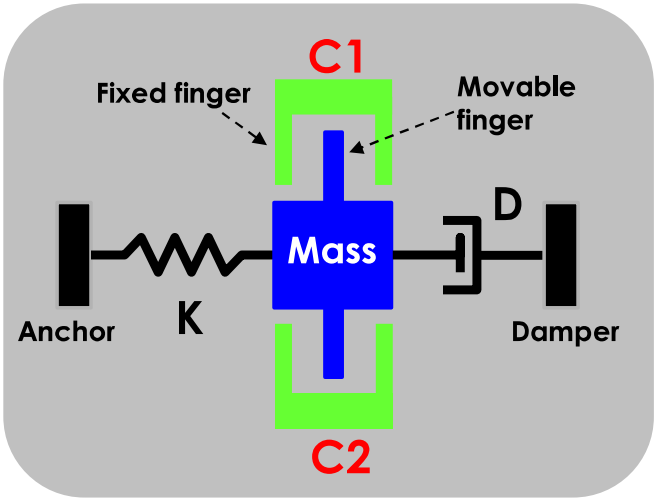
- ✓ Does not require fixed optical sensor bar, making 9-axis technology a convenient and portable solution.
- ✓ Motion sensor ensures that there are no line of sight issues.
- ✓ 9-axis sensor fusion algorithm enables real-time 1:1 motion, 360° motion detection

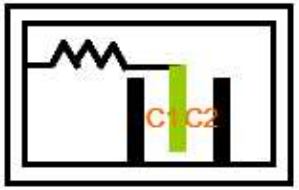
Motion Sensing Technology Comparison

G Sensor only	G Sensor + Gyro	G Sensor + Magnetic Sensor	G Sensor + Magnetic Sensor + Gyro
Wii (1st), iPhone (2G/3G)	Current Air Mouse, Wii motion plus	Gphone, iPhone (3GS)	CyWee solution
 Delay issue	 Temperature drift control issue	 Delay issue	
 Force interfusion	 Accumulated error Relative position issue Requires optical bar and provides no depth information	 Magnetic disturbance	• Provide 9-axis physical outputs with 9-axis input solution (3-axis G-sensor, 3-axis Gyro and 3-axis Magnetic sensor). • Real time 1:1 motion sensing. • Provide absolutely position solution. •No singularity issue •Provides depth information
 Pitch singularity			

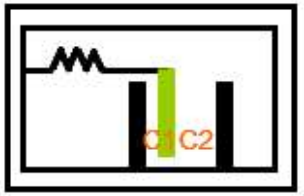
Accelerometer Problem

When rotating an accelerometer with angular motion (r*), there exists inherent problems**





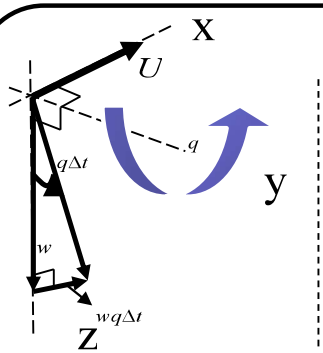
No Acceleration
C1 = C2



Linear Acceleration
C1 > C2

Accelerometer Problems:

- ✓ Decouple centrifugal force
- ✓ Decouple gravity
- ✓ Physical singular point



*r = radius

Cent. Force

Gravity

$$a_x = (\dot{U} + Wq) + g_x$$

Rotation Acceleration: coupled with centrifugal force and gravity

Example: Accelerometer Only

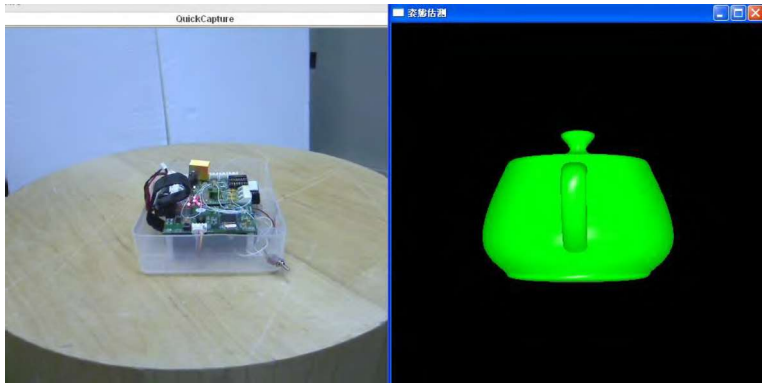
Capability:

- ✓ Can detect 3 axes acceleration
- ✓ Can detect X and Y axis tilt angle

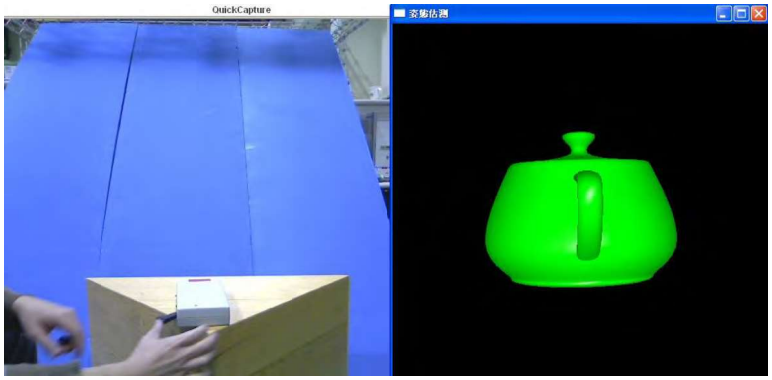
Shortcomings:

1) Delay issue
2) Force interfusion issue
3) Physical singular point issue

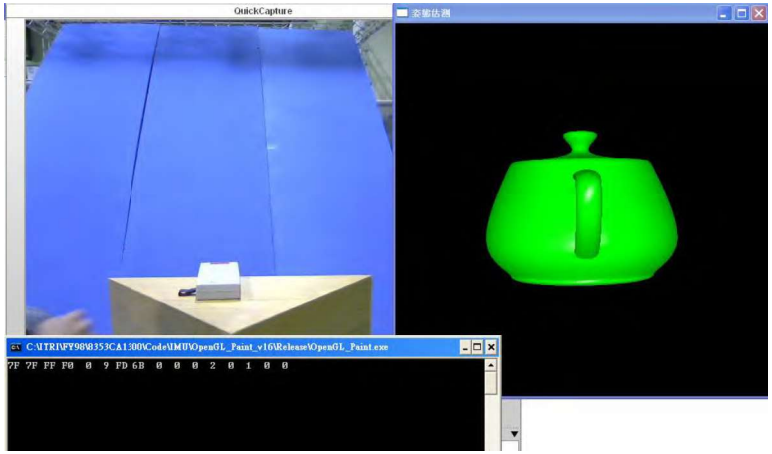
1) Delay issue



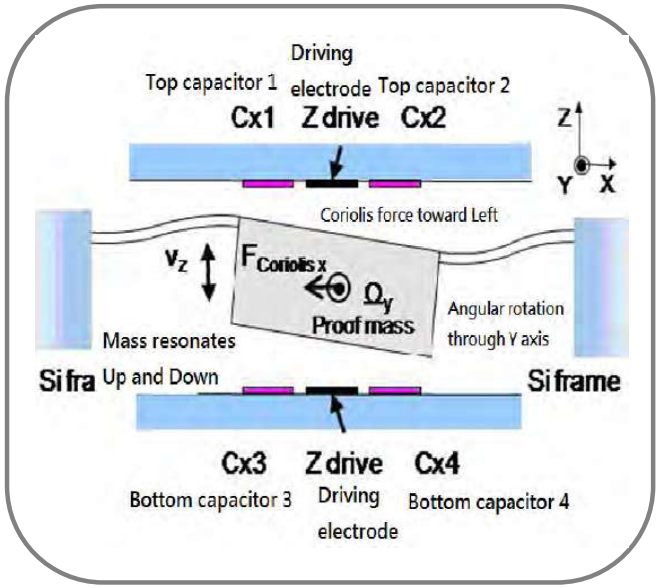
2) Force interfusion issue



3) Physical singular point issue

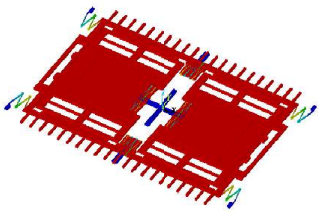


MEMS Gyro Working Principle

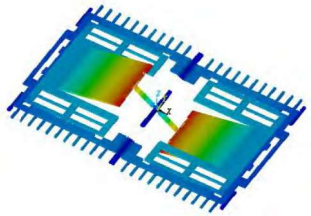


Key points:

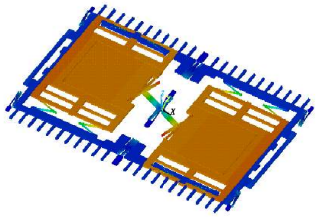
1. Mass vibrates at resonant frequency Wc in up and down direction
2. Mass rotates at angular speed Ω_Y
3. Coriolis force will be generated towards left direction (Fc = 2mv x Ω_Y)
4. Angular speed Ω_Y is determined by measuring Wheatstone Bridge voltage



Drive mode



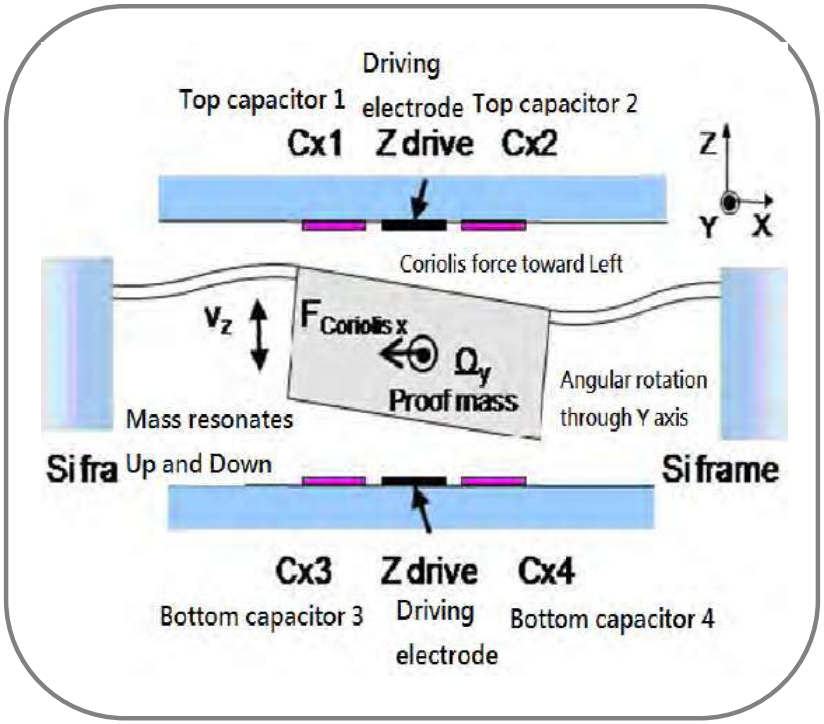
Roll mode



Yaw mode

Gyroscope Drifting

Gyroscope drifting mainly results from temperature changes that cause electric charges (Q) to change in the system.

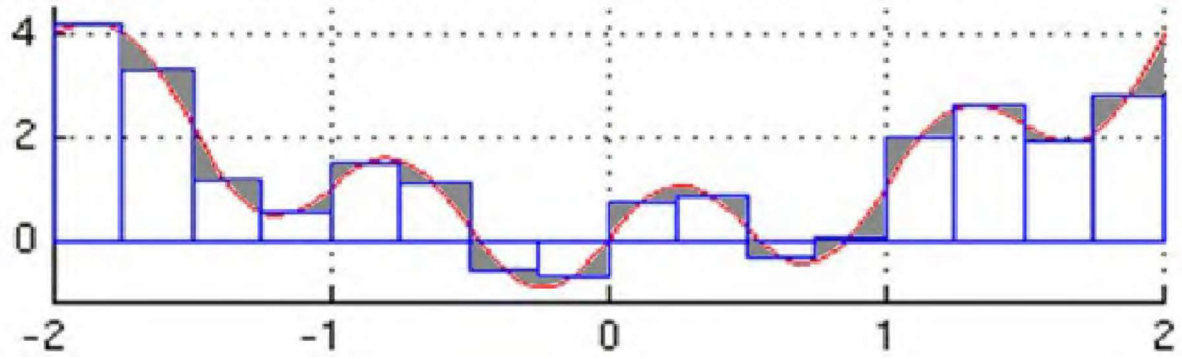


Domino Effect:

1. When temperature changes, Q changes
2. Cx1~Cx4 and system intrinsic capacitance changes as a result of Q
3. Changes in Cx1~Cx4 cause measuring circuit with drift signal
4. Drift signal directly impacts gyro outputs

Gyro Accumulated Error

The sum of digital and analog conversion error, and noise results in accumulated error.



Red = Ideal Case Blue = Actual Case Shaded = Accumulated Error

Ideal Case:

$$\theta_{x,y,z} = \int \omega_{x,y,z} dt$$

$$v_{x,y,z} = \int a_{x,y,z} dt$$

$$x_{x,y,z} = \int v_{x,y,z} dt$$

Actual Case:

$$\theta_{x,y,z} = \int (\omega_{x,y,z} + \varepsilon) dt$$

$$x_{x,y,z} = \int [\int (a_{x,y,z} + \varepsilon) dt] dt$$

(ε : drift, noise…)

noise

Example: Gyro Only

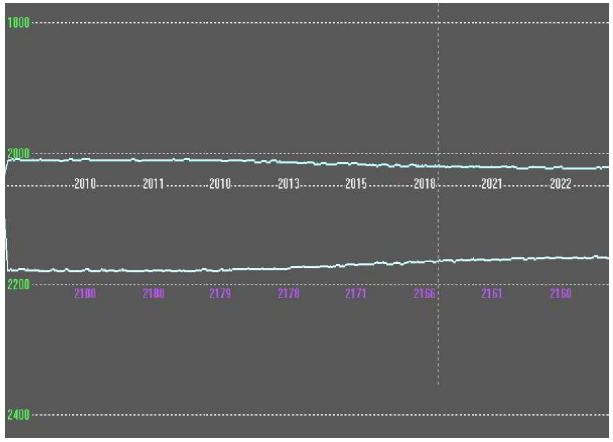
Capability:

- ✓ Detect 3 axes dynamic angular speed
- ✓ Quick angular speed response

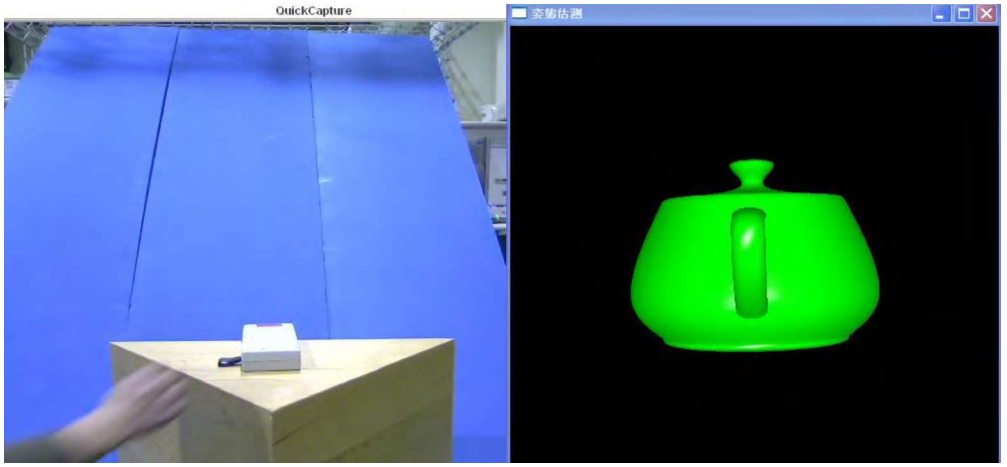
Shortcomings:

1) **Temperature drift issue**
2) **Relative position only**
3) **Accumulation error issue**

1) Temperature drift issue



2) Relative position only & 3) Accumulation error issue



Example: MR Only

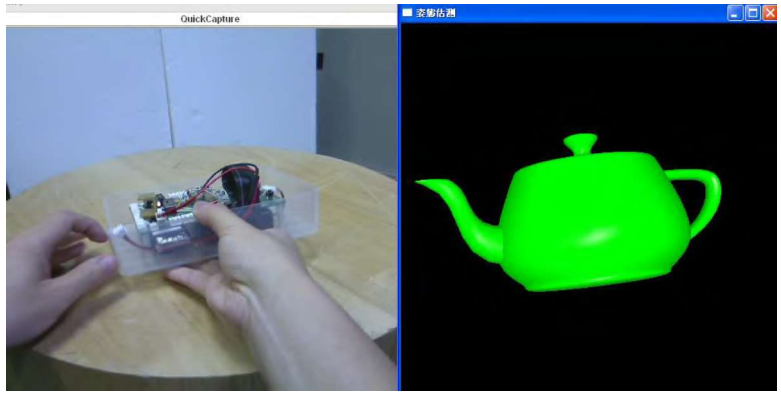
Capability:

✓ Can detect 3 axes magnetic field

Shortcomings:

1) **Delay issue**
2) **Unpredictable magnetism disturbance**

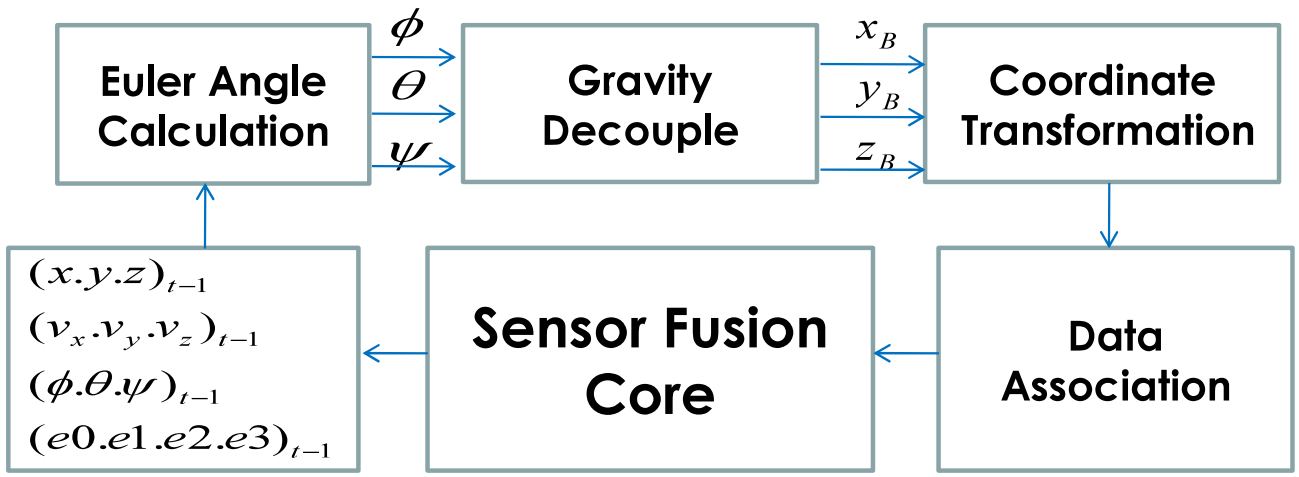
1) Delay Issue

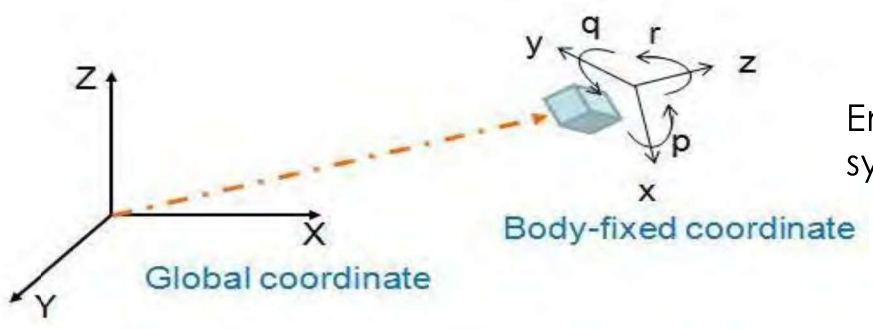


2) Unpredictable magnetism disturb.



CyWee 9-axes Sensor Fusion Solution



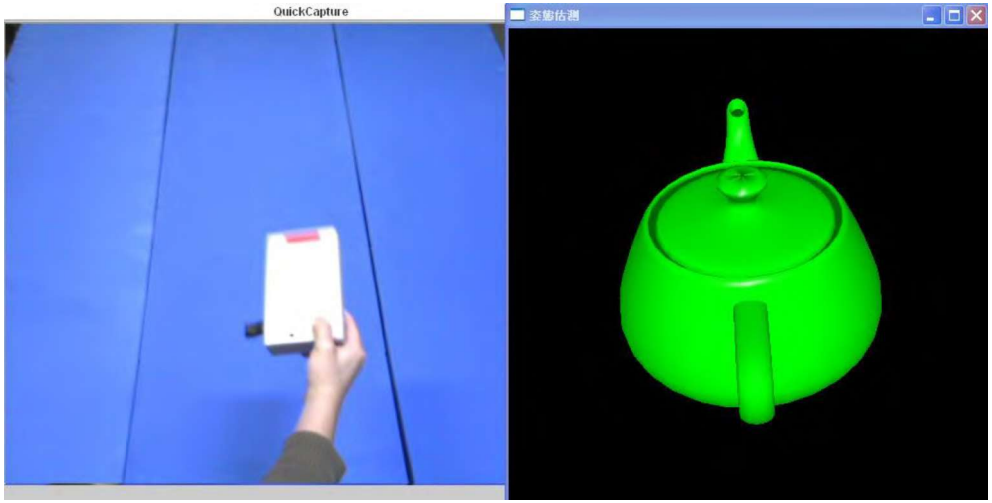


Entire 3D-location based system

CyWee Sensor Fusion Solution

Integrated CyWee Motion Module Solution:

- ✓ Integrated 3-axis accelerometer, 3-axis gyro, and 3-axis MR
- ✓ Sensor fusion motion recognition development
- ✓ Provides 9-axis output (3-axis acceleration, 3-axis rotational rate, and 3-axis orientation) and real time 1:1 motion recognition



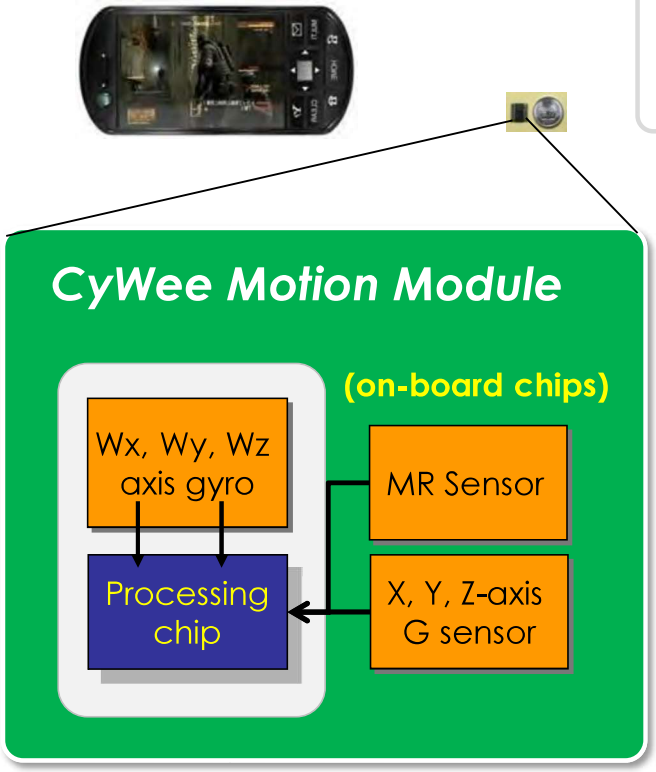
Pointing Function Performance Comparison

In laboratory testing, CyWee performed significantly better than Nintendo and Sony.

	CyWee	(Nintendo)	(Sony)
Sensing Type	Inertial sensing	Optical sensing	Optical + Inertial sensing
Response Time	67 ms (60 FPS camera)	116 ms (60 FPS camera)	133 ms (60 FPS camera)

Motion Sensing Applications

Endorsed by the Four Major Operators



Designated motion sensor provider for JIL gaming handsets

中国移动通信 CHINA MOBILE 移 动 信 息 专 家 = SoftBank verizon vodafone

CyWee's motion module supports various types of games, allows for **9-axis motion recognition, and 1:1 motion capture**

Key advantages:

- Proprietary algorithms provide accurate motion recognition

- Provides absolute position **(industry first)**

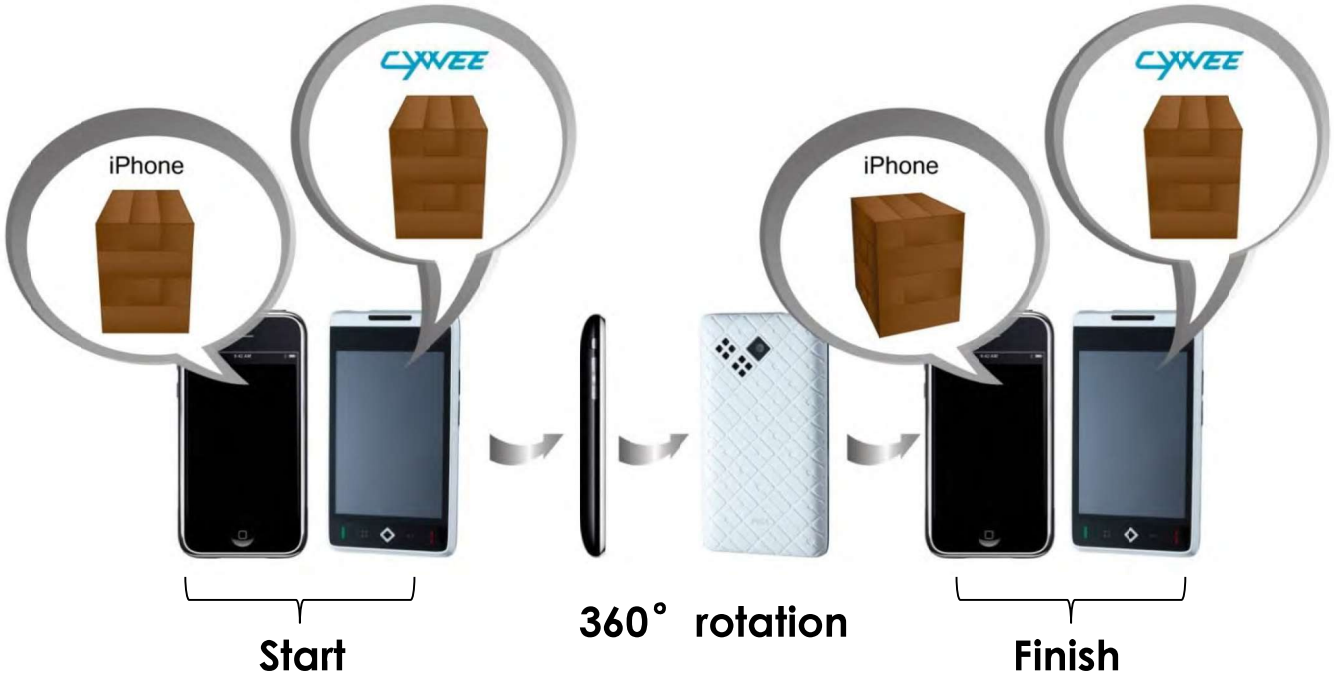
- Full 3D depth sensing for next generation motion gaming

Relative Position vs. Absolute Position

CyWee: after rotating 360 degrees, the blocks will return to its original location

iPhone 4: Due to accumulated error, the blocks **will no**t return to the original location

Absolute position is critical for FPS shooting games



The Perfect Motion Gaming Experience



FPS Shooting Games

- 9 axis output
- Absolute position
- 1:1 real-time motion capture
- No delay
- Freedom to move in 3D space



Archery Games

- 9 axis output
- Absolute position
- 1:1 real-time motion capture
- No delay
- 3D depth information



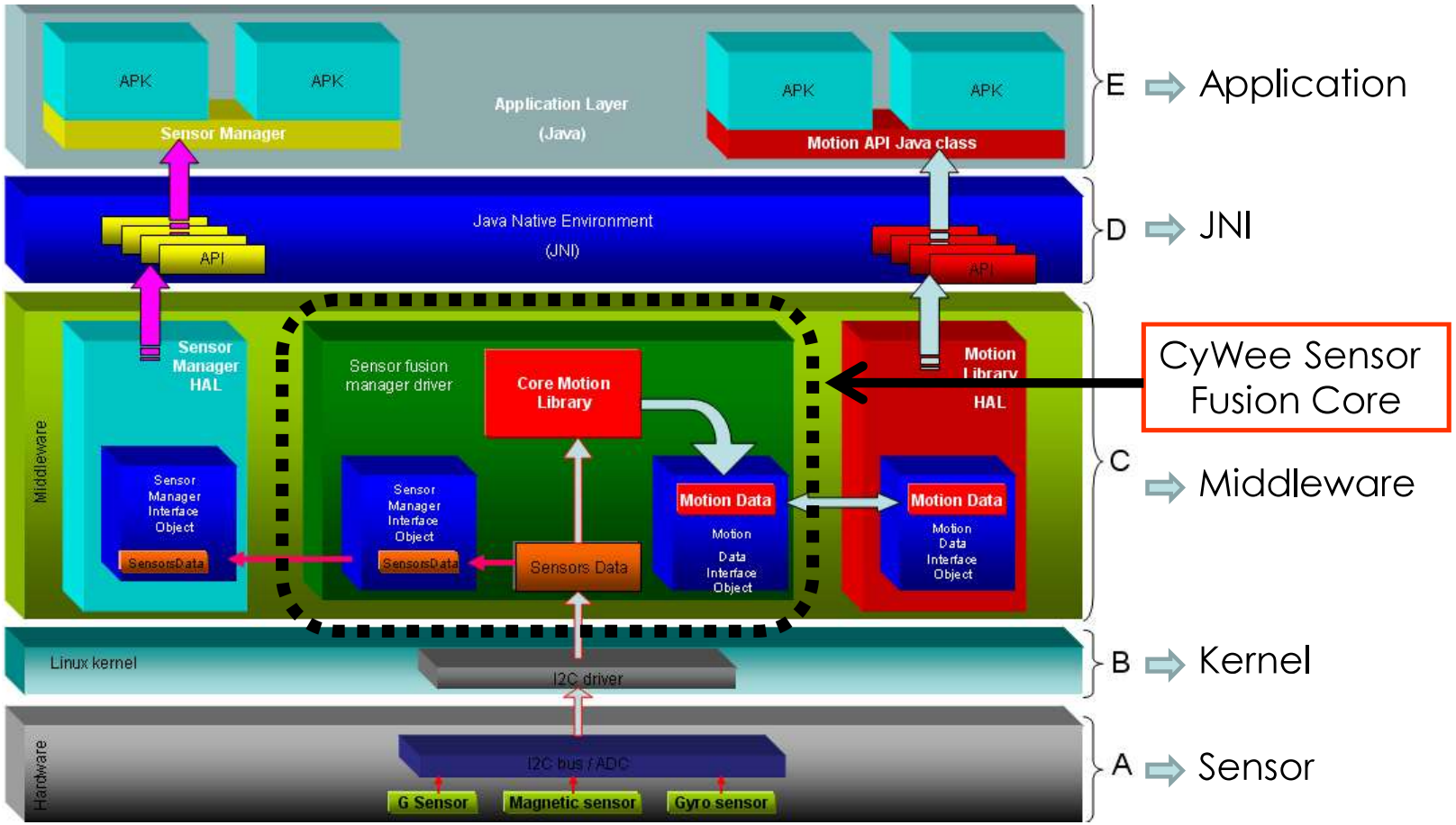
Sword Games

- 9 axis output
- Absolute position
- 1:1 real-time motion capture
- No delay
- 3D depth information



Application of CyWee SDK and Game Development

CyWee Motion Module on Android

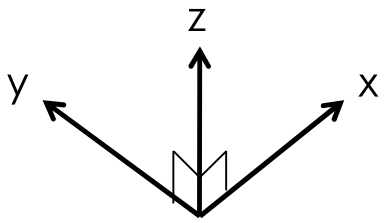


CyWee 9 Axis Algorithm

✓**9-axis Sensor output** – **Calibrated Sensor Data**

- Three-axis accelerometer: Offset Static Correction
- Three-axis gyroscope: Baseline Dynamic Correction
- Three-axis magnetic sensors: Offset Dynamic Correction

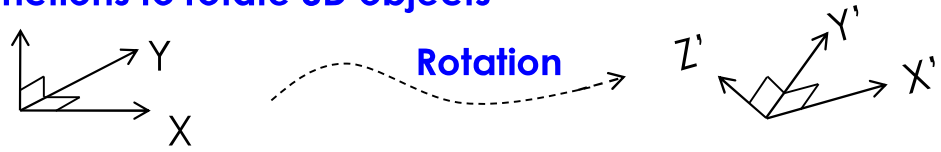
Euler angle (Euler angle) - **Output real-time, absolute angles Roll (Φ), Yaw (Ψ), Pitch (θ)**





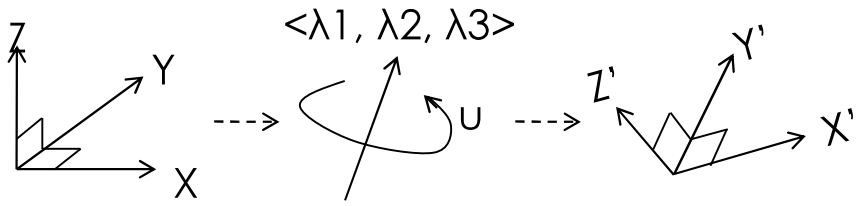
Sensor Fusion Output

✓ **(Rotation matrix) –** Output Rotation matrix can be directly applied to Open GL functions to rotate 3D objects



$$\begin{bmatrix} X' \\ Y' \\ Z' \end{bmatrix} = [Roll] \bullet [Yaw] \bullet [Pitch] \bullet \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} Rotation \\ Matrix \end{bmatrix} \bullet \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

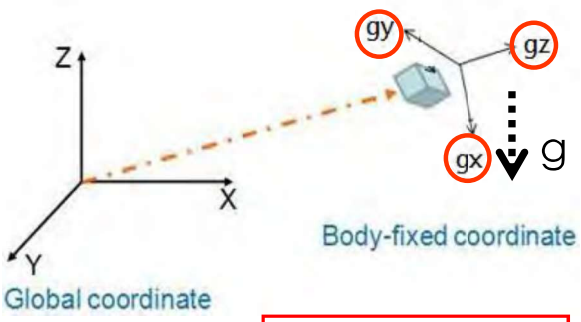
✓ **(Quaternions) –** If (Pitch = 90) there is no singular point.
Output can be directly applied to Open GL functions to rotate 3D objects



$$q_1 = \lambda_1 \sin(\mu/2)$$
$$q_2 = \lambda_2 \sin(\mu/2)$$
$$q_3 = \lambda_3 \sin(\mu/2)$$
$$q_4 = \cos(\mu/2)$$

CyWee 9 Axis Algorithm - Sensor Fusion Output

✓Distribution of Gravity outputs to three axis- gx, gy and gz

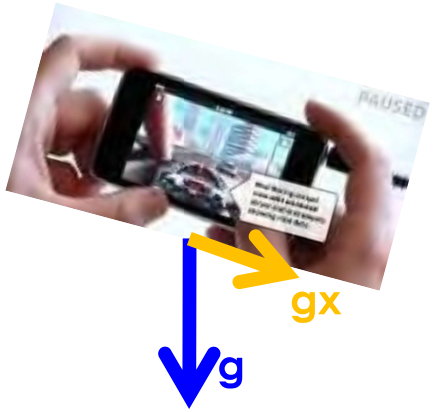


$$g_x = -g\sin\theta$$
$$g_y = g\cos\theta\sin\phi$$
$$g_z = g\cos\theta\cos\phi$$

g value of the change on the axis can be solved without the need to use
Low pass filter, hence get a faster dynamic response

Game developers can call the motion functions located in SDK
gx, gy and gz three output

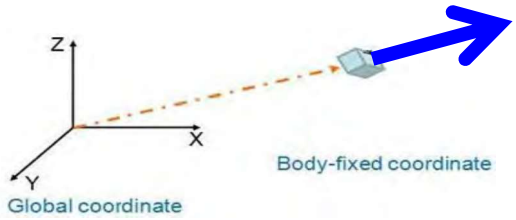
<Ex>



CyWee 9 Axis Algorithm - Sensor Fusion Output

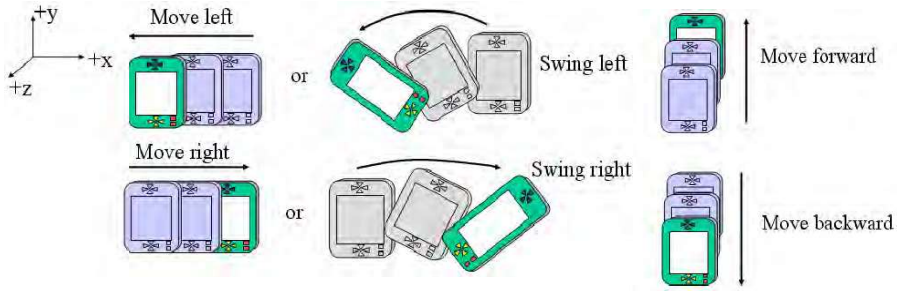
Linear acceleration can be derived from removing gravity and centrifugal force

[X, y, z axis of linear acceleration = **Accelerometer value** - **Centrifugal Force** –**Gravity**]



The direction of linear acceleration

Accurately detects every motion



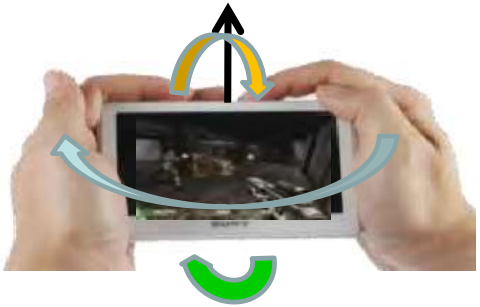
A New Motion Experience in Gaming

Before: a very basic game using G sensor



CyWee Sensor Fusion
(Real-time, absolute position: Roll, yaw, pitch)

After Sensor Fusion: 360 ° real-time motion detection, absolute position



Before: using touch screen to throw toilet paper



Using CyWee Sensor Fusion
(360 ° angle sensing)

After Sensor Fusion: Calculate trajectory of throw using motion without touch



CyWee Algorithm for Sensor Calibration

G

- Calibrated sensor raw data
- Roll, Pitch angle (Yaw = 0)
- Actions determine the output

G + M

- Calibrated sensor raw data
- Roll, Pitch, Yaw (delay)
- Rotation matrix (Yaw delay)
- Quaternions output (Yaw delay)
- Gravity changes (delay)
- Linear acceleration (delay)
- Actions determine the output



G + Gyro

- Calibrated sensor raw data
- Roll (real time), Pitch (real time), Yaw (real-time, relative position)
- Rotation matrix (Yaw relative)
- Quaternions output (Yaw relative)
- Gravity changes
- Linear acceleration
- Actions determine the output

G +Gyro + M

- Calibrated sensor raw data
- Roll (real time), Pitch (real time), Yaw (real time) - absolute position
- Rotation matrix
- Quaternions output
- Gravity changes
- Linear acceleration
- Actions determine the output
- (360 ° motion detection, rotation)

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CyWee Motion Database is Turnkey Solution

CyWee Motion API

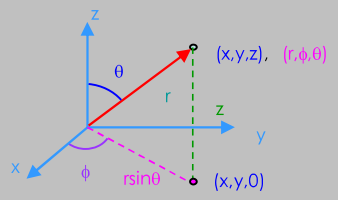
CyWee *Motion Modeling (critical step)*

CyWee Motion Database (world's largest)

Common Motion API Commands:

- Roll, Yaw, Pitch
- Rotation Matrix
- Quaternions
- Gravity
- Linear Acceleration

CyWee calculates thousands of motions:



$$r = \sqrt{x^2 + y^2 + z^2}, \phi = \tan^{-1}\left(\frac{y}{x}\right)$$

$$\theta = \cos^{-1}\left(\frac{z}{r}\right) = \cos^{-1}\left(\frac{z}{\sqrt{x^2 + y^2 + z^2}}\right)$$

Create Perfectly Mapped Motion Games



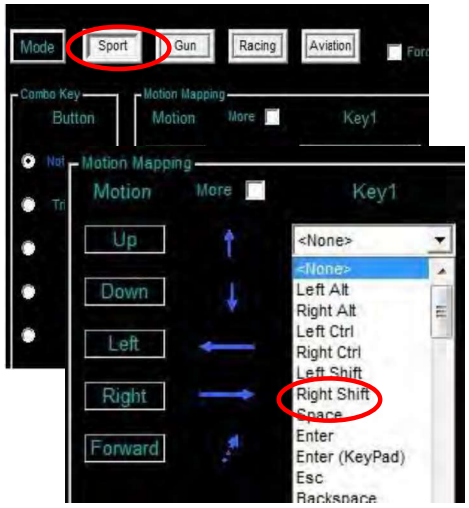
Create User Generated Content

- ✓ Easy to use mapping tool for developers and users
- ✓ Turn existing games into motion-sensing games

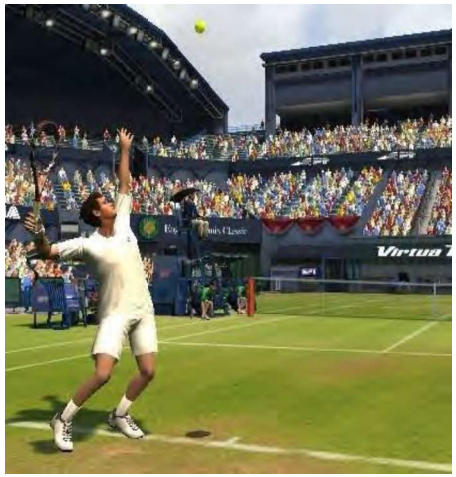
Take Existing Game

- Transformers-Revenge of the Fallen
- Tumblebugs
- Ultimate Racer Online
- UP
- Virtua Cop 2
- Virtua Tennis 2009
- Virtua Tennis 3
- WALL-E
- World Poker Championship

Select Mapping Key Requirements



Instantly Mapped Motion Game



New Motion Experience: Game Mapping

Before: Use touch screen to control shooter



CyWee Sensor Fusion
(Real-time, absolute position of roll, yaw, pitch)

After Sensor Fusion: Using roll, yaw, pitch



- **Pitch** angles must be provided in order to map vertical movements
- Provides **real-time** information and **absolute** position
- Gamers experience a life-like combat simulation

Map Existing Games to Support Motion

Before: Using touch screen to control FPS



Mapping of touch screen

After mapping: target enemies by rotating the handset



Before: Using only touch to throw paper balls



Mapping of touch screen



EXHIBIT 2028

IPR2018-01257 / IPR2018-01258



From: Joe Ye [mailto:jye@cywee.com]
Sent: 2009年7月29日 15:36
To: 'Shen, James'; cshey@sbcvc.com
Cc: 'Lsn'; monica@cywee.com
Subject: RE: Greeting

Dear James,

It has been a while since last time we met.

We have been working with JIL on Android OS phone for a while, and we support Qualcomm and Marvell platforms now.

Please find attached our mobile solution for your review and we believe we are ready to talk to Qualcomm now.

Joe

-----Original Message-----
From: Shen, James [mailto:jings@qualcomm.com]
Sent: Wednesday, July 29, 2009 3:09 PM
To: cshey@sbcvc.com; Joe Ye
Subject: RE: Greeting

Chauncey,

I will love to know their progress. I will be back from San Diego on this Friday.

Thanks,

James

From: Chauncey Shey [cshey@sbcvc.com]
Sent: Wednesday, July 29, 2009 11:05 AM
To: Shen, James; Joe Ye
Subject: Greeting

James,

Trust things are well in your side.

I would like to reconnect you with joe, ceo of cywee. Cywee has a huge wireless angle now. It is potentially more than exciting!

Joe will visit china soon and I believe it will be worth your time.

I will let joe to follow up with you.

Best,

Chauncey=

EXHIBIT 2029

IPR2018-01257 / IPR2018-01258

Cyber Wireless Entertainment Evolution

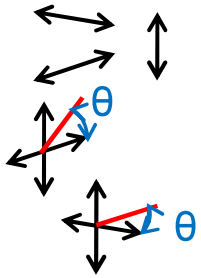


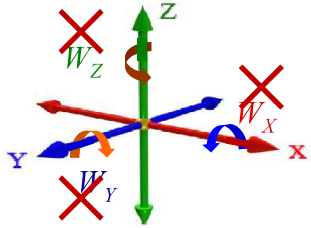
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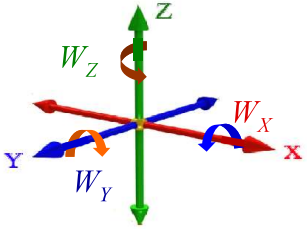
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What is the difference?

Only Accelerator	Accelerator Plus Gyroscope
You only can detect •X 、Y 、Z axis movement •X axis tilt static angle •Y axis tilt static angle You can't detect X 、Y 、Z axis dynamic angular speed	You can detect •X 、Y 、Z axis movement •X axis tilt static angle •Y axis tilt static angle •X 、Y 、Z axis dynamic angular speed





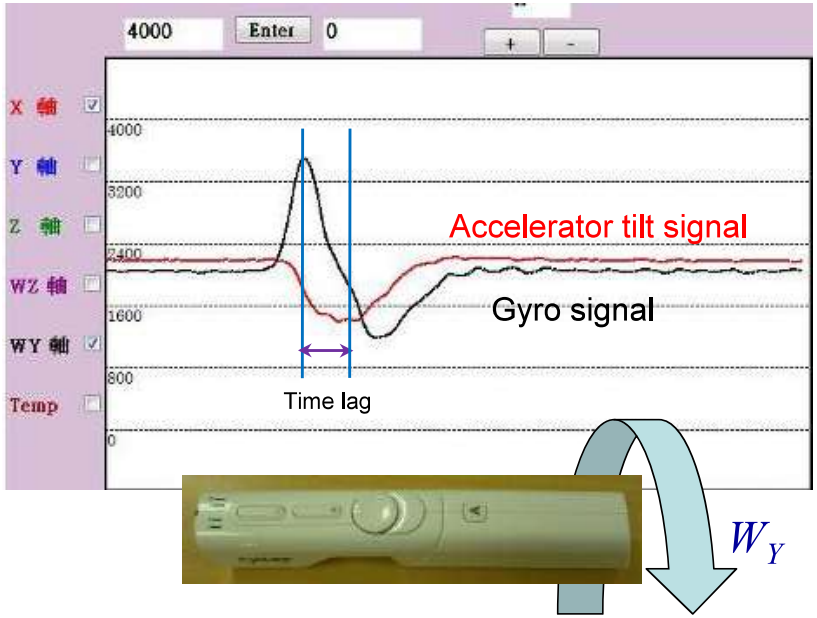


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Why Gyros?

Gyros are used to measure angular velocity and are required to measure angular rate of rotational movement quickly and accurately within a motion processing solution



CYWEE'S VALUE

CyWee's patented algorithms and experience with motion API's/ content mapping is invaluable in gyro based applications where accuracy is key.

Motion Module Features

- Gesture Recognition
- PC/Media center 3D remote
- GPS Dead Reckoning for LBS
- Image Stabilization
- Immersive Gaming

Forced feedback for realism

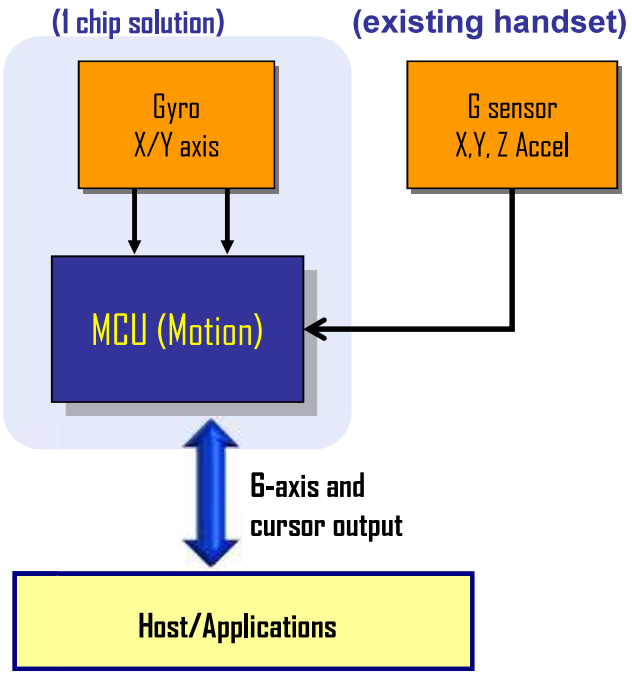




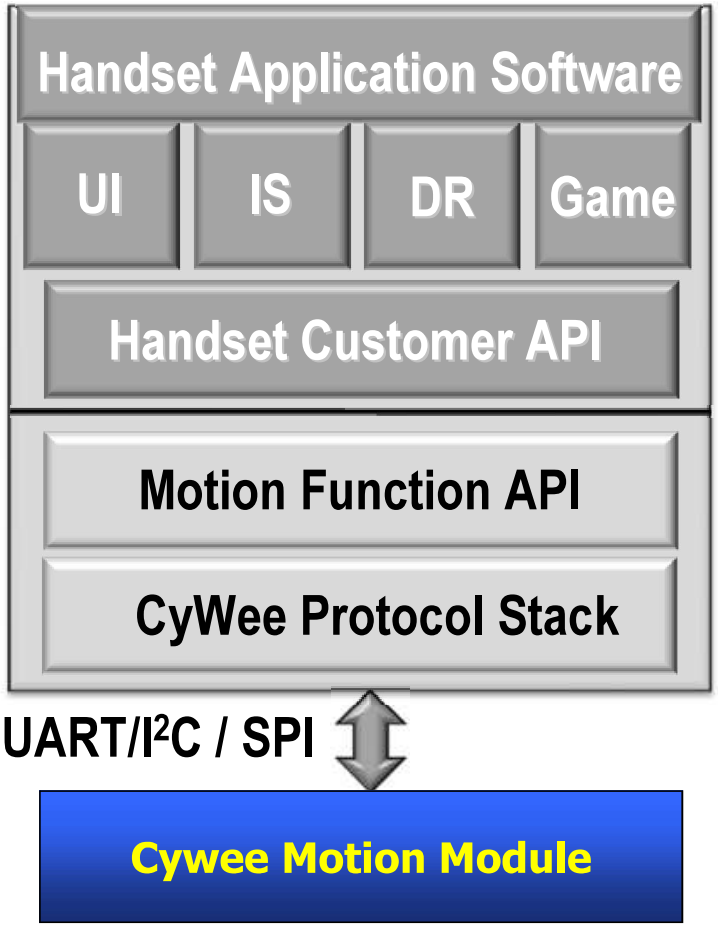
Vibration for sports and action games







Cywee Mobile Solution



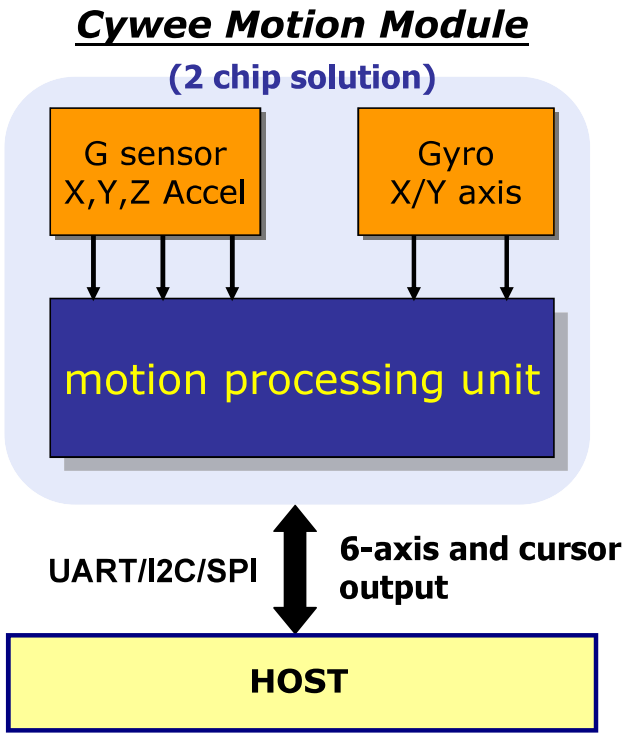
Applications:

- Smart user interface
- Gesture recognition
- Remote controller
- Motion gamepad
- Dead reckoning (GPS/PND)
- Optical image stabilization
- Health monitoring
- Power management

Features:

- Provide 3-axis acceleration and 3-axis rotational rate output
- Mouse cursor output
- Advance motion processing algorithm
- Easy and fast to integrate
- Auto temperature calibration
- Low power consumption

CyWee Motion Module Solution



World's First 6-Axis Solution Provider

-- Output 3-axis acceleration and 3-axis dynamic rotational rate

Specification:

- Integrated 3-axis accel and 2-axis gyro
- 6-axis output (3-axis acceleration and 3-axis rotational rate) and mouse cursor output
- Advance motion processing algorithm: sensor fusion, drift calibration, mouse cursor control, motion recognition mapping tool, power management
- 12-bit ADCs resolution
- Power voltage ~ 3V
- Low power consumption: ~22mA
- Digital interface : UART, I2C, and SPI
- Module size : 10.5 mm X 10 mm

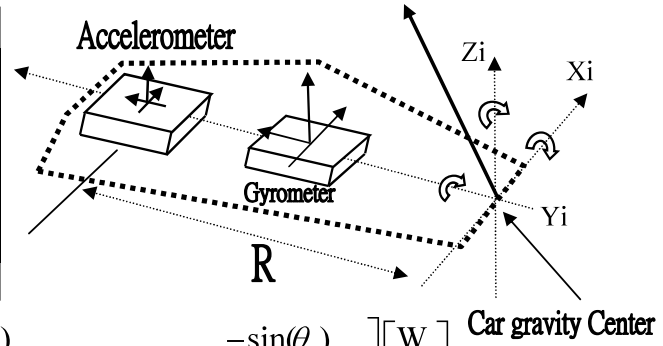
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Application of Inertial Sensing technology – GPS + INS

. A hybrid navigation system combines GPS and INS, where INS is activated in dead zone of GPS
. INS with 6 degrees of freedom (3-axis accelerometer and 3-axis gyroscope)

•Principle of INS (Inertial Navigation System):

$$\begin{bmatrix} A_{xc} \\ A_{yc} \\ A_{zc} \end{bmatrix} = \begin{bmatrix} \ddot{P}_{mx} \\ \ddot{P}_{my} \\ \ddot{P}_{mz} \end{bmatrix} + \begin{bmatrix} R\,\dot{W}_z + g\sin(\theta_y) \\ -R(W_x^2 + W_z^2) + g\cos(\theta_y)\sin(\theta_x) \\ R\,\dot{W}_x - g\cos(\theta_x)\cos(\theta_y) \end{bmatrix}$$



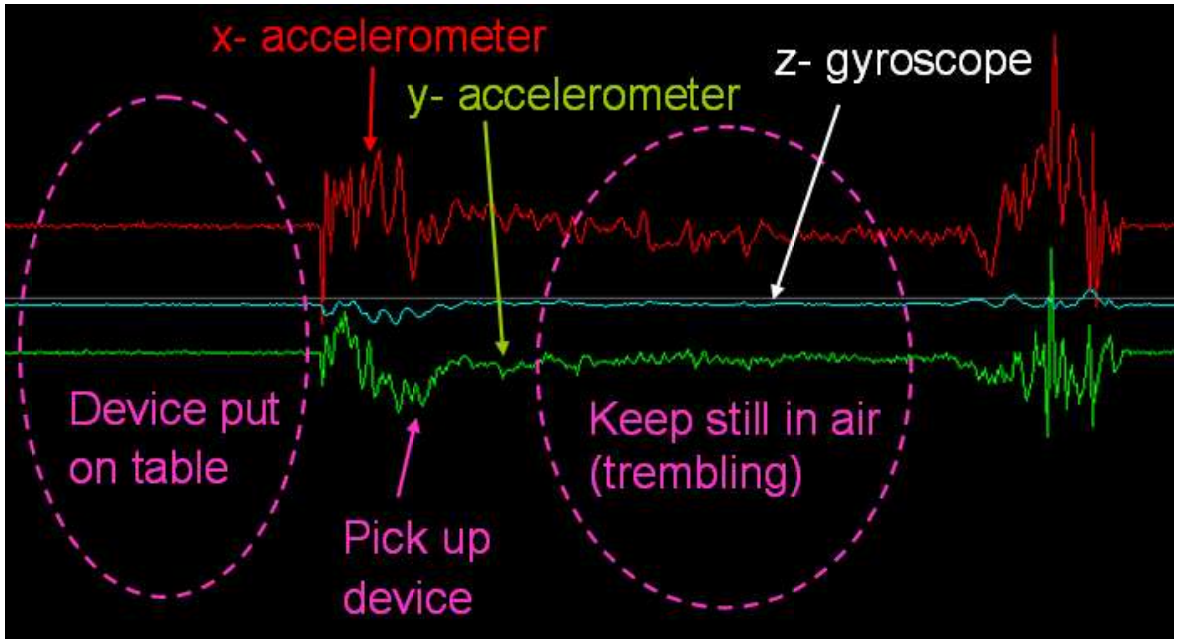
$$\begin{bmatrix} W_{xc} \\ W_{yc} \\ W_{zc} \end{bmatrix} = \begin{bmatrix} \cos(\theta_z)\cos(\theta_y) & \sin(\theta_z)\cos(\theta_y) & -\sin(\theta_y) \\ -\sin(\theta_z)\cos(\theta_x)+\cos(\theta_z)\sin(\theta_y)\sin(\theta_x) & \cos(\theta_z)\cos(\theta_x)+\sin(\theta_z)\sin(\theta_y)\sin(\theta_x) & \cos(\theta_y)\sin(\theta_x) \\ \sin(\theta_z)\sin(\theta_x)+\cos(\theta_z)\sin(\theta_y)\cos(\theta_x) & -\cos(\theta_z)\sin(\theta_x)+\sin(\theta_z)\sin(\theta_y)\cos(\theta_x) & \cos(\theta_y)\cos(\theta_x) \end{bmatrix} \begin{bmatrix} W_x \\ W_y \\ W_z \end{bmatrix}$$

Sensed Inertial signals: (A_{xc}, A_{yc}, A_{zc}, W_{xc}, W_{yc}, W_{zc})
Physical motion and rotation rate: (P_{mx}, P_{my}, P_{mz}, W_x, W_y, W_z)

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Application of Inertial Sensing Technology – Image Stabilization

. An inertial tremble-sensing technology is used in hand-held image capturing devices (ex. digital camera/cell phone)
. At lease two high sensitive inertial sensors are used in this application
. Trembling detection algorithm is key in differentiating tremble from normal movements.



Greater Range of Gaming made possible with CyWee Motion Processing









CyWee's module enables the added steering motion whereas iPhone only allows for dipping of the controller back and forth, left and right.

FPS Shooters





In FPS games, move in first person view and shift view directions by moving the phone in the desired direction. The added degree of freedom in movement adds realism and interactivity to FPS games.

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Helicopter Flying Mode



In flying mode, gyros will be of use in giving full range of navigation: pitch, yaw, and roll.

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Panoramic Pictures





View a widescreen picture by moving the handset screen from side to side to relive the moment in panoramic view.

Virtual Tours



Take a virtual tour of apartment, museum, or building by simply moving the handset in a simulation of an actual tour.

Location Based Applications





By plugging in popular and common APIs, users can track their positioning by rotating your handset in location based applications in mobile phones.

Control Your Living Room Experience



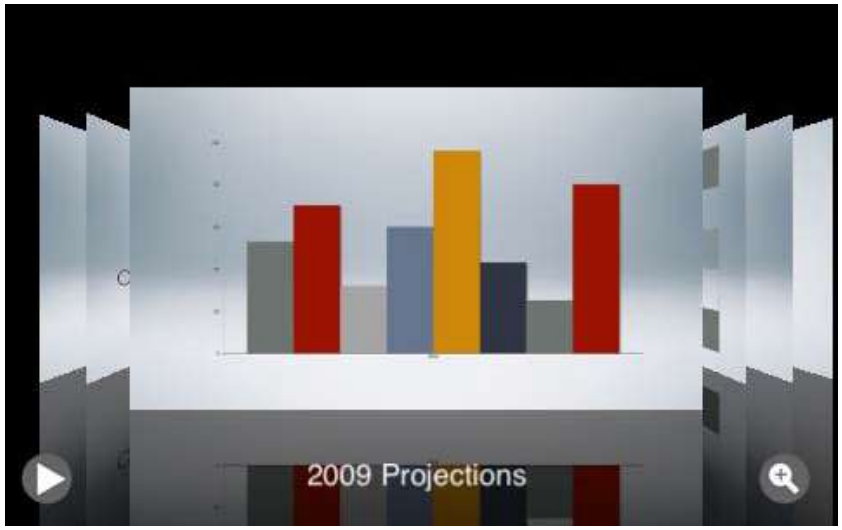




Use your mobile phone to control your home media center. Watch DvD's, stream online video, TV, and more…

Phone as an Air Mouse





Use your phone to give business presentations. Your phone transforms into an air mouse with full 6-axis range of movement.

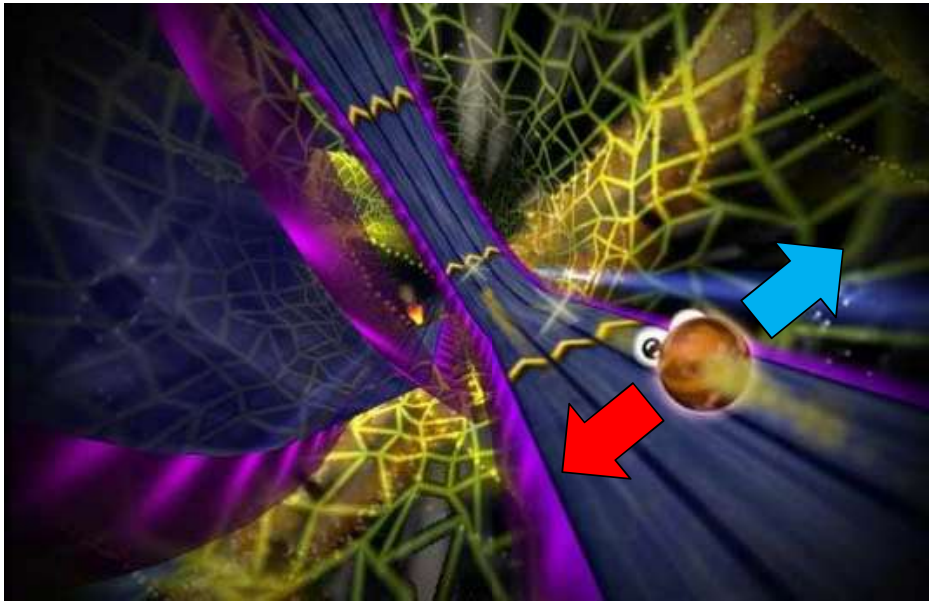
Phone as a Game Controller

Map games onto your phone and use your phone as a gaming controller





Mobile Controller for Driving Games



Use the mobile phone as a controller to play driving games. Simply turn the mobile-controller as you would a steering wheel.



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Mobile Controller for Sports Games





Use the mobile phone as a controller to play sports games such as tennis and golf. Enjoy 1:1 response that match your natural movements.



EXHIBIT 2030

IPR2018-01257 / IPR2018-01258

MUTUAL
NON-DISCLOSURE AGREEMENT

This Mutual Non-Disclosure Agreement (the "Agreement") is made and entered into effective April 23, 2008, by and between **QUALCOMM Incorporated**, a Delaware corporation ("QUALCOMM"), with offices located at 5775 Morehouse Drive, San Diego, California 92121, and **CyWee Group Ltd.**, a BVI corporation, with offices located at Palm Grove House, P.O. Box 438, Road Town, Tortola, British Virgin Islands, with regard to the following facts:

WHEREAS, each party to this Agreement possesses confidential, proprietary and/or trade secret information including, without limitation, information in tangible or intangible form relating to or including: business, product, marketing, licensing or sales activities, policies, practices, outlooks, studies, reports, analyses, strategies or forecasts, finances, revenue, pricing, costs or profits, released or unreleased products including, but not limited to, software, hardware, development, research, designs, specifications, performance characteristics, code, formulas, algorithms, data, techniques, processes, inventions, testing strategies, industry, customer or consumer information and third party confidential information (the "INFORMATION"); and

WHEREAS, each party in possession of INFORMATION (the "Disclosing Party") desires to disclose some of its INFORMATION to the other party (the "Receiving Party") subject to the terms and conditions of this Agreement;

NOW, THEREFORE, in consideration of the promises made herein, the receipt of certain INFORMATION and good and other valuable consideration, the receipt of which is hereby acknowledged, the parties hereto agree as follows:

1. Permitted Use. The Receiving Party shall handle, use, treat and utilize such INFORMATION as follows: (a) hold all INFORMATION received from the Disclosing Party in strict confidence; (b) use such INFORMATION only for the purpose of (i) evaluating the possibility of forming a joint business relationship or other commercial arrangement between the parties concerning such INFORMATION, and (ii) if and when such relationship is formed by a written agreement, furthering the purpose and intent expressly stated in such written agreement; (c) reproduce such INFORMATION only to the extent necessary for such purpose; (d) restrict disclosure of such INFORMATION to its employees with a need to know (and advise such employees of the obligations assumed herein); and (e) except as set forth in Section 3 herein, not disclose such INFORMATION to any third party, including but not limited to any vendor, customer, manufacturer or independent contractor, without prior written approval of such Disclosing Party. In addition, with respect to any equipment, component, software, or other items delivered to the Receiving Party by the Disclosing Party, the Receiving Party shall not reverse engineer, disassemble, decompile, or otherwise analyze the physical construction of, any such items.

The restrictions on the Receiving Party's use and disclosure of INFORMATION as set forth above shall not apply to any INFORMATION which the Receiving Party can demonstrate:

i. is wholly and independently developed by the Receiving Party without the use of INFORMATION of the Disclosing Party; or

ii. is or has become generally known to the public without breach of this Agreement by the Receiving Party; or

iii. at the time of disclosure to the Receiving Party, was known to such Receiving Party free of restriction and evidenced by documentation in the Receiving Party's possession; or

iv. is approved for release by written authorization of the Disclosing Party, but only to the extent of and subject to such conditions as may be imposed in such written authorization; or

v. is disclosed in response to a valid order of a court or other governmental body in the United States or any political subdivision thereof, but only to the extent of and for the purposes of such order; provided, however, that if the Receiving Party receives an order or request to disclose any INFORMATION by a court of competent jurisdiction or a governmental body, then the Receiving Party agrees:

a. if not prohibited by the request or order, immediately to inform the Disclosing Party in writing of the existence, terms, and circumstances surrounding the request or order;

b. to consult with the Disclosing Party on what steps should be taken to avoid or restrict the disclosure of INFORMATION;

c. to give the Disclosing Party the chance to defend, limit or protect against the disclosure; and

d. if disclosure of INFORMATION is lawfully required, to supply only that portion of the INFORMATION which is legally necessary and try to obtain confidential treatment for any INFORMATION required to be disclosed.

2. Designation. INFORMATION shall be subject to the restrictions of Section 1 if it is in writing or other tangible form and clearly marked as proprietary or confidential when disclosed to the Receiving Party or, if not disclosed in tangible form, if clearly identified as confidential or proprietary at the time of disclosure. The parties agree to use reasonable efforts to summarize the content of oral disclosures which are proprietary or confidential but failure to provide such summary shall not affect the nature of the INFORMATION disclosed or detract from the protection afforded under this Agreement if such INFORMATION was identified as confidential or proprietary when orally disclosed.

3. Affiliates. This Agreement does not permit either party to disclose INFORMATION to any third party (including, without limitation, that party's affiliates). Notwithstanding the foregoing, QUALCOMM may re-disclose INFORMATION to its Affiliates who have a need to know and shall treat such INFORMATION in a manner that is consistent with the confidentiality obligations of QUALCOMM in this Agreement and such Affiliates may re-disclose INFORMATION to other such Affiliates and to QUALCOMM. QUALCOMM's Affiliates may also disclose INFORMATION to the other party hereto. In such event, the other party hereto shall treat such INFORMATION in accordance with the provisions of this Agreement as if such INFORMATION was disclosed directly by QUALCOMM, and QUALCOMM and/or its

Affiliates shall have the right to enforce the provisions of this Agreement against the other party hereto in connection with any and all breaches or violations of this Agreement with respect to such INFORMATION by the other party hereto. QUALCOMM's Affiliates may also receive INFORMATION from the other party hereto. In such event, the Affiliate of QUALCOMM receiving such INFORMATION shall be responsible to treat such INFORMATION in accordance with the confidentiality obligations of QUALCOMM set forth in this Agreement, determined as if QUALCOMM had received such INFORMATION. QUALCOMM shall be responsible for any improper disclosure or use by its Affiliates of such INFORMATION to the same extent as if QUALCOMM had received such INFORMATION directly and made the same disclosure or use of such INFORMATION as did its Affiliates. The term "Affiliate" shall mean any entity with respect to which QUALCOMM owns or controls, directly or indirectly, one hundred percent (100%) of the beneficial ownership (but an entity shall remain an Affiliate only so long as it meets such ownership requirements), and the term "INFORMATION" shall also include information that is under the ownership, possession or control of an Affiliate but otherwise meets the definition of INFORMATION.

4. No License or Representations. No license to a party of any trademark, patent, copyright, mask work protection right or any other intellectual property right is either granted or implied by this Agreement or any disclosure hereunder, including, but not limited to, any license to make, use, import or sell any product embodying any INFORMATION. No representation, warranty or assurance is made by either party with respect to the non-infringement of trademarks, patents, copyrights, mask protection rights or any other intellectual property rights or other rights of third persons.

5. No Obligation. Neither this Agreement nor the disclosure or receipt of INFORMATION shall be construed as creating any obligation of a party to furnish INFORMATION to the other party or to enter into any agreement or relationship with the other party with respect to mutual business.

6. Return of Information. All INFORMATION shall remain the sole property of the Disclosing Party which originally disclosed such INFORMATION, and all materials containing any such INFORMATION (including all copies made by the Receiving Party) shall be returned to the Disclosing Party immediately upon termination or expiration of this Agreement or destroyed, or upon the Receiving Party's determination that it no longer has a need for such INFORMATION. Upon request of the Disclosing Party, the Receiving Party shall certify in writing that all materials containing such INFORMATION (including all copies thereof) have been returned to the Disclosing Party or destroyed.

7. Export Compliance Assurance. The Receiving Party acknowledges that all products, proprietary data, know-how, software or other data or information (herein referred to as "Products") obtained from QUALCOMM are subject to the United States (U.S.) government export control laws, which may restrict or prohibit their export, re-export, or transfer. U.S. government restrictions are implemented principally through the Export Administration Regulations ("EAR", 15 C.F.R. §§ 730 et seq., available at http://www.bis.doc.gov/) administered by Department of Commerce, Bureau of Industry and Security and the Foreign Asset Control Regulations administered by the Department of Treasury, Office of Foreign Assets

Control ("OFAC", 30 C.F.R. Part 500 et. Seq., available at http://www.treas.gov/offices/enforcement/ofac/).

The Receiving Party agrees that neither it nor its subsidiaries or affiliates will directly or indirectly export, re-export, transfer, or release, or cause to be exported or re-exported (herein referred to as "export"), any such Products or any direct Product thereof to any destination or entity prohibited or restricted under U.S. law including but not limited to U.S. government embargoed or sanctioned countries, entities, or nationals thereof, unless it shall obtain prior to export an authorization from the applicable U.S. government agency either in writing or as provided by applicable regulation. The U.S. government maintains embargoes or sanctions against the countries listed in the EAR, Country Groups E:1/2 to Part 740, Supplement 1. The current list of embargoed or sanctioned countries consists of Cuba, Iran, North Korea, Sudan, and Syria. This list is amended by the U.S. government from time to time and all such amendments shall be applicable to this Agreement. To the extent such Products are subject to National Security controls, the Receiving Party also agrees that, unless authorized by U.S. law (either by regulation, specific written authorization, or qualification for an applicable license exception, such as License Exception ENC), it shall not knowingly export, directly or indirectly, any of the Products, or the direct product thereof, to any country or nationals thereof listed in Country Group D:1 in Supplement No. 1 to Part 740 of the EAR, as the same may be amended from time to time. Unless otherwise authorized by U.S. export control laws or by applicable authorization from the proper U.S. government agency, the Receiving Party further agrees that no Products received from QUALCOMM will be directly or indirectly employed in missile technology, sensitive nuclear, or chemical biological weapons end uses or in any manner transferred to any party for any such end use. Furthermore, the Receiving Party agrees not to export Products listed in EAR Supplement No. 2 to Part 744 for military end-uses in the People's Republic of China as defined in the EAR Part 744.21.

The Receiving Party also agrees to comply with all trade laws applicable in other country jurisdictions as they pertain to import, use, export or distribution. The terms of this Export Compliance Assurance shall survive any termination or expiration of this Agreement.

8. Term and Termination. This Agreement shall become effective on the date first set forth above and shall terminate upon the happening of the earlier of:

(a) The written notice of either party to the other of its election, with or without cause, to terminate this Agreement; or

(b) The expiration of sixty (60) months from the date first set forth above.

9. Notice. Any notice or other communication made or given by either party in connection with this Agreement shall be sent via facsimile (with confirmation) or by registered or certified mail, postage prepaid, return receipt requested, or by courier service addressed to the other party at its address set forth below:

QUALCOMM Incorporated
5775 Morehouse Drive
San Diego, California 92121

CyWee Group Ltd.
Palm Grove House, P.O. Box 438, Road Town
Tortola, British Virgin Islands

Attn: Legal Department	Attn: Joe Ye
Fax: (858) 845-1250 / 658-2503	Fax: (886)2-8502-5718

10. Survivability. Each party agrees that all of its obligations undertaken herein as a Receiving Party shall survive and continue after any termination or expiration of this Agreement.

11. Governing Law and Arbitration. This Agreement shall be governed in all respects solely and exclusively by the laws of the State of California, U.S.A. without regard to conflict of laws principles. All disputes, controversies, or claims arising out of, relating to or in connection with this contract including the determination of the scope of the agreement to arbitrate, shall be finally settled by arbitration in accordance with the Arbitration Rules of the United Nations Commission on International Trade Law ("UNCITRAL"), applicable at the time of submission of the dispute to arbitration. The American Arbitration Association, ("AAA") shall be the Appointing Authority and shall appoint a single arbitrator. The arbitration case shall be administered by the AAA in accordance with its "Procedures for Cases Under the UNCITRAL Arbitration Rules" ("Rules"). The place of arbitration shall be San Diego, California, and the exclusive language to be used for the arbitral proceedings shall be English.

In the event either party shall bring any action to enforce or protect any of its rights under this Agreement, the prevailing party shall be entitled to recover, in addition to its damages, its reasonable attorneys' fees and costs incurred in connection therewith.

Nothing herein will prevent a party, prior to appointment of the arbitrator, from making application to any court of competent jurisdiction, for any provisional remedy available at law or in equity. Such application for relief shall not constitute a waiver of this agreement to arbitrate. Upon appointment, the arbitrator shall have exclusive authority to order provisional or interim relief, except that any relief ordered by the arbitrator may be immediately and specifically enforced by a court otherwise having jurisdiction. The parties waive objection to venue and consent to the personal jurisdiction of the federal courts of San Diego, California, U.S.A. in any action to enforce this agreement to arbitrate or any order or award of the arbitrator, or for the provisional or interim remedies provided for herein.

Discovery shall be limited to written requests for the production of specific documents. The period for requesting documents shall be sixty (60) days commencing upon the day that the answer is due under the Rules. The responding party shall have thirty (30) days to produce the requested documents by sending copies to the requesting party or its representative via a recognized international courier service. The parties will also voluntarily produce all documents that they intend to use at the arbitration hearing and a list of intended witnesses before the close of discovery subject to supplementation for purposes of rebuttal or good cause shown. The parties hereby waive any right to seek any discovery not provided for in this contract irrespective of whether the laws of any country provide for different or additional discovery in international arbitration. The arbitrator will hold a pre-hearing conference within three days of the close of discovery and will schedule and hold the final hearing within thirty (30) days of the close of discovery. EACH PARTY HERETO HEREBY AGREES THAT THE ARBITRATION PROCEDURE PROVIDED HEREIN WILL BE THE SOLE AND EXCLUSIVE METHOD OF RESOLVING ANY OF THE AFORESAID DISPUTES, CONTROVERSIES OR CLAIMS.

12. Miscellaneous. This Agreement constitutes the entire understanding among the parties hereto as to the INFORMATION and supersedes all prior discussions between them relating thereto. No amendment or modification of this Agreement shall be valid or binding on the parties unless made in writing and signed on behalf of each of the parties by its authorized officer or representative. No party may assign or transfer, in whole or in part, any of its rights, obligations or duties under this Agreement. The failure or delay of any party to enforce at any time any provision of this Agreement shall not constitute a waiver of such party's right thereafter to enforce each and every provision of this Agreement. In the event that any of the terms, conditions or provisions of this Agreement are held to be illegal, unenforceable or invalid by any court of competent jurisdiction, the remaining terms, conditions or provisions hereof shall remain in full force and effect.

13. Counterparts, Electronic and Facsimile Delivery. This Agreement may be executed in two or more identical counterparts, each of which shall be deemed to be an original and all of which taken together shall be deemed to constitute the Agreement when a duly authorized representative of each party has signed a counterpart. The parties intend to sign and deliver this Agreement by electronic or facsimile transmission. Each party agrees that the delivery of the Agreement by electronic or facsimile transmission shall have the same force and effect as delivery of original signatures and that each party may use such electronic or facsimile signatures as evidence of the execution and delivery of the Agreement by all parties to the same extent that an original signature could be used.

IN WITNESS WHEREOF, the parties have executed this Agreement on the date set forth above.

CyWee Group Ltd.,
a BVI corporation

By: _____
Print Name: Joe Ye
Title: Chief Executive Officer

QUALCOMM Incorporated,
a Delaware corporation

By: _____
Print Name: John Scott
Title: Senior Legal Counsel

[Signature Page to Mutual Non-Disclosure Agreement]