JOINT INSTITUTE
交大密西根学院

Capstone Project: VMware#1-AR in Data Centers

Design Review #2

Group 21
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Chenyun Tao Yaxin Chen

Instructor
Mingjian Li
Sponsor & Mentor
Gavin Lu Yixing Jia

Team Introduction

Leader

Shuyi Zhou
Senior
ECE

Member

Chenyun Tao
Senior
ECE

Member

Liying Han
Senior
ECE

Member

Yaxin Chen
Senior
ECE

Member

Jinglei Xie
Senior
ECE

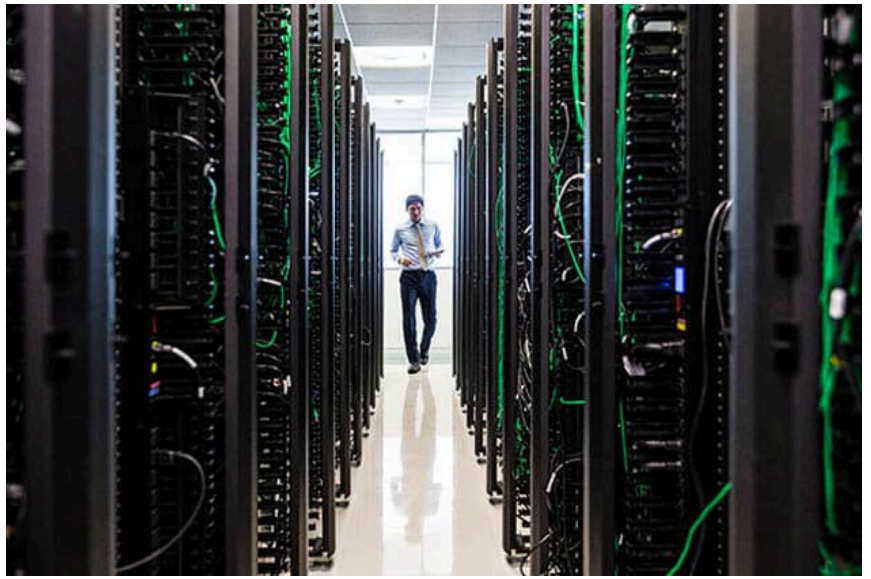
Contents

Contents

Problems & Needs in Data Centers (DC)

Maintenance and audits

- Do not have integrated information system
  - Need an integrated system that involves all the information together
- Lack user-friendly instructions
  - Need a more user-friendly tool for instructions and information access

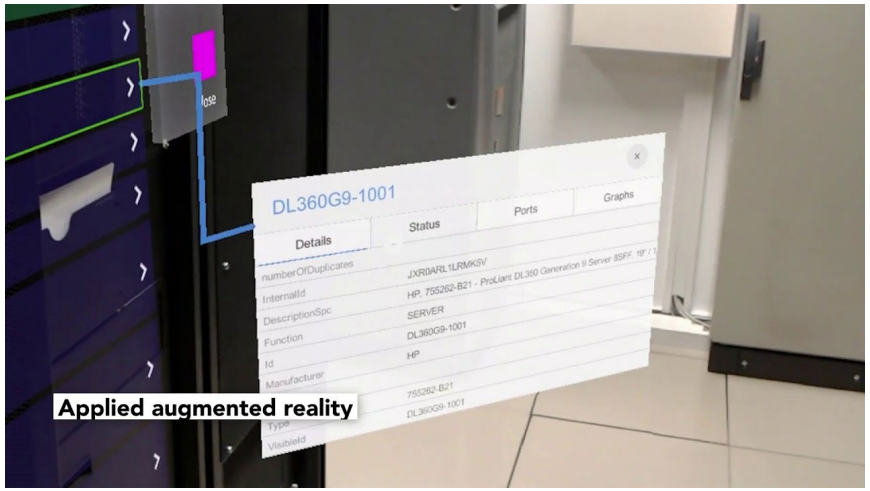


www.cisco.com

Project Goal

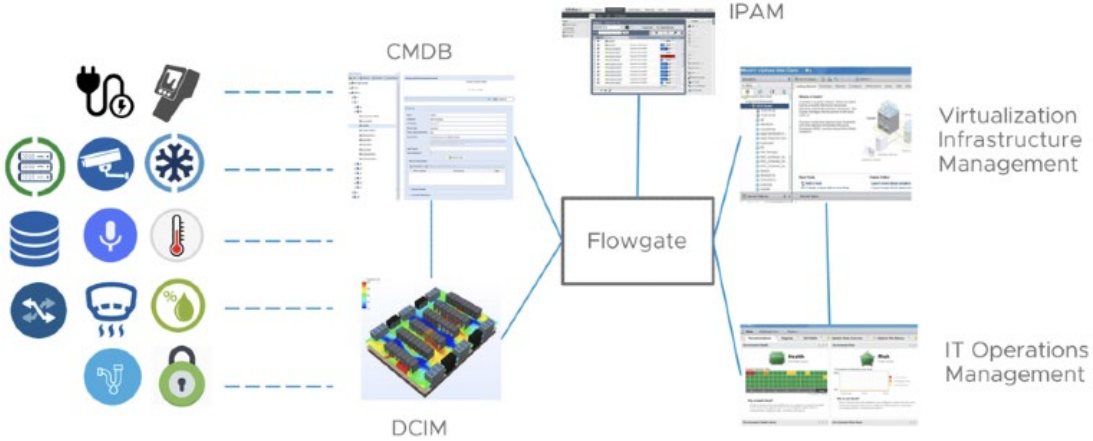
An Augmented Reality (AR) App
for aiding on-site DC maintenance & audit

- **Front-end: AR**
  - A user interface to display the information vividly



www.youtube.com/watch?v=1Pe028PjQhs

- **Back-end: Flowgate**
  - An integrated system containing all necessary information of DC



https://github.com/vmware/flowgate

Customer Requirements (CR) & Engineering Specifications (ES)

CR: Short Reaction Time

ES:

- Barcode localization & identification: < 0.55s [1]
- Database query complexity: O(log(n))
- AR image generation: < 0.1s [2]

CR: Portable Device

ES:

- Platform: Android 7.0+ / iOS 11.0+ [3]
- Light: >= 40lx [4]
- Software package size: < 110MB for Android / < 940MB for iOS [5]

[1] E. Ohbuchi, H. Hanaizumi and L. A. Hock, "Barcode readers using the camera device in mobile phones," *2004 International Conference on Cyberworlds*, Tokyo, Japan, 2004, pp. 260-265, doi: 10.1109/CW.2004.23.
[2] A. Baek, K. Lee, and H. Choi, "CPU and GPU parallel processing for mobile Augmented Reality." 2013.
[3] https://developers.google.com/ar/discover/supported-devices & https://developer.apple.com/documentation/arkit
[4] L. Blom, "Impact of light on augmented reality." Diva Portal. 2018.
[5] https://play.google.com/store/apps & https://www.apple.com/app-store

Customer Requirements (CR) & Engineering Specifications (ES)

CR: Information Correctness

ES:

- Barcode localization correctness: > 90% [1]
- Data retrieval accuracy: > 99% [2]

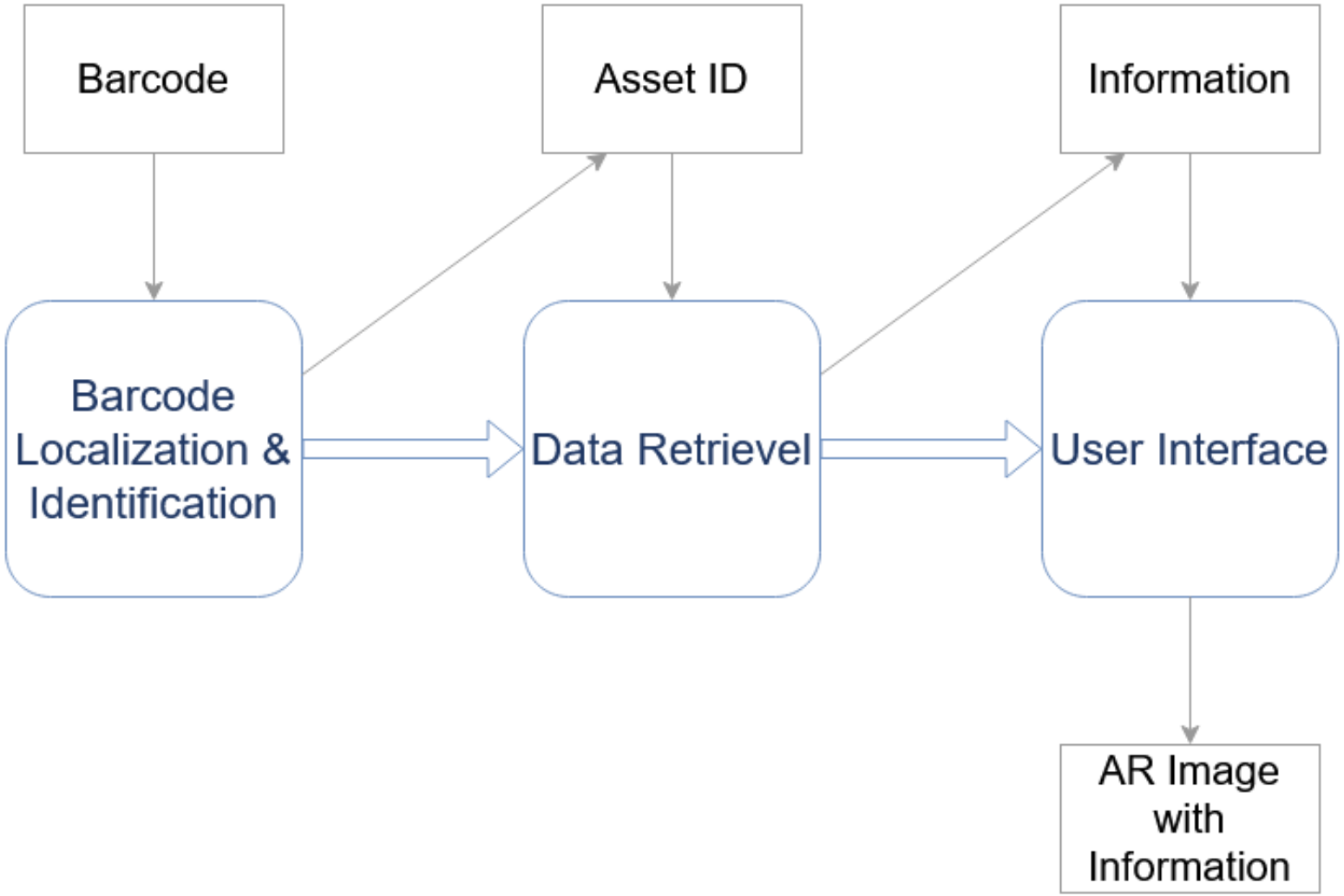
CR: Comfortable Display

ES:

- Frame rate: > 15 frames/s [3]
- Sensible temperature of device: < 40 °C [4]

[1] O. Oktay et al., "Stratified Decision Forests for Accurate Anatomical Landmark Localization in Cardiac Images," in IEEE Transactions on Medical Imaging, vol. 36, no. 1, pp. 332-342, Jan. 2017, doi: 10.1109/TMI.2016.2597270.
[2] https://www.labce.com/spg650115_barcode_reading_and_accuracy.aspx
[3] A. Craig. Augmented Reality Hardware, pp. 69-124. 2013.
[4] https://support.apple.com/en-us/HT201678 & https://support.google.com/pixelphone/answer/9134668?hl=en

Concept Diagram



Contents

Concept Generation

➢ **Barcode Localization & Identification**

- To select from various SDK (Software Development Kit)
- Generated from ES & difficulty in implementation

➢ **ZXing**

- Open source
- Scan only one barcode
- Slow & Lower accuracy

➢ **ML Kit**

- Open source (Google)
- Scan multiple barcodes
- A little slow

➢ **Scandit**

- Close source
- Faster
- More accurate

[1] http://www.discoversdk.com/compare/scandit-_-barcode-scanner-sdk-vs-zxing

Concept Selection

Design criterion	Weight factor	Unit	ZXing			ML Kit			Scandit		
			Value	Score	Rating	Value	Score	Rating	Value	Score	Rating
Reaction time	0.17	Exp	Long	5	0.85	Fair	6	1.02	Short	8	1.36
Information correctness	0.5	Exp	Low	5	2.5	Fair	6	3	High	7	3.5
Implement. difficulty	0.17	Exp	High	4	0.68	Low	8	1.36	Low	8	1.36
Cost	0.17	$	0	10	1.7	0	10	1.7	>100	2	0.34
					5.73			7.08			6.56

Concept Selection

Design criterion	Weight factor	Unit	ZXing			ML Kit			Scandit		
			Value	Score	Rating	Value	Score	Rating	Value	Score	Rating
Reaction time	0.17	Exp	Long	5	0.85	Fair	6	1.02	Short	8	1.36
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Cost	0.17	$	0	10	1.7	0	10	1.7	>100	2	0.34
					5.73			7.08			6.56

- **Challenge:** how to integrate with our app using AR kit?

Contents

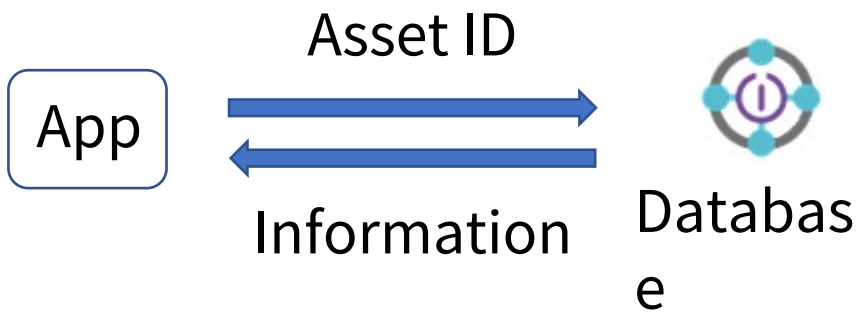
Concept Generation

➢ **Data Retrieval**

- Generated from CR of short reaction time

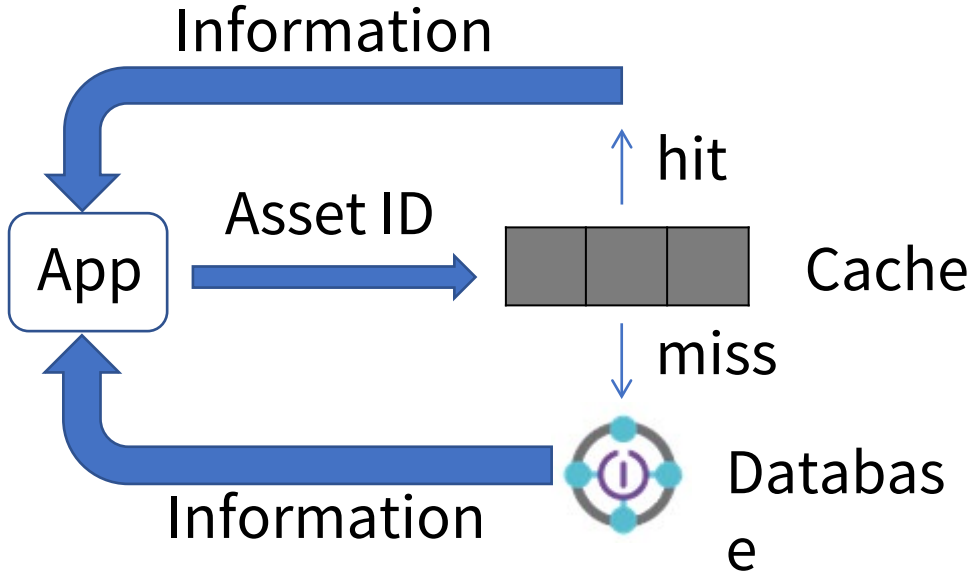
➢ **Direct Retrieval**

- Directly retrieve information from remote database and transmit through network



➢ **Cache**

- Retrieve from local cache first
- If miss, retrieve from remote database



Concept Selection

Design criterion	Weight factor	Unit	Direct Retrieval			Cache [1]		
			Value	Score	Rating	Value	Score	Rating
Time requirement	0.33	Exp	Fair	5	1.65	Low	6	2.31
Space requirement	0.33	Exp	Low	7	2.31	Fair	5	1.65
Implementation difficulty	0.17	Exp	Fair	5	0.85	High	3	0.51
History record	0.17	Exp	Unsupported	3	0.51	Supported	7	1.19
					5.32			5.66

[1] David Patterson and John Hennessy, Computer Organization and Design - Hardware/Software Interface, 4th edition, Morgan Kaufmann, 2008, ISBN 978-0-12-374493-7

Concept Selection

Design criterion	Weight factor	Unit	Direct Retrieval			Cache [1]		
			Value	Score	Rating	Value	Score	Rating
Time requirement	0.33	Exp	Fair	5	1.65	Low	6	2.31
Space requirement	0.33	Exp	Low	7	2.31	Fair	5	1.65
Implementation difficulty	0.17	Exp	Fair	5	0.85	High	3	0.51
History record	0.17	Exp	Unsupported	3	0.51	Supported	7	1.19
					5.32			5.66

- **Challenge:** how to set size of cache and expired time of information?

[1] David Patterson and John Hennessy, Computer Organization and Design - Hardware/Software Interface, 4th edition, Morgan Kaufmann, 2008, ISBN 978-0-12-374493-7

Contents

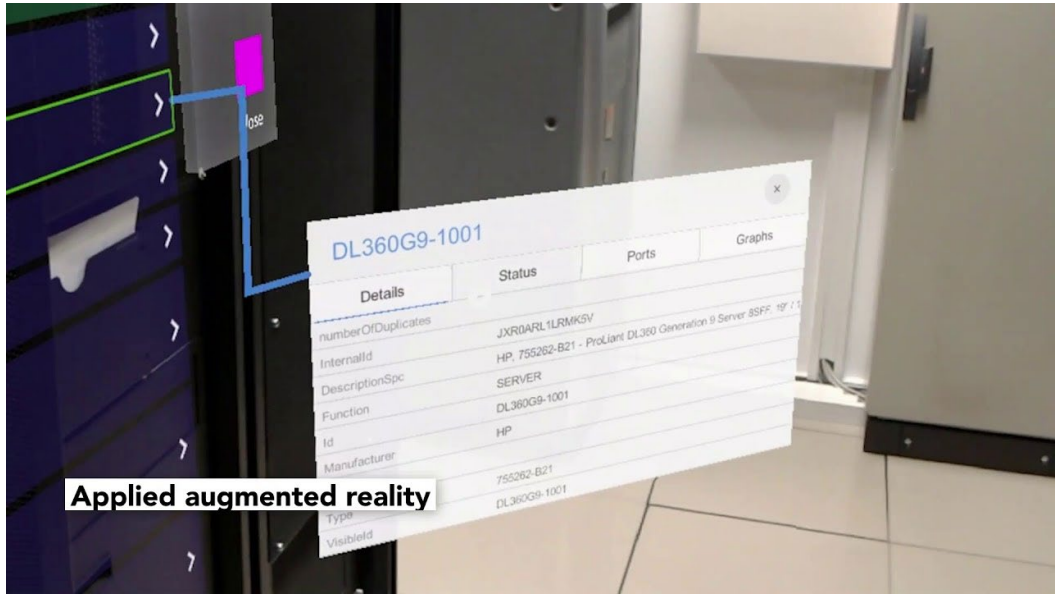
Concept Generation

➢ User Interface

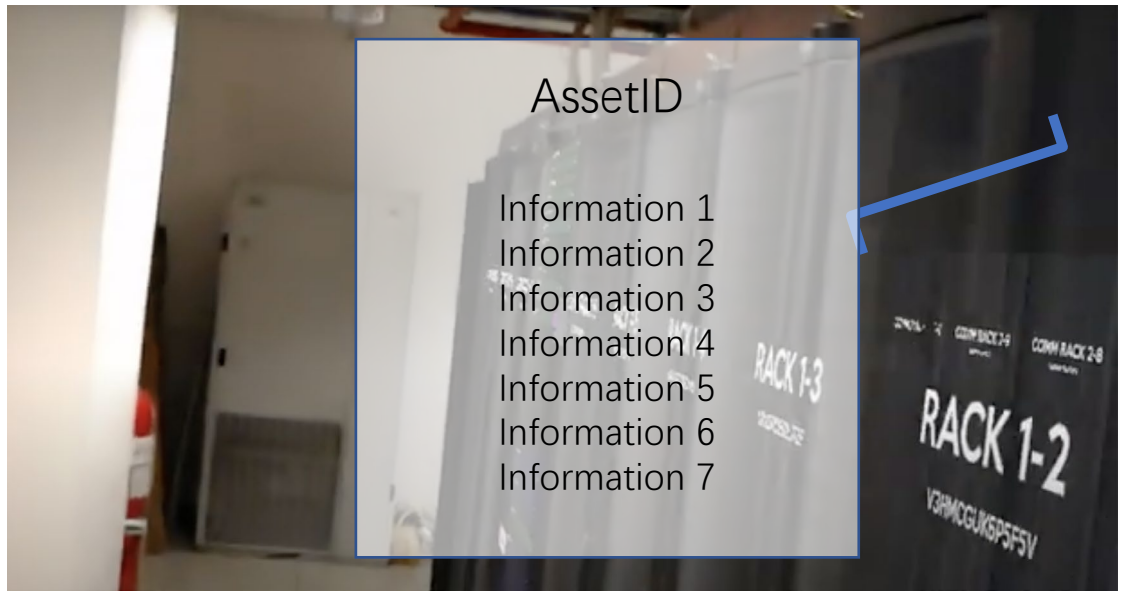
- Generated: CR & Survey about existing similar softwares

➢ How to display data?

- Place infomation in 3-D (AR) coordinate
- Place infomation on screen (2-D coordinate), but connected to the server with a line



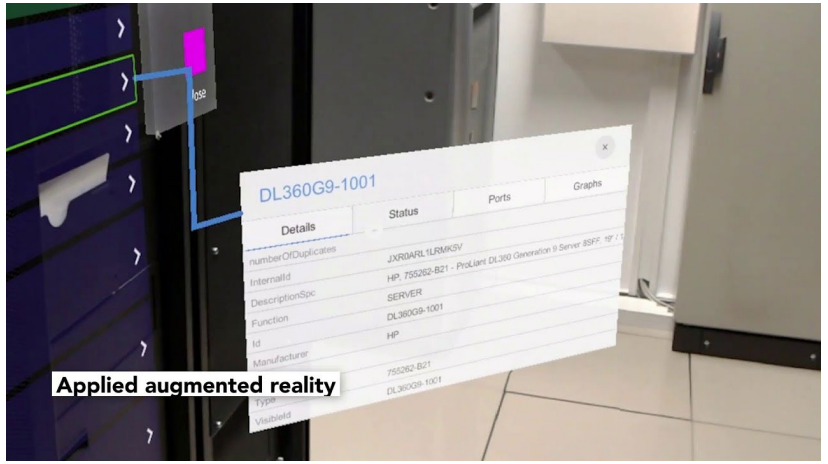
www.youtube.com/watch?v=1Pe028PjQhs



www.youtube.com/watch?v=1Pe028PjQhs

Concept Selection

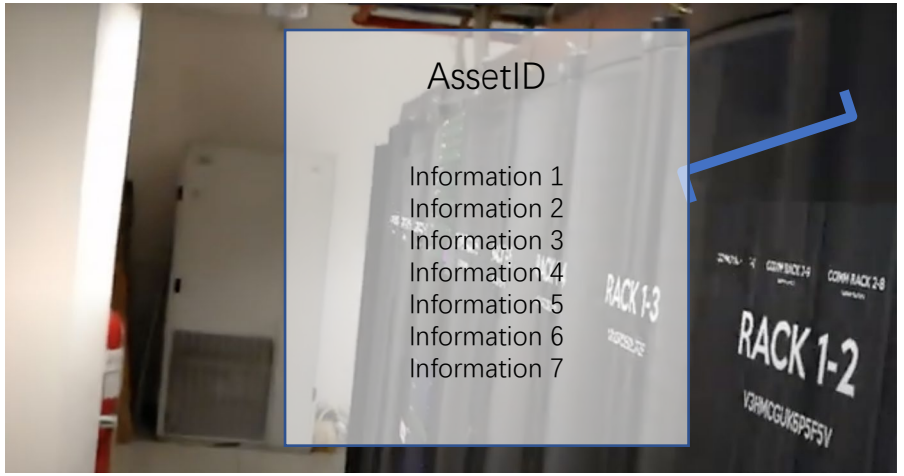
Design criterion	Weight factor	Unit	3-D display		
			Value	Score	Rating
Read data	0.17	Exp	Fair	6	1.02
Select data	0.5	Exp	Easy	10	5
Go to data	0.16	Exp	Fair	8	1.28
Implementation	0.17	Exp	Easy	8	1.36
					8.66



www.youtube.com/watch?v=1Pe028PjQhs

Concept Selection

Design criterion	Weight factor	Unit	2-D display		
			Value	Score	Rating
Read data	0.17	Exp	Clear	10	1.7
Select data	0.5	Exp	Difficult	7	3.5
Go to data	0.16	Exp	Easy	10	1.6
Implementation	0.17	Exp	Difficult	6	1.02
					7.82



www.youtube.com/watch?v=1Pe028PjQhs

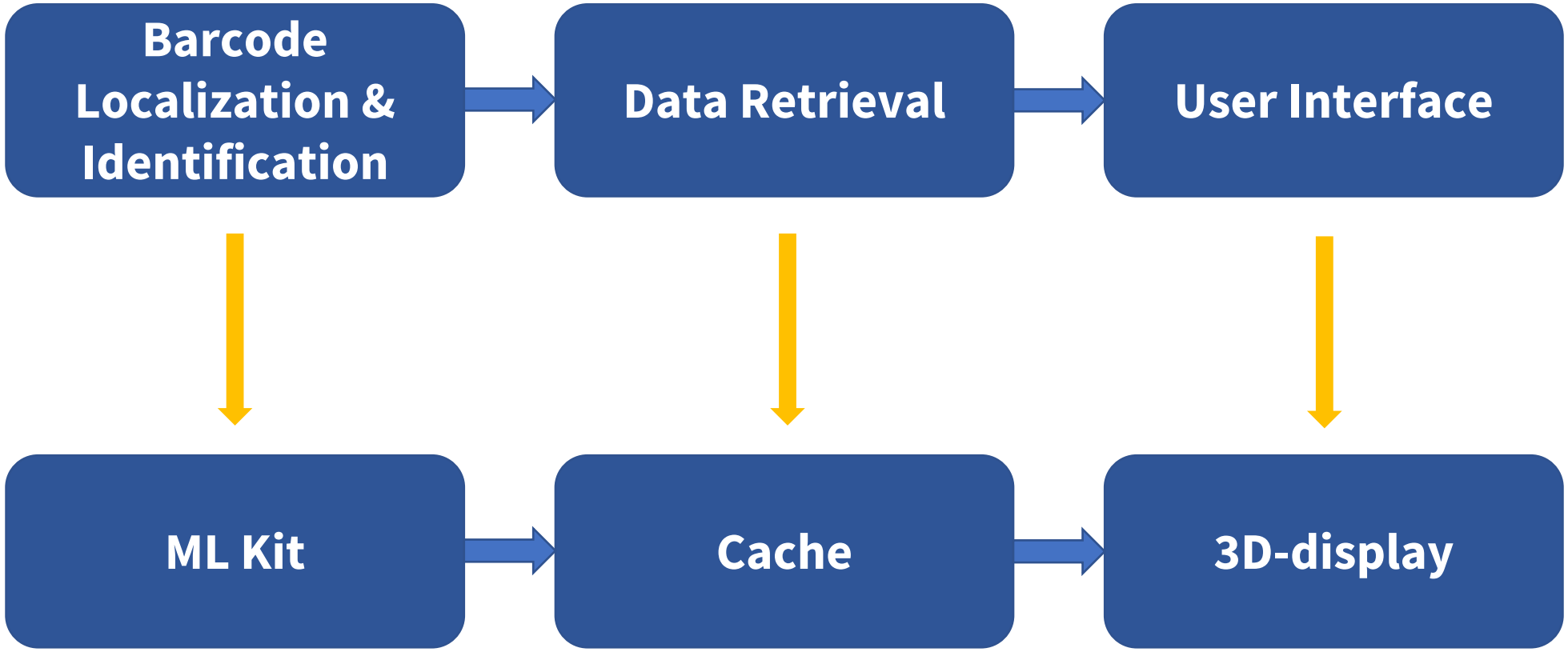
Concept Selection

Design criterion	Weight factor	Unit	3-D display			2-D display		
			Value	Score	Rating	Value	Score	Rating
Read data	0.17	Exp	Fair	6	1.02	Clear	10	1.7
Select data	0.5	Exp	Easy	10	5	Difficult	7	3.5
Go to data	0.16	Exp	Fair	8	1.28	Easy	10	1.6
Implementation	0.17	Exp	Easy	8	1.36	Difficult	6	1.02
					8.66			7.82

- **Challenge:** how to make the data easy to read?

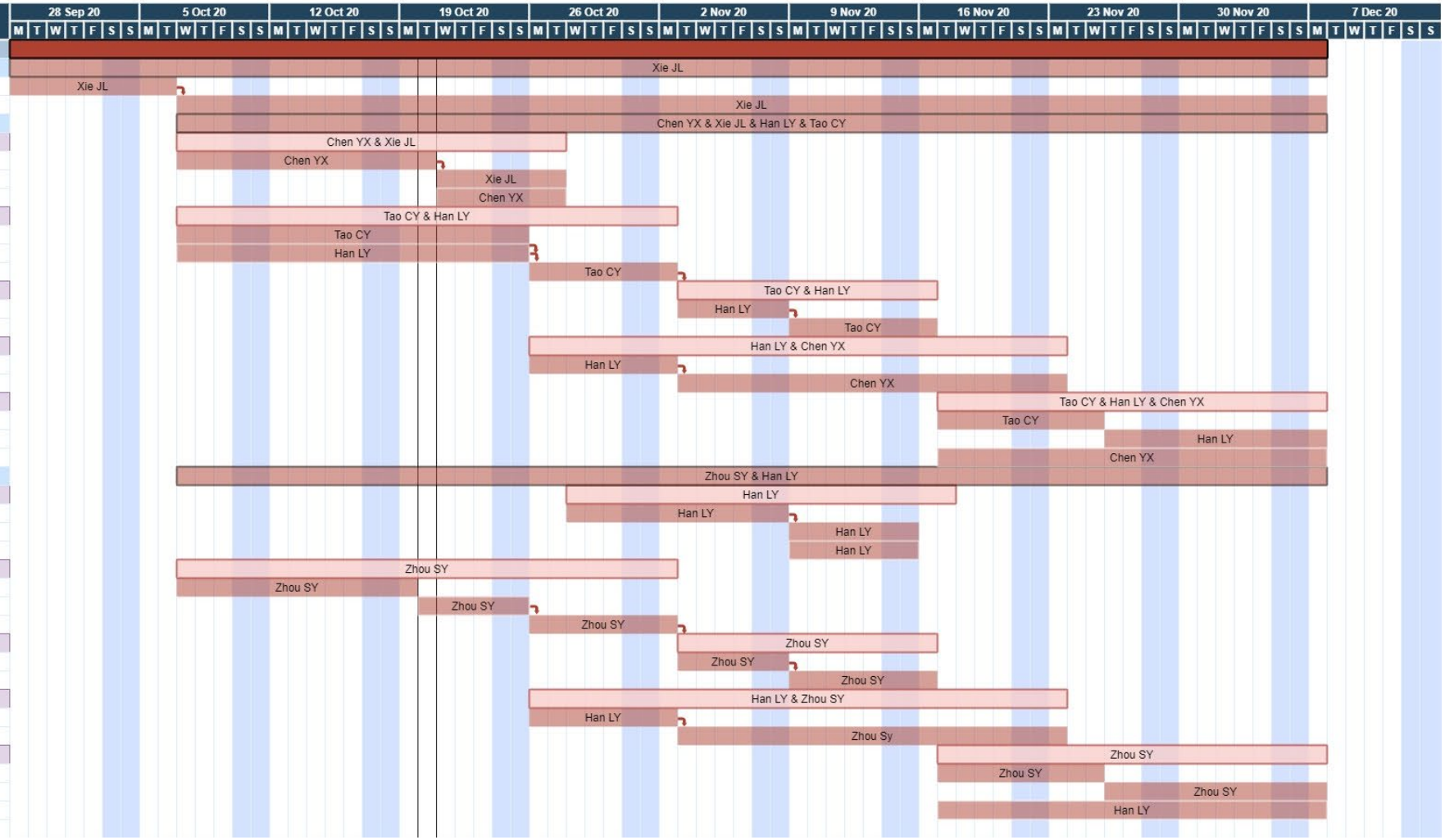
Contents

Conclusion for Concept Generation



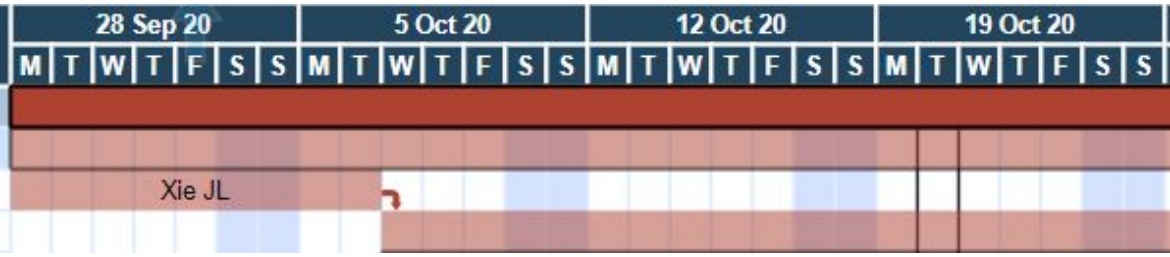
Project Plan - General View

	Task Name	Assignee	Duration	Start	ETA
	Complete project execution		70 days	28.09.20	7.12.20
0	Flowgate Environment	Xie JL	70 days	28.09.20	7.12.20
0.1	Install environment on server	Xie JL	9 days	28.09.20	6.10.20
0.2	Maintain Database	Xie JL	61 days	6.10.20	7.12.20
1	Android		61 days	6.10.20	7.12.20
1.1	Milestone 1: Connect Flowgate with app		21 days	6.10.20	27.10.20
1.1.1	Init and get token	Chen YX	14 days	6.10.20	20.10.20
1.1.2	Post method	Xie JL	7 days	20.10.20	27.10.20
1.1.3	Get method	Chen YX	7 days	20.10.20	27.10.20
1.2	Milestone 2: Baisc Integration of AR		21 days	6.10.20	2.11.20
1.2.1	Create an AR app on phone	Tao CY	19 days	6.10.20	25.10.20
1.2.2	Scan bar scan	Han LY	19 days	6.10.20	25.10.20
1.2.3	Integrate 1.2.1 and 1.2.2	Tao CY	11 days	25.10.20	2.11.20
1.3	Milestone 3: Finish a Prototype		14 days	2.11.20	16.11.20
1.3.1	Transfer the bar code position to AR world position	Han LY	7 days	2.11.20	9.11.20
1.3.2	Place some information on the bar code position	Tao CY	7 days	9.11.20	16.11.20
1.4	Milestone 4: Good UI		29 days	26.10.20	23.11.20
1.4.1	Design UI	Han LY	7 days	26.10.20	2.11.20
1.4.2	Implement UI to deal with one bar	Chen YX	21 days	2.11.20	23.11.20
1.5	Improve algorithm		21 days	17.11.20	7.12.20
1.5.1	Sava data	Tao CY	9 days	17.11.20	26.11.20
1.5.2	Multiple bar codes	Han LY	12 days	26.11.20	7.12.20
1.5.3	Continuous of AR	Chen YX	21 days	17.11.20	7.12.20
2	iOS		61 days	6.10.20	7.12.20
2.1	Milestone 5: Connect Flowgate :Translate java to swift	Han LY	21 days	6.10.20	27.10.20
2.1.1	Init and get token	Han LY	14 days	6.10.20	20.10.20
2.1.2	Post method	Han LY	7 days	20.10.20	27.10.20
2.1.3	Get method	Han LY	7 days	20.10.20	27.10.20
2.2	Milestone 2: Baisc Integration of AR	Zhou SY	21 days	6.10.20	2.11.20
2.2.1	Create an AR app on phone	Zhou SY	19 days	6.10.20	25.10.20
2.2.2	Scan bar scan	Zhou SY	19 days	6.10.20	25.10.20
2.2.3	Integrate 1.2.1 and 1.2.2	Zhou SY	11 days	25.10.20	2.11.20
2.3	Milestone 3: Finish a Prototype	Zhou SY	14 days	2.11.20	16.11.20
2.3.1	Transfer the bar code position to AR world position	Zhou SY	7 days	2.11.20	9.11.20
2.3.2	Place some information on the bar code position	Zhou SY	7 days	9.11.20	16.11.20
2.4	Milestone 4: Good UI		29 days	26.10.20	23.11.20
2.4.1	Design UI(same as Android part)	Han LY	7 days	26.10.20	2.11.20
2.4.2	Implement UI to deal with one bar	Zhou SY	21 days	2.11.20	23.11.20
2.5	Improve algorithm: Translate Java to Swift		21 days	17.11.20	7.12.20
2.5.1	Sava data	Zhou SY	9 days	17.11.20	26.11.20
2.5.2	Multiple bar codes	Zhou SY	12 days	26.11.20	7.12.20
2.5.3	Continuous of AR	Han LY	21 days	17.11.20	7.12.20



Project Plan - Flowgate Environment

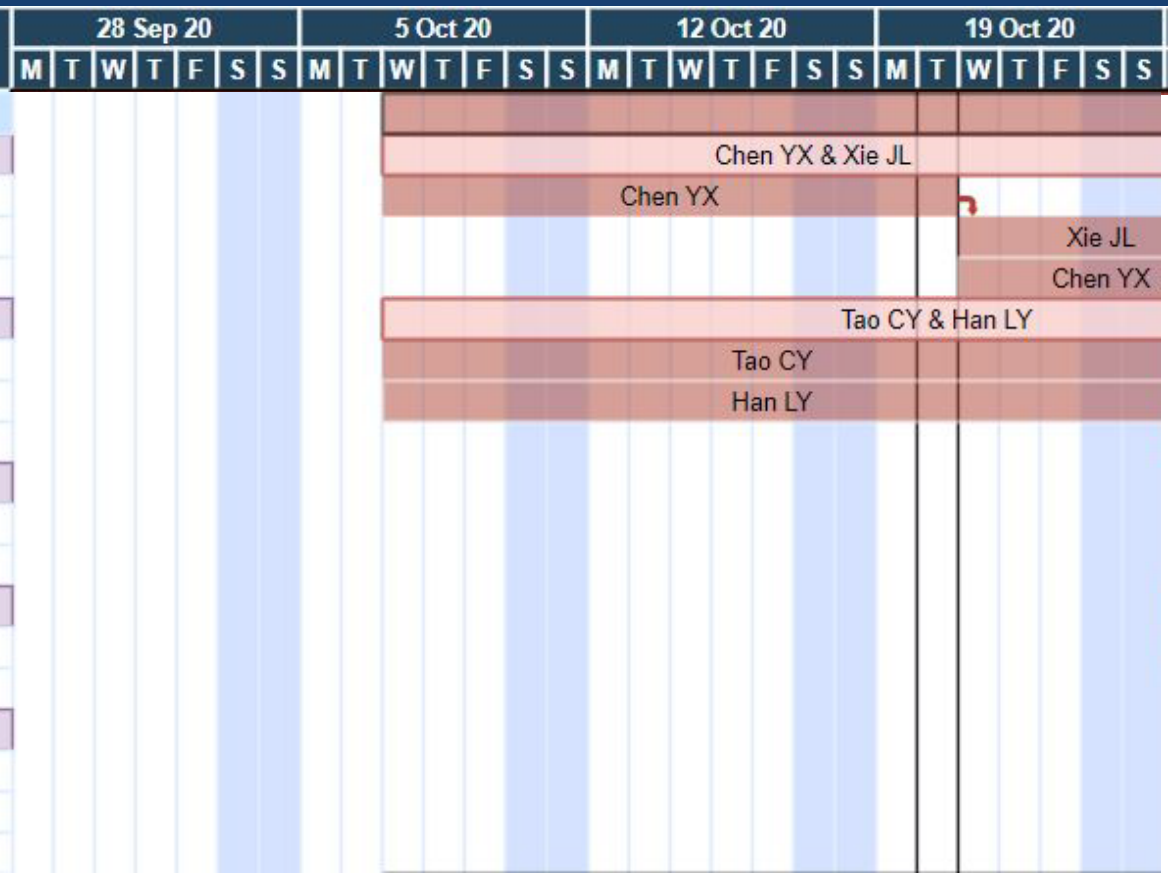
	Task Name	Assignee	Duration	Start	ETA
	Complete project execution		70 days	28.09.20	7.12.20
0	Flowgate Environment	Xie JL	70 days	28.09.20	7.12.20
0.1	Install environment on server	Xie JL	9 days	28.09.20	6.10.20
0.2	Maintain Database	Xie JL	61 days	6.10.20	7.12.20



- Finished installation and configuration of Flowgate server

Project Plan - Andriod

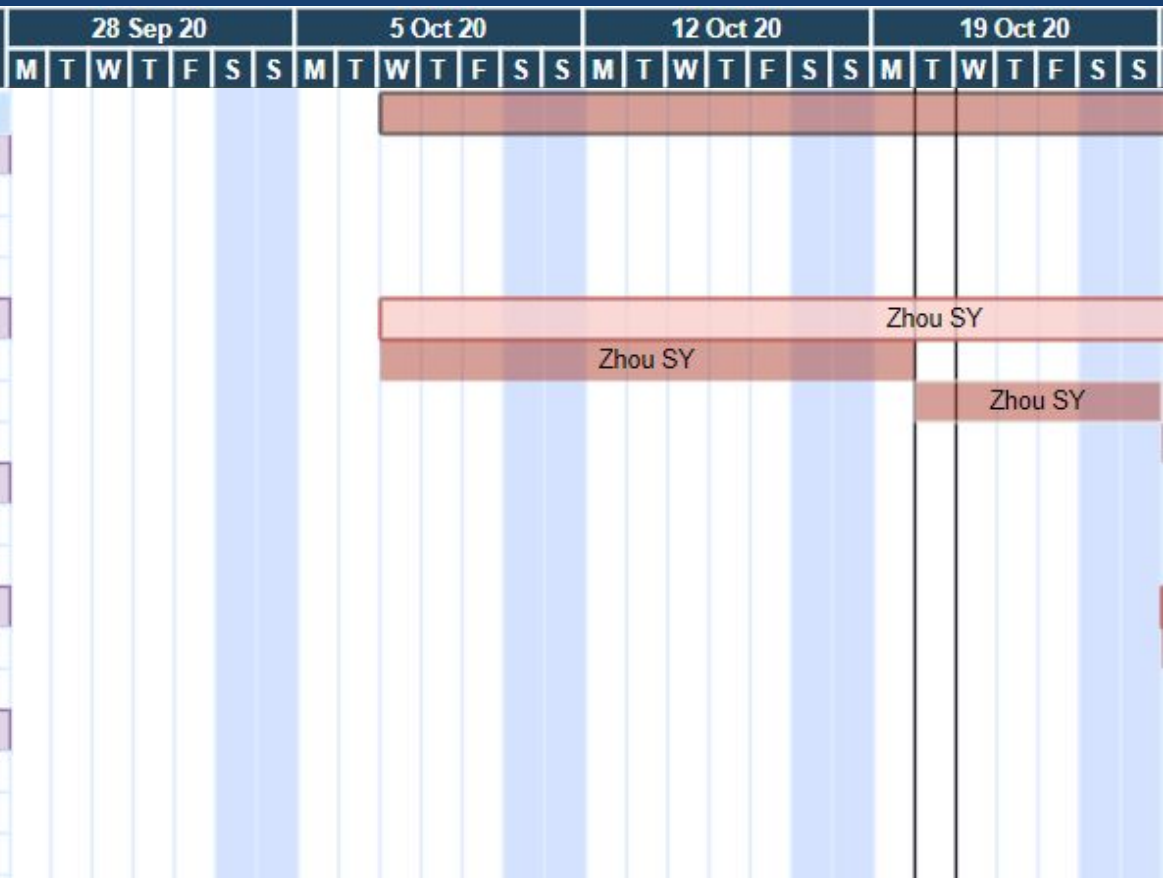
	Task Name	Assignee	Duration	Start	ETA
1	Android		61 days	6.10.20	7.12.20
1.1	Milestone 1: Connect Flowgate with app		21 days	6.10.20	27.10.20
1.1.1	Init and get token	Chen YX	14 days	6.10.20	20.10.20
1.1.2	Post method	Xie JL	7 days	20.10.20	27.10.20
1.1.3	Get method	Chen YX	7 days	20.10.20	27.10.20
1.2	Milestone 2: Baisc Integration of AR		21 days	6.10.20	2.11.20
1.2.1	Create an AR app on phone	Tao CY	19 days	6.10.20	25.10.20
1.2.2	Scan bar scan	Han LY	19 days	6.10.20	25.10.20
1.2.3	Integrate 1.2.1 and 1.2.2	Tao CY	11 days	25.10.20	2.11.20
1.3	Milestone 3: Finish a Prototype		14 days	2.11.20	16.11.20
1.3.1	Transfer the bar code position to AR world position	Han LY	7 days	2.11.20	9.11.20
1.3.2	Place some information on the bar code position	Tao CY	7 days	9.11.20	16.11.20
1.4	Milestone 4: Good UI		29 days	26.10.20	23.11.20
1.4.1	Design UI	Han LY	7 days	26.10.20	2.11.20
1.4.2	Implement UI to deal with one bar	Chen YX	21 days	2.11.20	23.11.20
1.5	Improve algorithm		21 days	17.11.20	7.12.20
1.5.1	Sava data	Tao CY	9 days	17.11.20	26.11.20
1.5.2	Multiple bar codes	Han LY	12 days	26.11.20	7.12.20
1.5.3	Continuous of AR	Chen YX	21 days	17.11.20	7.12.20



- Established connection to the server successfully
- Implementing data fetching from server and data writing to server
- Implementing AR App in Android; bar code scanning has been realized

Project Plan - IOS

	Task Name	Assignee	Duration	Start	ETA
2	iOS		61 days	6.10.20	7.12.20
2.1	Milestone 5: Connect Flowgate :Translate java to swift	Han LY	21 days	6.10.20	27.10.20
2.1.1	Init and get token	Han LY	14 days	6.10.20	20.10.20
2.1.2	Post method	Han LY	7 days	20.10.20	27.10.20
2.1.3	Get method	Han LY	7 days	20.10.20	27.10.20
2.2	Milestone 2: Baisc Integration of AR	Zhou SY	21 days	6.10.20	2.11.20
2.2.1	Create an AR app on phone	Zhou SY	19 days	6.10.20	25.10.20
2.2.2	Scan bar scan	Zhou SY	19 days	6.10.20	25.10.20
2.2.3	Integrate 1.2.1 and 1.2.2	Zhou SY	11 days	25.10.20	2.11.20
2.3	Milestone 3: Finish a Prototype	Zhou SY	14 days	2.11.20	16.11.20
2.3.1	Transfer the bar code position to AR world position	Zhou SY	7 days	2.11.20	9.11.20
2.3.2	Place some information on the bar code position	Zhou SY	7 days	9.11.20	16.11.20
2.4	Milestone 4: Good UI		29 days	26.10.20	23.11.20
2.4.1	Design UI(same as Android part)	Han LY	7 days	26.10.20	2.11.20
2.4.2	Implement UI to deal with one bar	Zhou SY	21 days	2.11.20	23.11.20
2.5	Improve algorithm: Translate Java to Swift		21 days	17.11.20	7.12.20
2.5.1	Sava data	Zhou SY	9 days	17.11.20	26.11.20
2.5.2	Multiple bar codes	Zhou SY	12 days	26.11.20	7.12.20
2.5.3	Continuous of AR	Han LY	21 days	17.11.20	7.12.20



- Created a simple AR App in IOS system
- Implementing bar code scanning

Project Delivery at Expo

A smart phone / tablet App that can:

- Scan the bar code of a device to get information about it
- Mark out the device in the AR interface
- Display information of the device onto the AR interface
- Change specific parameters of the device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Q & A