MOBILE APPLICATION FOR AUTOMATIC CONTROL SYSTEM “SMART INTERCOM”

Home automation systems - systems capable to perform actions and solve certain everyday tasks without human involvement.

A **mobile application** is a computer program designed to run on a mobile device such as a phone/tablet or watch.

Target platforms

- Apple iOS
- Google Android
- Microsoft Windows 10 (UWP)

Using developed application user is able to:

- Be notified when someone came to his house
- Lock/unlock the door over the Internet
- Communicate with his visitors
- Generate the token barcode to open the door
- Generate and send token barcode for his guest
- Review the history of visits

Requirements to the application:

- Application should be available for three main platforms
- Cross platform technologies should be used for mobile application development
- Application should have user friendly interface
- Application should be light weight and responsive
- Application should provide user possibility to be authenticated and authorizated
- Application should communicate with the system components over secured protocol

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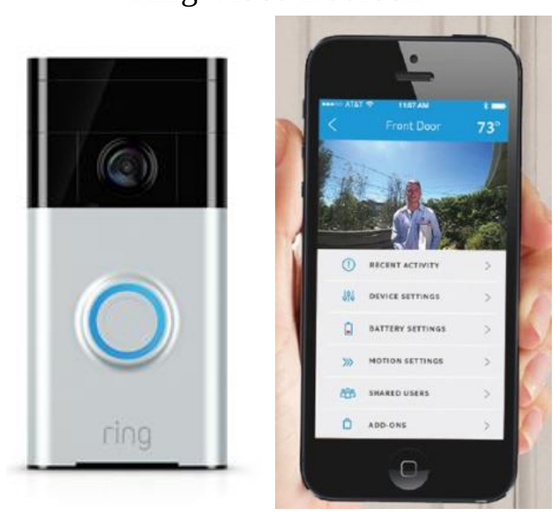
Изм.	Лист	№ докум	Підпис	Дата	Mobile application for automatic control system “Smart intercom”	Лит.	Масса / Масштаб
Розроб.		Чернобай Ю.Ю.				У	
Перев.		Дергачов К.Ю.				Лист 1	Листів 10
Н. Контр.		Дергачов К.Ю.				ХАІ гр. 362М	

EXISTING SOLUTIONS

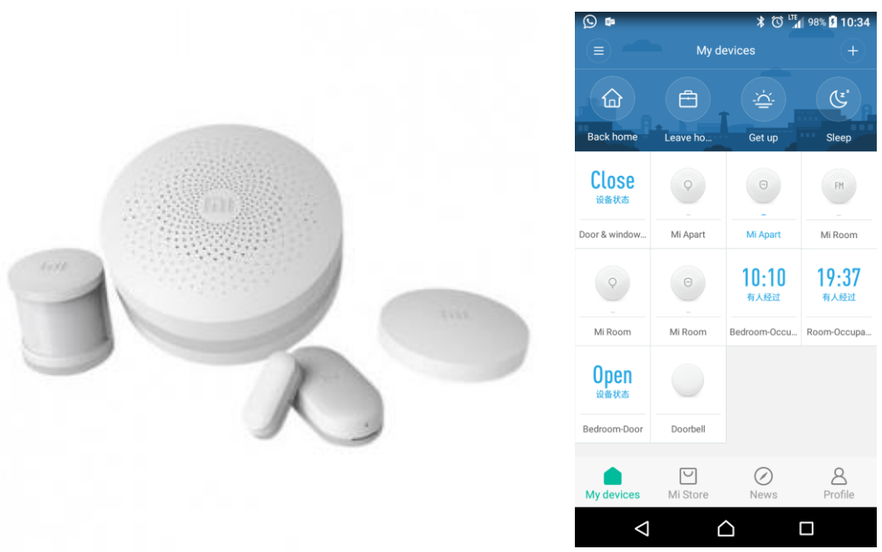
Functionality of existing solutions overview

Criteria	Variants			
	Xiaomi MI Smart Home Suite	Ring Video Doorbell	Saful Intercom System	Developed system
Mobile application	+	+	+	+
Remote lock/unlock	-	-	-	+
Video conferencing	+	+	+	+
Access via internet	+	-	+	+
Guest pass	-	-	-	+
Access without smartphone	-	+	+	+
Smart home integration	+	+	-	+
Audit of events	-	-	-	+
Decentralized structure	+	-	-	+

Ring Video Doorbell



Xiaomi MI Smart Home



Saful Intercom System

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Перев.		Дергачов К.Ю.				Лист 2 / Листів 10
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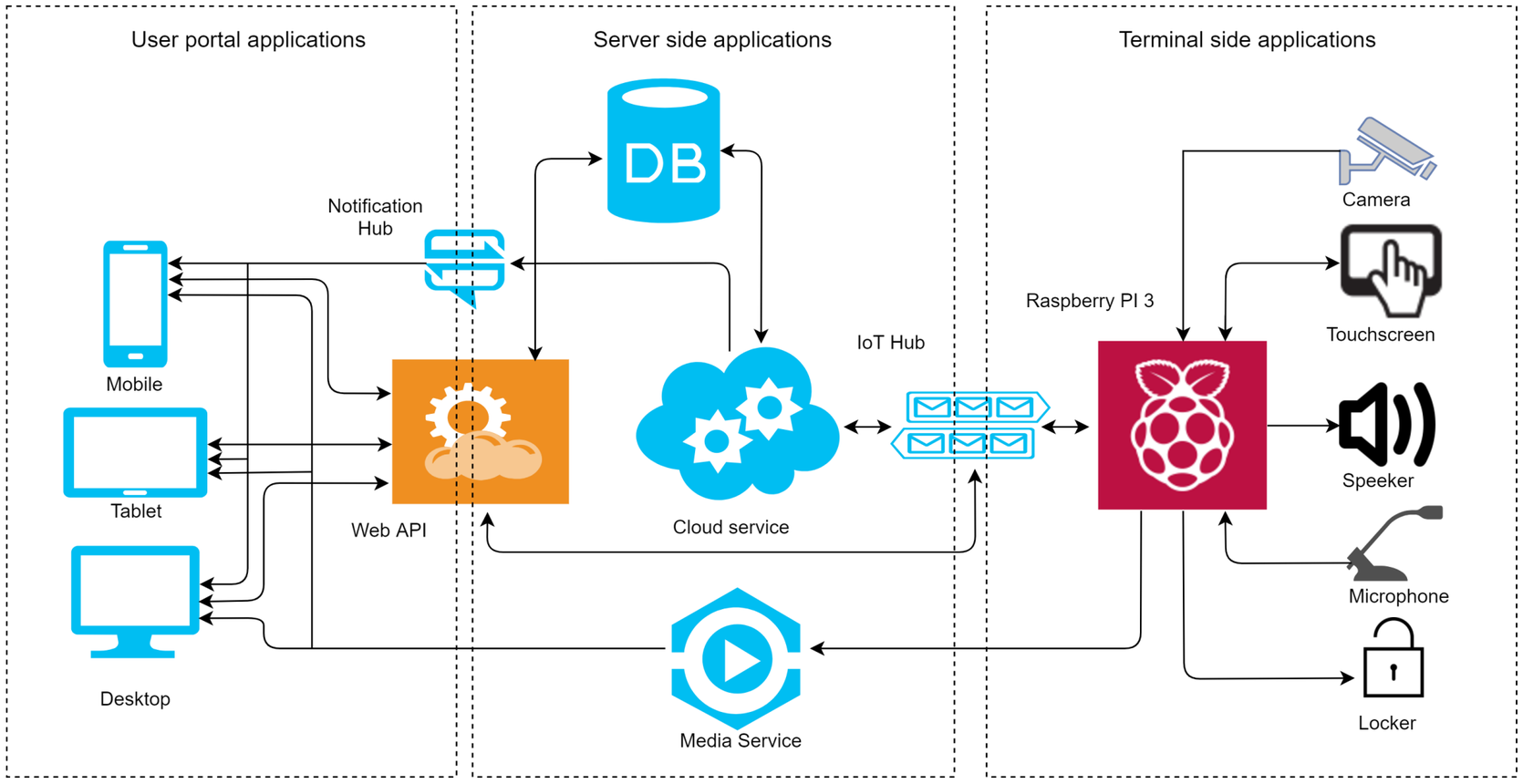
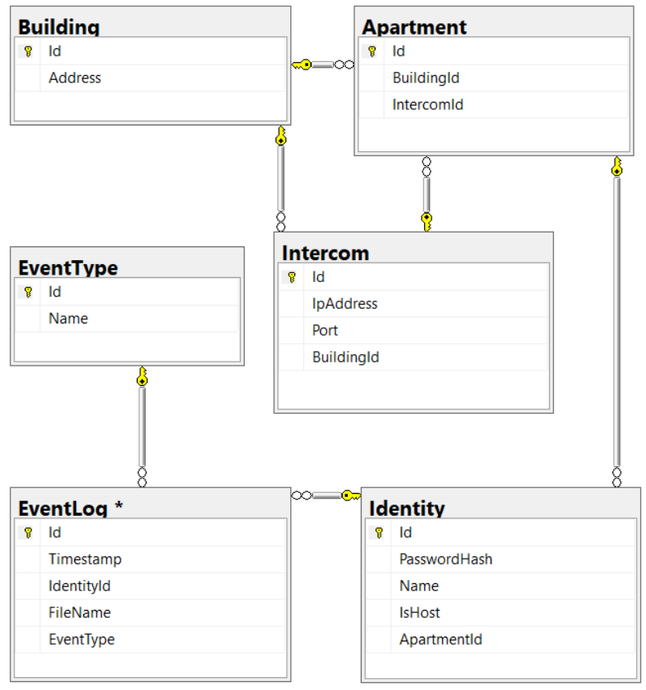
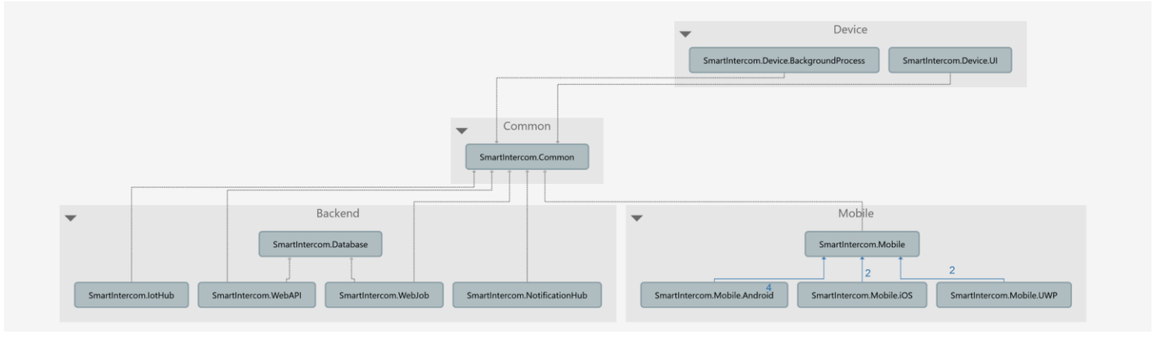
SYSTEM STRUCTURE



Database structure diagram



Solution structure diagram



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Изм.	Лист	№ докум	Підпис	Дата	System structure	Лит.	Масса	Масштаб
Розроб.		Чернобай Ю.Ю.				у		
Перев.		Дергачов К.Ю.				Лист 3	Листів 10	
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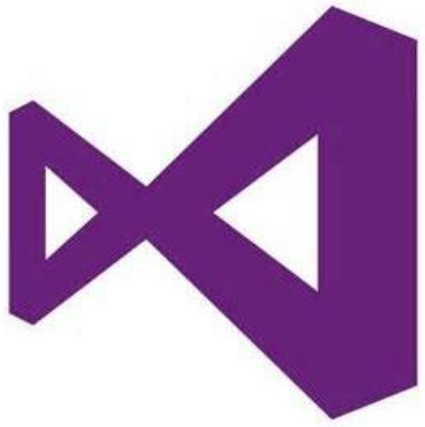
USED TECHNOLOGIES

Requirements to technologies

- IoT development support
- Cloud development support
- Mobile development support
- Test automation support
- Common programming language
- Free for non commercial usage

Technological base

- C# programming language
- .Net Framework 4.6.2
- Microsoft Xamarin
- Microsoft Xamarin.Forms
- Nunit
- Selenium



.Net Framework, C#

- .Net class library
- Entity framework
- LINQ
- Rest Sharp
- MVVM Cross
- Tasks and TPL
- XAML
- Events and delegates

Xamarin

- Xamarin Native
- Xamarin Forms
- Portable Class Libraries
- Universal Windows Platform
- Mobile emulators
- Remote debugging
- Native performance
- Native user experiences
- Full hardware support
- Free for commercial usage

Development environment

- Microsoft Windows 10 operation system
- Microsoft .Net Framework 4.6
- Microsoft Visual Studio 2017
- JetBrains ReSharper 10
- Xamarin studio
- Windows 10 SDK
- Android SDK
- Mobile development SDK
- Mobile Emulator
- Git for Windows

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Розроб.		Чернобай Ю.Ю.				У		
Перев.		Дергачов К.Ю.				Лист 4	Листів 10	
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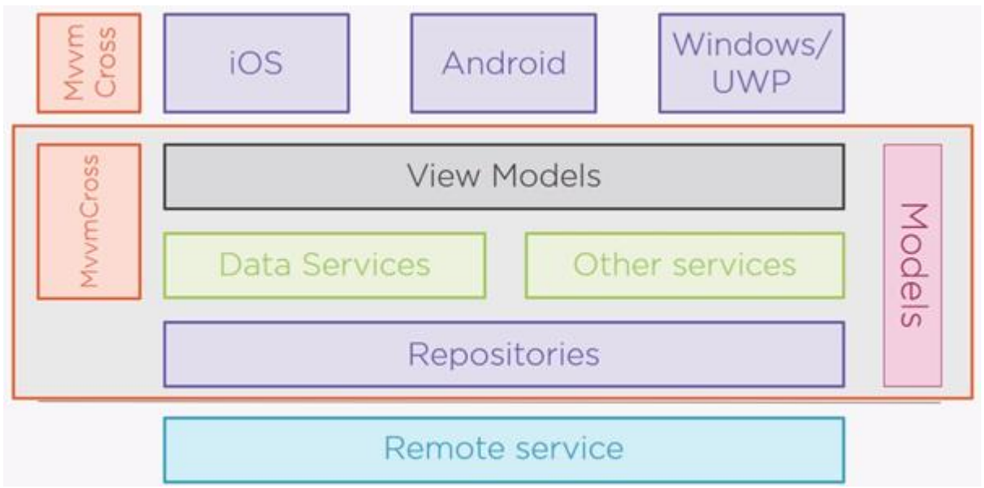
MEANS OF IMPLEMENTATION

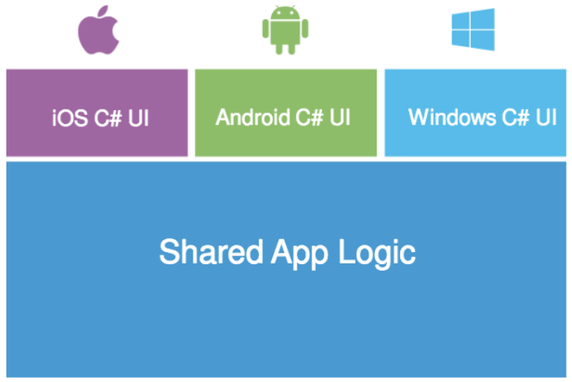
Development frameworks overview

Criteria	Framework			
	Xamarin	PhoneGap	Qt	Unity
Cross platform development	+	+	+	+
Shared code base	+	+	+	+
Shared UI markup	+	-	-	-
Free for noncommercial usage	+	+	+	+
Programming language	C#	JavaScript	C++	C#, JavaScript
Automated testing support	+	+	-	-
Native UX inheritance	+	-	-	-

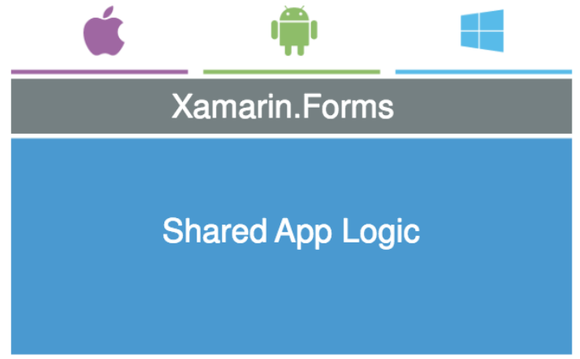
Structure of Xamarin application



XAMARIN NATIVE



XAMARIN FORMS



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Розроб.		Чернобай Ю.Ю.				Лист 5 / Листів 10
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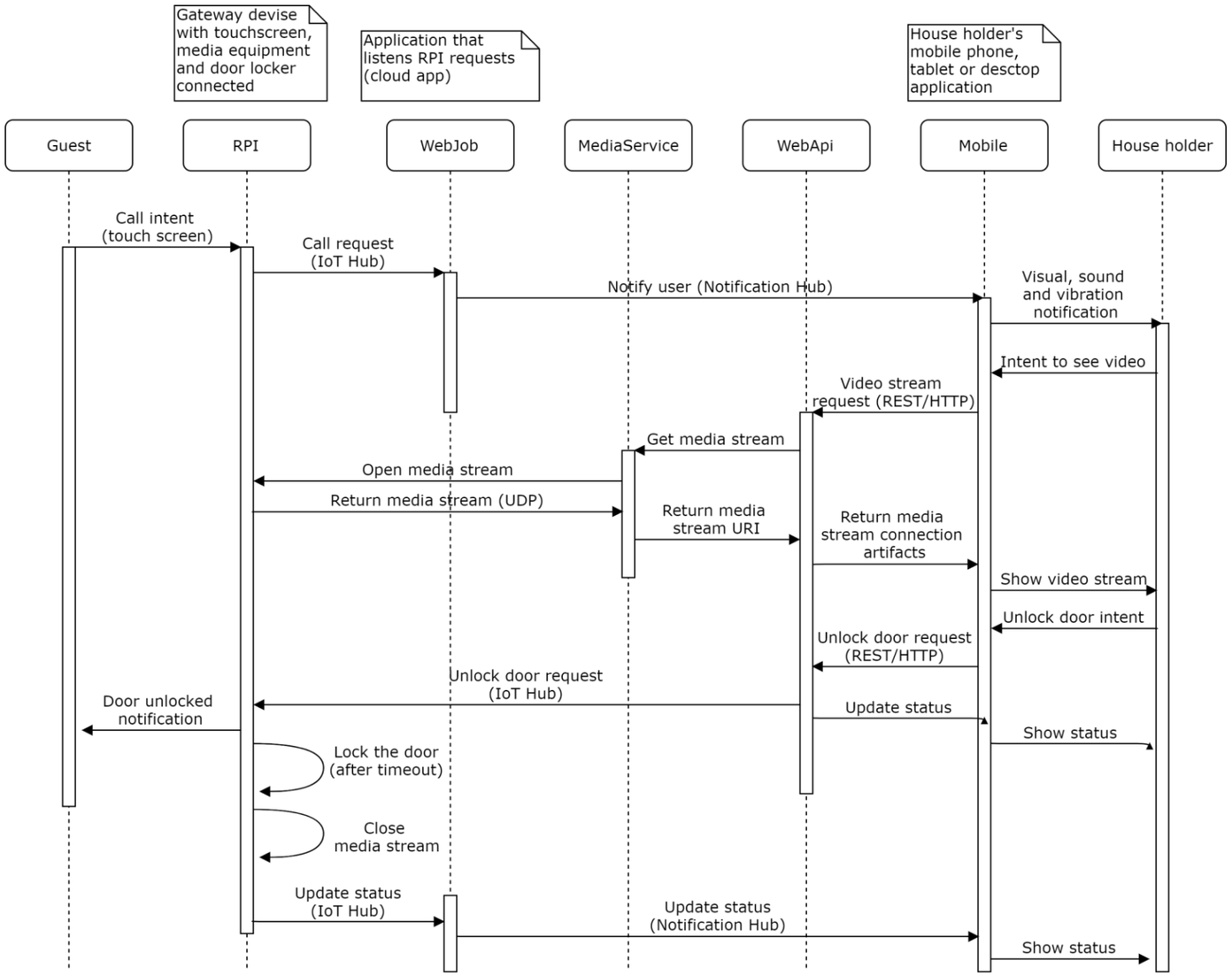
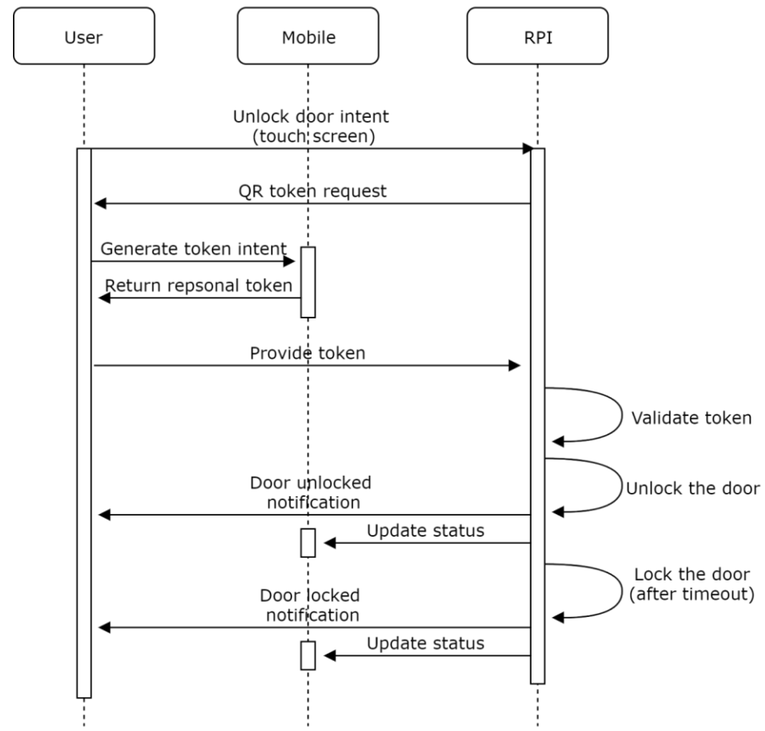
ALGORITHMS AND DIAGRAMS

The sequence diagram of the system “Smart intercom” main workflow



The sequence diagram of the system token authorization workflow



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Изм.	Лист	№ докум	Підпис	Дата	Algorithms and diagrams	Лит. / Масса / Масштаб: У
Розроб.		Чернобай Ю.Ю.				Лист 6 / Листів 10
Перев.		Дергачов К.Ю.				
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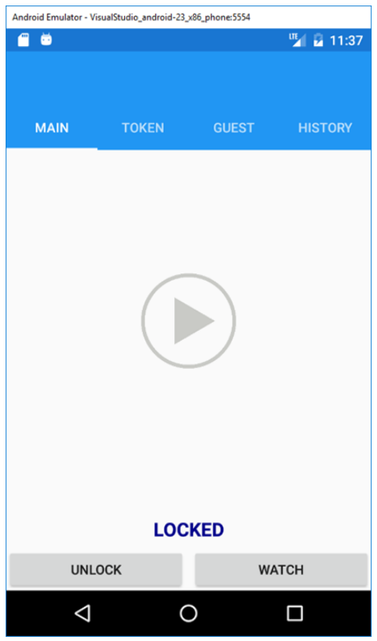
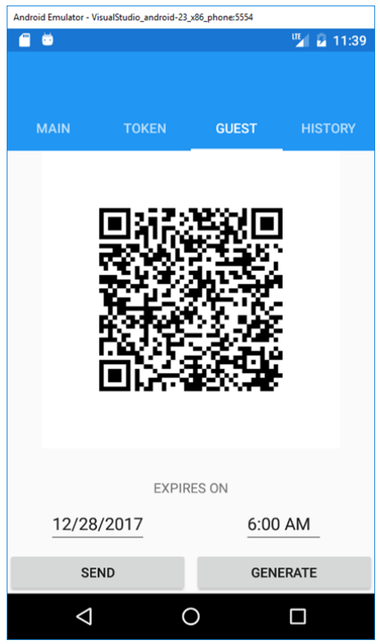
SIMULATION RESULTS

Main page

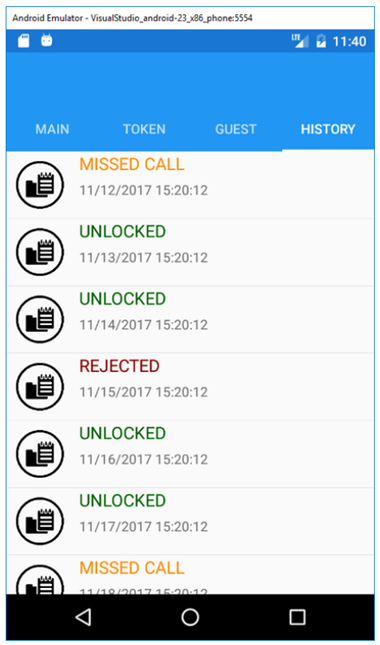


Token page

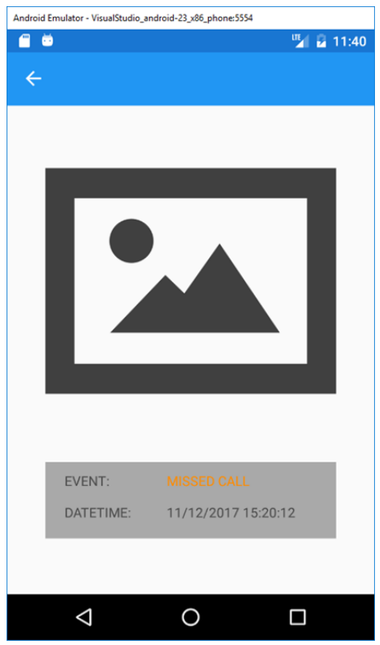
Guest page



History page



History item details page



Simulation purposes

- Allows to speed up development
- Allows to debug during development
- Simplifies UI design
- Reduces costs spent for environment rent
- Allows to automate testing
- Simplifies UI testing
- Reduces amount of deployment errors
- Increases development convenience

Simulation instruments

- Software development kit
- Environment emulator
- Debugging engine
- Test automation engine

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TESTING RESULTS

Tests groups

By the test object:

1) functional testing;
2) performance / load / stress testing;
3) usability testing;
4) user interface testing (UI testing);
5) security testing;
6) localization testing;
7) compatibility testing.

By degree of isolation:

1) unit testing;
2) integration testing;
3) system testing.

By the level of readiness

1) alpha testing;
2) beta testing;
3) acceptance testing.

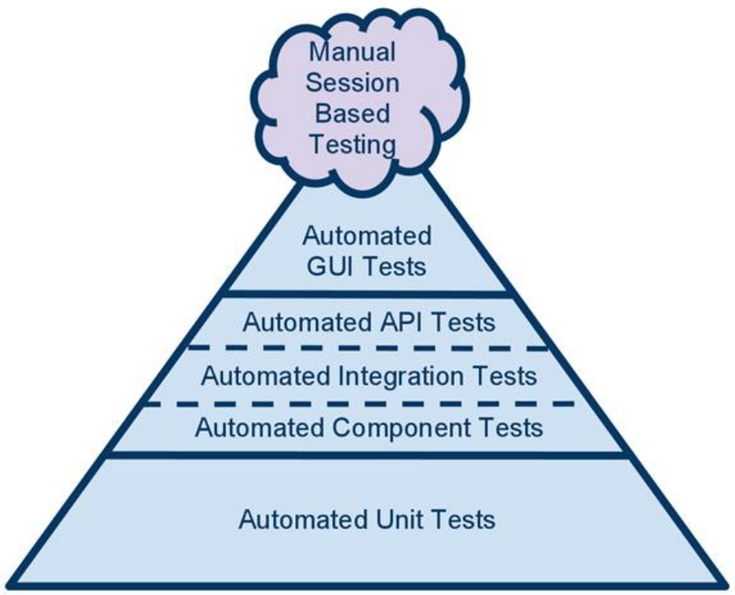
By the level of automation:

1) manual testing;
2) automated testing.

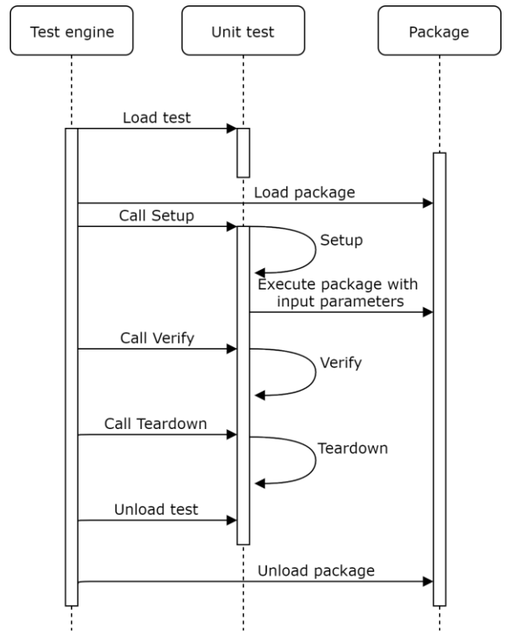
By knowledge about the system under test:

1) black box testing;
2) white box testing;
3) testing by the "gray box" method.

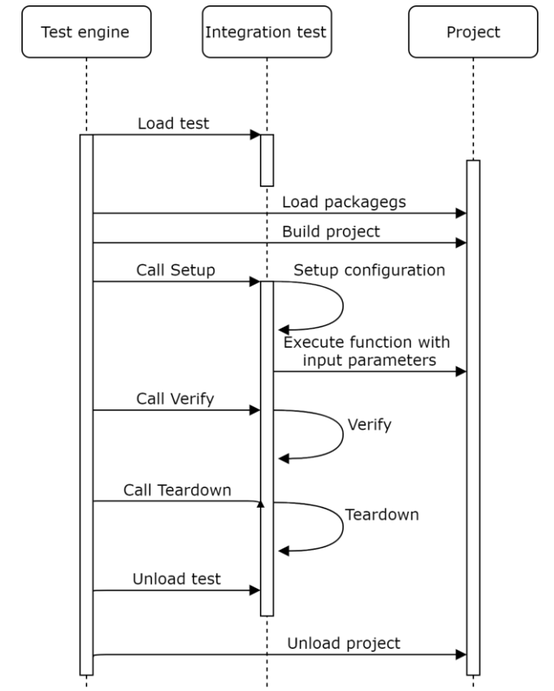
Software testing automation pyramid



Unit testing sequence diagram



Integration testing sequence diagram



The application test suite consists of **67 unit tests**, **14 integration tests**, **27 user interface test** and suite for acceptance testing. By the moment of writing this paper all tests were executed successfully. It means that the system on each level works successfully.

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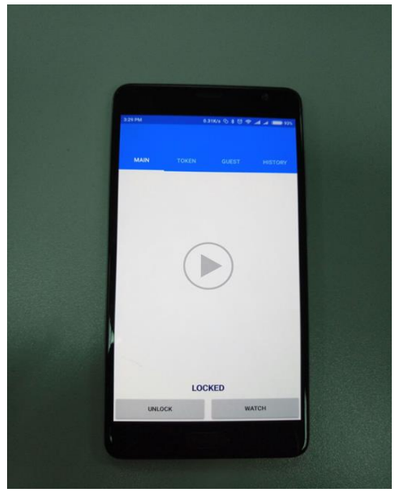
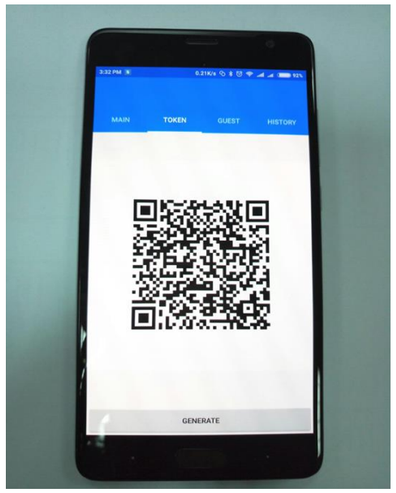
Н. Контр.		Дергачов К.Ю.				ХАІ гр. 362М		

EXPERIMENTAL RESULTS

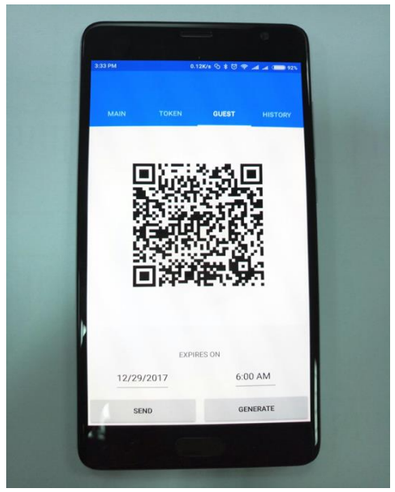
Main page



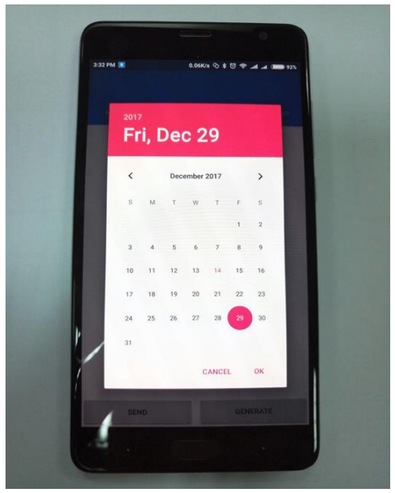
Token page



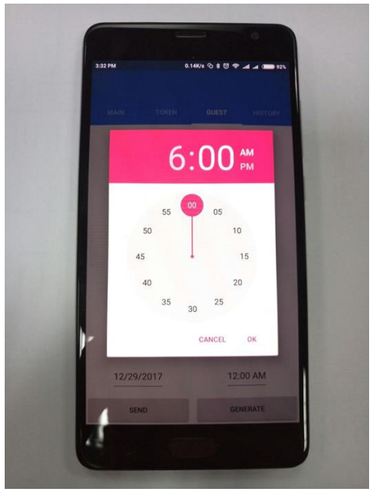
Guest page



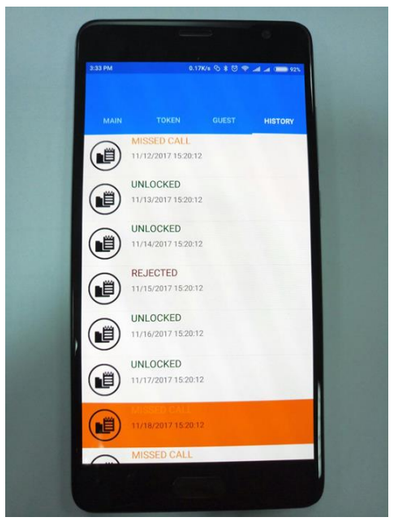
Date picker on the Guest page



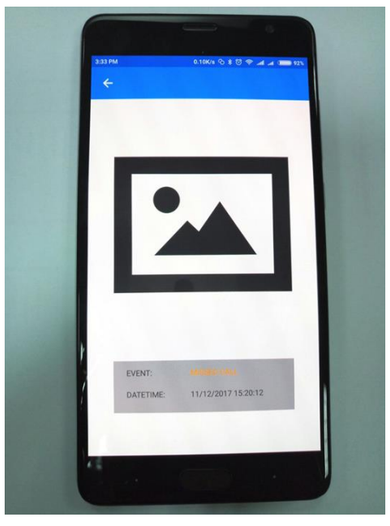
Time picker on the Guest page



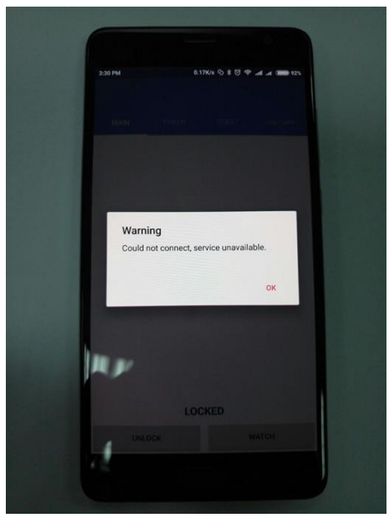
History page



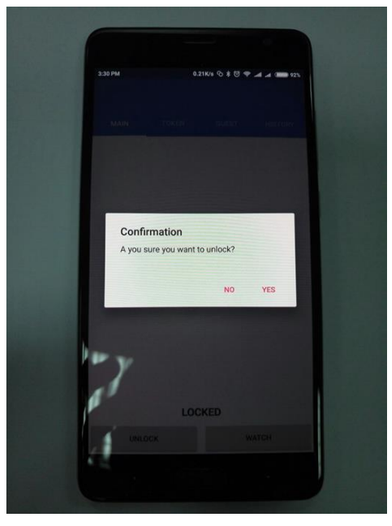
History item details page



Warning modal



Confirmation modal



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Изм.	Лист	№ докум	Підпис	Дата	Experimental part	Лит. у / Масса / Масштаб
Розроб.		Чернобай Ю.Ю.				Лист 9 / Листів 10
Перев.		Дергачов К.Ю.				
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ECONOMICAL JUSTIFICATION FOR THE SYSTEM DEVELOPMENT

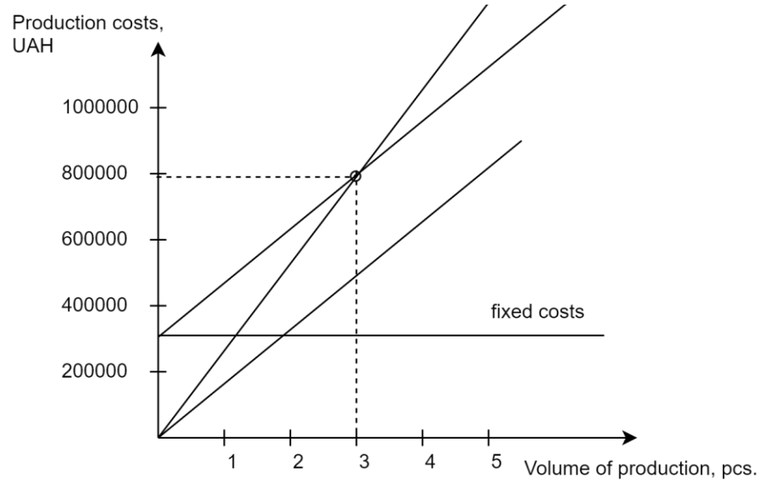
Calculation of production costs and product prices by item

№	Topics	Amount, UAH	Description
1	Materials and bought products	2440	From table 6.3
2	Wage	133991.81	
3	Additional wage	20098.77	15% from wage
4	Deductions to social funds	33899.93	22% from wage and additional wage
5	Amortization	139.65	$\frac{25\% \cdot p \cdot 54}{12 \cdot 22}$
6	Shop management costs	13399.18	$P_{УЦ} = WAGE \cdot \frac{H_{SM}}{100}$
7	General plant costs	26798.36	$P_{wage} = WAGE \cdot \frac{H_{wage}}{100}$
8	Cost price (C)	230767.7	p.1+….+p.7
9	Profit (P)	46153,54	20% from C
10	Price without VAT	276921,24	P+C
11	VAT	55384.25	20% from price without VAT
12	Price with VAT	332305.5	p.10+p.11

Fixed assets

№	Equipment	Price, UAH	Quantity	Amount, UAH
1	Table	600	4	2400
2	Chair	120	4	480
3	Personal computer	27000	4	108000
4	Software	5000	3	15000
	Total			147480

Break-even point figure



Composition of work

Positions	Official salaries, UAH	
	Month	Day
Lead software engineer	40000	1818.18
Software engineer	25000	1136.36
Software testing engineer	15000	618.82
Systems engineer	20000	909.09

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Изм.	Лист	№ докум	Підпис	Дата	Economical justification for the system development	Лит. У / Масса / Масштаб
Розроб.		Чернобай Ю.Ю.				Лист 10 / Листів 10
Перев.		Дергачов К.Ю.				
Н. Контр.		Дергачов К.Ю.				ХАІ гр. 362М