

# Configuration Manual

MSc Research Project Cloud Computing

Swapnil S Vernekar Student ID: 21174041

School of Computing National College of Ireland

Supervisor: Yasantha Samarawickrama

#### National College of Ireland Project Submission Sheet School of Computing



Student Name:	Swapnil S Vernekar
Student ID:	21174041
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## Configuration Manual

Swapnil S Vernekar 21174041

### 1 Android application development environment

For this research project, an android application is in use which is installed on the android mobile device. For the purpose of its development, android studio code is been used. Its and IDE which is developed by the google which enables developers to develop robust applications.

For this research project Android Studio Flamingo - 2022.2.1 Patch 2 is used which is improved by jetbrains industries.



Figure 1: Android studio code

There are two most important dependencies that must be imported for this application to work which is the google's vision library and the firebase plugin. Google vision library is used for integration with cameras as this application has image processing functionality embedded in it and the firebase plugin is used in order to connect the application to the firebase console for data store and monitoring purposes. All of these dependencies must be added into the build.gradle file. Once these dependencies are added, the application will be connected to the firebase console and also able to use the camera.



Figure 2: Dependencies on build.gradle file

After the dependencies are imported the respective class files in java can be created with their individual logic. After setting up all the class files, the structure of the application looks as follows.



Figure 3: Structure of the project

There is a power equation used in this application logic which has a set of weights which give priority to the network parameters. The weights are W1, W2, W3 and the W4. These weights can be adjusted based on the priority to be given. This equation is very critical as it is used intensively by the decision making engine for offloading tasks. For this research the weights are given as follows:-

Performance Parameter weight	Value
Bandwidth W1	0.3
Latency W2	1
Signal Strength W3	0.2
Battery Level W4	0.1

However, these weights can be changes as per the use case.



Figure 4: Performance Equation with weights

After setting up the power equation with its respective weights, the application is now ready to be tested on the device. For this research, virtual device emulator is used and the application is installed on it and is tested. The android emulator device Nexus 5 API 29 is used which has android version 10 installed on it. For setting up a new emulator go to run and select the select device tab.



Figure 5: Emulator setup 1

Then click on device manager tab then select create device. There will be a set of virtual devices displayed, select on one of those and choose on select operating system and click on create. The operating system will be then downloaded and emulator will start.

Virtual Device Configuration ×									×	
Choose a devi	ice definition									
						_ _	Pivel 2			
Category										
						ר	7			
							/	Ratio: long Density: 420dpi		
							5.0 1920px			

Figure 6: Select device

Virtual Device Configura     System	n Image		×
Recommended x86 I			
			29
			Android
			10.0
			Google Inc.
			x86
Die 🕹			We recommend these Google Play images because this device is compatible with Google Play.

Figure 7: Select Operating System

After the emulator is started, the application can then be built and the system will start installing the apk on the installed virtual machine device in the android studio code.

### 2 Firebase Console

The application is connected with the firebase console which provides an insights to all the application level metrics such as the performance, start time, CPU utilization. Using this console, lot of application level information can gathered and can be used to improve the logic even further.

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🛧 Project Overview 🔹	Performance 🛎 swapnil -		
Project shortcuts			
🛜 Firestore Database	Percentile  Percentile  Filter		Last 7 days Aug 2 - Aug 8
Performance			
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Test Lab	App start time (1.55s) is 72% faster compared to 1 day prior		
Analytics Dashboard     Dealtime Analytics		70% 155	
Conversions		-72% 1.555	+
S Events	5.006		
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roduct categories	3.005		
	2.005	1	<b>_</b>
uild	1.005	Т	Т
telease & Monitor 🛛 🗸 🗸		Select a metric	Select a metric
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Engage 🗸 🗸	All versions     I.0 (1)      Select version		
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customize your nav!			
rou can now rocus your console experience by customizing your	Network requests Custom traces Screen rendering	Last	refreshed: less than a minute ago
Spark Upgrade			
o-cost \$0/month	Q Search all domains and URLs	All network requests 👻	Create custom URL pattern
<	Natural report topos	Td shares	Antiona

Figure 8: Firebase Console

To get access to this console requires signin to this service which can be done using the personal email id. Once an account is created, the console will popup showing all the insights of the application.

#### 3 Cloud Environment Setup

For the purpose of development of the cloud environment for this research work, microservice architecture is been used where in AWS'S lambda function plays an important role for the execution of the computational task. The lambda function is been created by selecting the environment as NodeJs as the node js application will be deployed on it.

Fund	tions (6)				La	st fetched 2 minutes ago	C	Actions 🔻 Create f	unction	
Q 1	Filter by tags and attributes or search by keyword							< 1	>	0
	Function name	▽	Description	$\nabla$	Package type ⊽	Runtime	⊽	Last modified		
	offloadTask		-		Zip	Node.js 18.x		last month		
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	dsbaOffloading		-		Zip	Node.js 18.x		2 days ago		
	historicalRecords		-		Zip	Node.js 18.x		last month		
	Resource-Auto-Tagger-AWS		-		Zip	Python 3.8		last year		

Figure 9: Lambda Function

As the node.js code to be uploaded is more than 20 mb, an s3 bucket is to be used where all the node.js file is uploaded and then lambda function is pointed to this bucket to fetch the code and finally deploy it. In order to trigger this lambda function, an API gateway needs to be setup which will provide with an api end point which can be used to invoke this lambda function remotely using the application and to start the computation. For creating the api gateway, search for the api gateway on the search area of AWS and then click on create API. Select the rest API as it supports Lambda, HTTP, AWS Services.

aws III Services Q Search	[Alt+5] 🕑 🖉 Ireland 🔻 MSCCLOUD/x21174041@student.ndr/Lie 🔻
API Gateway $ imes$	НТТР АРІ
APIs Custom domain names VPC links	Build low-latency and cost-effective REST APIs with built-in features such as OIDC and OAuth2, and native CORS support. Works with the following: Lambda, HTTP backends Import Build
	WebSocket API Build a WebSocket API using persistent connections for real-time use cases such as chat applications or dashboards. Works with the following: Lambda, HTTP, AWS Services Build
	REST API         Develop a REST API where you gain complete control over the request and response along with API management capabilities.         Works with the following:         Lambda, HTTP, AWS Services         Import         Build

Figure 10: API Gateway

Give an appropriate name to the api created and then select the lambda function to be invoked. Then click on create function.

Amazon API Gateway	APIs > Create	Show hints	0					
APIs	Choose the protocol							
Custom Domain Names	Select whether you would like to create a REST API or a WebSocket API.							
VPC Links	● REST ○ WebSocket							
	Create new API							
	In Amazon API Gateway, a REST API refers to a collection of resources and methods that can be invoked through HTTPS endpoints.							
	New API      Clone from existing API      Import from Swagger or Open API 3      Example API							
	Settings							
	Choose a friendly name and description for your API.							
	API name* My API							
	Description							
	Endpoint Type Regional V 0							
	* Required		Create API					

Figure 11: API Gateway creation

Once the api gateway is setup, click on actions and create a resource. Give the appropriate name for it as it will be the endpoint of the api. Then create the resource.

👫 Amazon API Gateway	APIs > Thesi	isOffloadingApi (jzn5t6spof) > R	esources > / (v8inifyh75)	Show hints	0
APIs	Resources	Actions - / Methods			
Custom Domain Names VPC Links	<ul> <li>✓ /</li> <li>/imager</li> <li>POST</li> </ul>	RESOURCE ACTIONS Create Method Create Resource Enable CORS Edit Resource Documentation	No methods defined for the resource.		
API: ThesisOffloadi		APIACTIONS			
Resources		Deploy API Import API			
Stages		Edit API Documentation			
Authorizers		Delete API			
Gateway Responses					
Models					
Resource Policy					
Documentation					
Dashboard					
Settings					
Usage Plans					
API Keys					

Figure 12: API Gateway creation

After the resource is created, click on create method and select POST method as the application will be sending the image to the lambda function. Select integration type as the lambda function and then finally select the lambda function to be invoked and then save. Then deploy the api by selecting deploy tab. Give the appropriate deployment name and click on deploy.

Deploy API	×
Choose a stage where your API will be depl API could be deployed to a stage named be	oyed. For example, a test version of your ta.
Deployment stage Deployment description	✓
	Cancel Deploy

Figure 13: Deploy API

The api gateway will be completely configured and the flow of the api call will be as follows.



Figure 14: API Gateway connection to lambda function

Once the API gateway is connected to the lambda function, the lmbda console will show the connectivity to the API which is created and is linked to.

ambda > Functions > offloadTask DffloadTask		Throttle 🗗 Copy ARN Actions 🔻
▼ Function overview Info		
API Gateway     (3)     (3)	+ Add destination	Description - Last modified last month Function ARN Parnaws:lambda:eu-west-1:250738637992:function:offloadTa sk Function URL Info -
Code Test Monitor Configuration Aliases Versions		
Code source Info		Upload from 🔻

Figure 15: Lambda console

As node js is used for cloud environment development of the image rendering algorithm, all the node modules needs to be installed for it to work properly. But before that, the system must be installed with node.js post which further steps can be followed.

To check the version of node installed use command  $\mathbf{node}$  -v



Figure 16: Node version

After the above step, install aws-sdk and jimp library using **npm install aws-sdk** and **npm install jimp** command. After installing these packages, there will be a node modules folder created with all the dependencies and the file structure will be similar to the image below.



Figure 17: Project Structure

Now this project can be zipped and be uploaded on S3 bucket.

To create the S3 bucket for storing the deployment file for the image processing algorithm, search for S3 bucket in search bar in AWS .

Servi	ices Q Search	[Alt+S]	Σ	Global ▼ MSCCLOUD/x21174041@stud		
mazon	\$3					
▼ A	ccount snapshot pdated: Aug 9, 2023 by Storage Lens. Metrics are general	ted every 24 hours. Learn more 🔀		View Storage Lens dashboard		
Total storage Object		Dbject count	Average object size	You can enable advanced metrics in the		
69.4 0	GB 2	2 M	36.1 KB	"default-account-dashboard" configuration.		
Bucket	kets (49) Info ts are containers for data stored in S3. Learn more		C Copy cont	tent Empty Delete Create bucket		
Bucket	kets (49) Info Is are containers for data stored in 53. Learn more 🖸 Find buckets by name	AWS Region	C Copy cont	tent         Empty         Delete         Create bucket           < 1 >         Image: Creation date         Image: Creation date         Image: Creation date		
Bucket	kets (49) Info ts are containers for data stored in 53. Learn more Find buckets by name Name 21123777-Input-bucket	AWS Region     EU (reland) eu-west-1	Copy cont     Access Bucket and objects not public	tent Empty Delete Create bucket < 1 > ⊘ ▼ Creation date ▼ July 21, 2023, 20:40:29 (UTC-01:00)		
Bucket	kets (49) Info Is are containers for data stored in 53. Learn more Find buckets by name Name 21123777-input-bucket 21123777-output-bucket	AWS Region     EU (reland) eu-west-1     EU (reland) eu-west-1	Copy cont     Access     Bucket and objects not public     Bucket and objects not public	tent Empty Delete Create bucket		
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Figure 18: S3 bucket creation

Click on create bucket button and give appropriate name to the bucket. Leave all other settings as it is. After the bucket is created, the zip file can now be uploaded on this bucket for lambda to fetch and deploy it.

Serv	vices Q Search		[Alt+S]	D ¢	🕜 🛛 Global 🔻	MSCCLOUD/x2117404	1@student.ncirLie •
Amazon	1 S3 > Buckets > x2117	4041-thesis-lambda					(
x21	174041-thesis	s-lambda 📷					
Obje	Objects Properties Permissions Metrics Management Access Points						
<b>Obj</b> Objec	Objects (1) Objects are the fundamental entities stored in Amaton 53. You can use Amaton 53 Inventory (2) to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more (2)						
C	Copy S3 URI	🗗 Copy URL 🔛 Download	Open 🖸 Delete Actions 🔻	Create folder 🛃 Upl	oad		
Q	Find objects by prefix					< 1 >	۲
	Name	▲ Туре		⊽ Size	▼ .	Storage class	▽
	imageEdit.zip	zip	July 12, 2023, 13:42:42 (UTC+01:00)		34.7 MB	Standard	

Figure 19: S3 bucket creation

Once the zip file is uploaded, go to lambda and select the lambda function which was created. Scroll down and select upload from, and click on amazon S3 location. Give the S3 link and click on save. The code will then be imported on the lambda function.

aws	Services Q Search	[Alt+S]	► 수 ⑦ Ireland ▼	MSCCLOUD/x21174041@student.ncirl.ie ▼			
Ξ			sk Function URL Info -	Q			
	Code Test Monitor Configuration Aliases	Versions					
	Code source Info			Upload from			
	The deployment package of your Lambda function "offloadTask" is too large to enable inline code editing. However, you can still invoke your function.						
	Code properties Info						
	Package size 34.7 MB	SHA256 hash  SHA25	Last modified July 12, 2023 at 01:43 PM GMT+1				
	Runtime settings Info						
	Runtime Nodole 19 v	Handler Info	Architecture Info				

Figure 20: Upload Zip



Figure 21: Giving S3 link

After the code is deployed, the system is configured and the task can now be completely offloaded on the cloud.

### References

[1] android, "android-studio-flamingo-patch-2," in *Android*. [Online]. Available: https://androidstudio.googleblog.com/2023/05/android-studio-flamingo-patch-2-now. html?hl=cs