1. **The Wearable IoT Device**

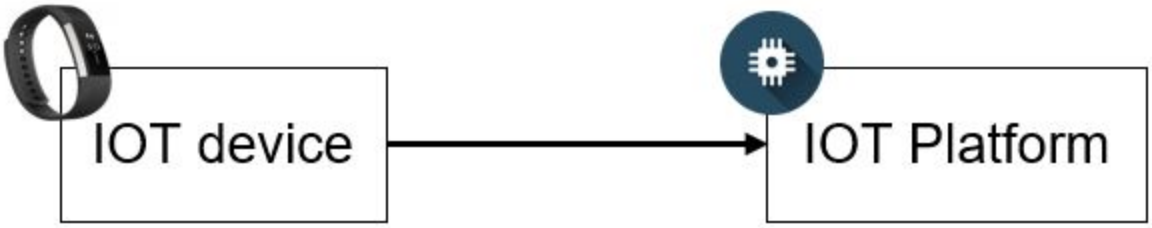

Figure 1. Wearable registered as IoT Device

Our IoT device will come in the form of a cellular-connected wear device, giving them the capability to connect to the cloud (Eg. IBM Internet of Things Platform) without pairing with a smartphone. This feature will prove to be advantageous with the low Senior citizens' tech adoption rate. Additionally, the device's unique ID will be registered with the user's details.

The smart watch's embedded sensors will include a heart rate sensor and inertial measurement unit (IMU). By analyzing the IMU's data, the user's gait/movement could be monitored, actively looking out for abrupt and sudden movements known in most falls. Coupled with the data from the heart rate sensor, situations of cardiac arrest can be detected similarly.

When the wearable device detects an accident such as a fall or cardiac arrest, its data will be uploaded into the cloud database.

2. **Data storage**

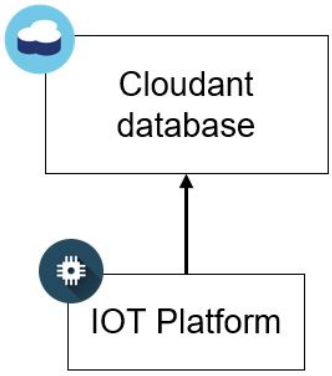

Figure 2. Data from IoT platform uploaded to Cloudant database

Sending data into the cloud database (Eg. IBM Cloudant) only during predicted emergency situations helps our solution to have lower latency and also ensures SCDF command is only looking at potential emergency cases, which will be further elaborated later.

Your Databases

Name	Size	# of Docs	Partitioned	Actions
users	10.5 KB	10	No	
wearables_data	27.0 KB	37	No	

Figure 3. Two types of database storing users particulars and wearables' data

	_id	_rev	address	responder_person	Mobile	latitude	longitude	name	age	lock_id	password	device_id
	0fa6a9d1452...	1-5b58bdeaf...	9 Battery Roa...	Hemes Yeo	86854916	1.2018	103.44272	Brian Ong	50	dfv7976	51524	123461
	0fa6a9d1452...	1-81a6a8087...	10 Haig Road ...	Praveen Yiker...	91321899	1.22264	103.57015	Eng Beng Leo...	55	wece159	61981	123465
	3c39f7f34de...	1-68d295e98...	Blk 246 Houg...	Long James	83161981	1.22501	103.5016	Ong Soon Meng	61	dfv9816	81914	123460
	3f9c455abc5...	1-ce86be224...	108 Hougang ...	Brandon Koo	99479847	1.20282	103.44218	Shawn Lin Pe...	49	da2f1f6	19199	123462
	67c6c171001...	1-9c8f5fd98c...	101 Kitchene...	Yip Siew Mai	98198191	1.22018	103.52116	Jack Leo	81	fdv1f88	98191	123459
	67c6c171001...	1-4cda9d986...	Bedok North ...	Janice Ow	91784984	1.21451	103.53051	Tan Song Ming	45	6198ghj	49841	123456
	71834ab7a1e...	1-0049b72c0...	Blk 110,10-2...	Jasesh Meen	87471711	1.22088	103.56574	Janice Siow	42	edcx188	19178	123464
	ed2e532219...	1-16f9f73a2c...	419 River Vall...	Meng Leng Tan	81651561	1.21373	103.52579	Bryan Lim	84	dvfd6fv	11998	123458
	f6c9e69858c...	1-694e9a1a2...	18 Boon Lay ...	Maven Yik	98494917	1.25421	103.50104	Merlin Lim	90	sr1v188	32191	123463
	f7f591d58c0...	1-e0f7123df...	Richfield Tec...	Shawn Yeo	89189191	1.21369	103.53134	Ming Leng	65	hjdfv11	19918	123457

Figure 4. Users database showing particulars of users

	_id	_rev	type_of_accident	heart_rate	device_id	timestamp	movement	vertical_position
	0699f4df46e6748114...	1-56aab2f7908efbd9f...	cardiac arrest	180	123456	2020-06-14T11:59:22...	8.858958	
	212d64ecb4e57bce7...	1-56ad30bd3950b999...	cardiac arrest	162	123456	2020-06-14T11:25:16...		2.6043837
	212d64ecb4e57bce7...	1-da1ad4de76d02fe3...	cardiac arrest	131	123456	2020-06-14T11:25:21...		
	212d64ecb4e57bce7...	1-ed0906de101ae1b8...	cardiac arrest	264	123456	2020-06-14T11:59:22...		3.4416075
	212d64ecb4e57bce7...	1-7f148bb51b47e9fa...	cardiac arrest	196	123456	2020-06-14T11:59:23...	9.802695	
	24fe9ae126bcbbe359...	1-0c6af1cb1c9a6196...	cardiac arrest	264	123456	2020-06-14T11:59:24...		-4.2574077
	2f645771b791213b7c...	1-a45771f1cb5fdc388...	cardiac arrest	180	123456	2020-06-14T11:25:17...		2.7301273
	2f645771b791213b7c...	1-91a503d41ffa5daa4...	cardiac arrest	264	123456	2020-06-14T11:25:17...		2.7301273
	2f645771b791213b7c...	1-b620ba52214eff97...	cardiac arrest	131	123456	2020-06-14T11:25:21...	10.483827	
	3341ffb0c78848105f...	1-27618367ad773624...	cardiac arrest	251	123456	2020-06-14T11:59:25...	7.663447	
	3341ffb0c78848105f...	1-c3c2a67c71141478...	cardiac arrest	131	123456	2020-06-14T11:59:27...		3.3995461
	38e60ba144a19c547c...	1-f17c58570f819f96e...	cardiac arrest	196	123456	2020-06-14T11:25:14...		3.2568421
	38e60ba144a19c547c...	1-44636566fe998775...	cardiac arrest	232	123456	2020-06-14T11:25:18...	9.316978	
	56f66c33aa1c96db41...	1-a99d0a3f28610088...	cardiac arrest	180	123456	2020-06-14T11:59:29...		2.4433882
	5caab5a665a0606eda...	1-ff03001a7caad944b...	cardiac arrest	131	123456	2020-06-14T11:25:14...	8.988896	
	5caab5a665a0606eda...	1-81cd7c0568acf0c0...	cardiac arrest	251	123456	2020-06-14T11:25:19...	8.504243	
	5caab5a665a0606eda...	1-5f84b17ffe7fac0b3...	cardiac arrest	264	123456	2020-06-14T11:59:22...	8.858958	

Figure 5. Wearable database to show data from wearables device

Data from the wearable device will be uploaded and stored into the *wearable_data* database, with its unique wearable ID as an identifier to lookup the particulars of the user in another *user* database.

3. **SCDF and CFR alerted and dispatched**

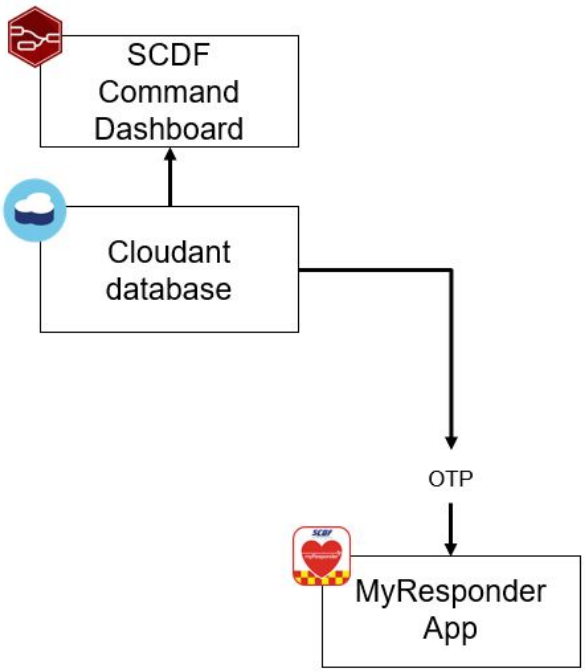

Figure 6. SCDF monitors emergency data. Data triggers notification to myResponder app.

When data representing an emergency situation is received by the cloud database, two parties will be informed simultaneously; SCDF command as well as registrants of the myResponder application. Each of these two workflow is elaborated below:

SCDF command:

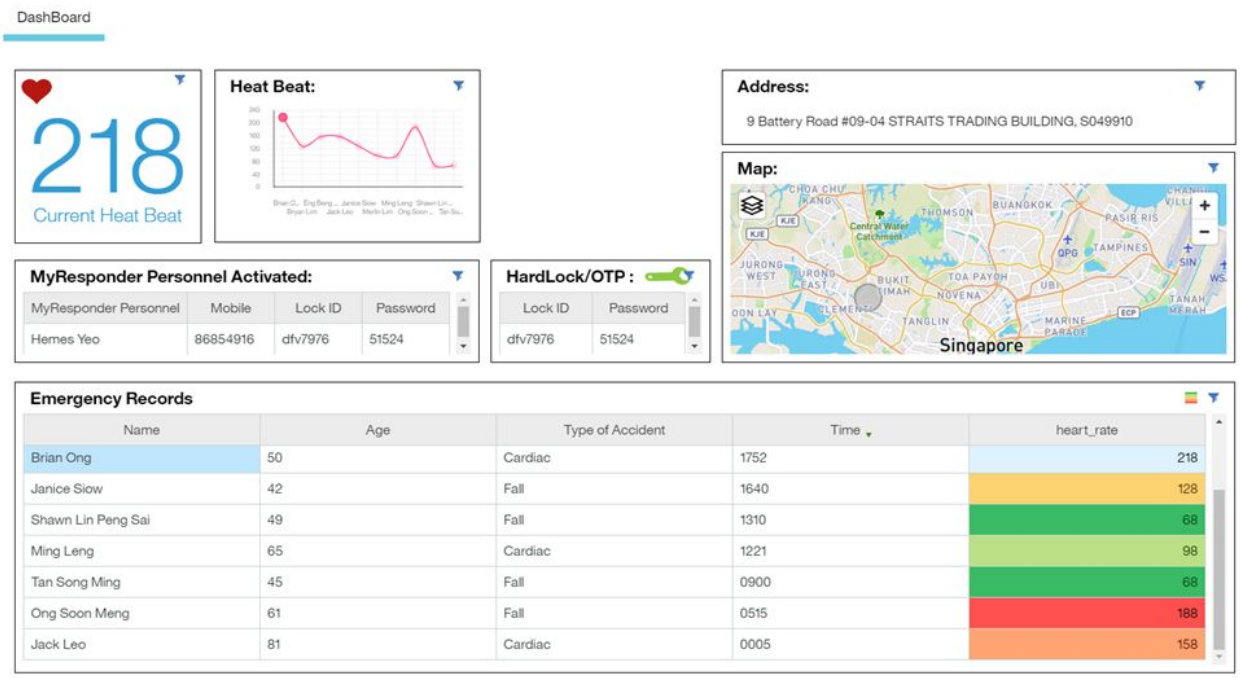

Figure 7. Dashboard viewed from SCDF command

SCDF command will be able to monitor any potential emergency cases through an interactive dashboard (Eg. Node-red dashboard, IBM Watson Studio Dashboard) in real-time.

This allows SCDF to view both data from the wearables, as well as the particulars of the user such as address and age. Most importantly, SCDF command would also be able to see the details of the responders, if any, such as mobile number to facilitate any necessary communication.

SCDF could then deploy resources to the scene when necessary.

myResponder Application:

Figure 8. Interface of myResponder app from notification to accepting case

Our solution aims to build on top of the myResponder App. As such, people on the myResponder App who are in the vicinity of the emergency will be notified. Once a responder chooses to respond to the emergency, he/she will be given an auto-generated one-time-password (OTP) by the cloud database. This allows the responder to access a smart strong box outside the household of the emergency address.

4. <u>CFR accesses the Smart Strong Box using the OTP and attends to the alert sender</u>

Figure 9. Entering OTP into Smart strong box to access keys

Responders are then required to key in the OTP into the strong box to gain access to the encapsulated key, which were placed by the household users themselves as part of implementing our solution.