



# EverySecond

A digital short-term memory for the elderly

By Emily Xie

# An Anecdote

featuring Mr. Bai

## As individuals age...

- Cognitive and physical abilities decline
- Individuals can struggle with daily activities
  - safely navigating the indoors and outdoors
  - taking medication at the right times
  - regularly eating nutritious meals
  - safely interacting with others
- Family members are concerned about their health and safety

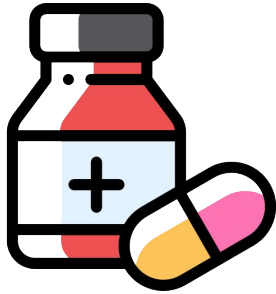


**“What if my elderly relative is in a dangerous situation, and there’s no one to help them?”**

# Meet EverySecond,

a digital-short term memory for the elderly

Helps keep track of an elderly user's:



Medicine consumption



Food intake



Interactions with people

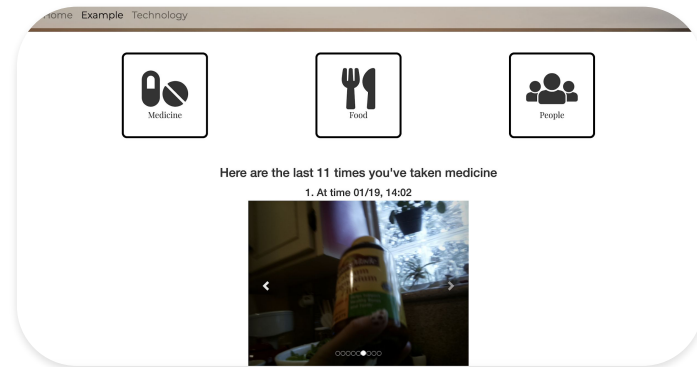
**With EverySecond, caregivers and family members can check up on their elderly relatives quickly and remotely.**



**Wearable Camera  
Device**



**Cloud Processing:**  
Object detection,  
index and query



**Web App:**  
remote checkup  
and quick recall





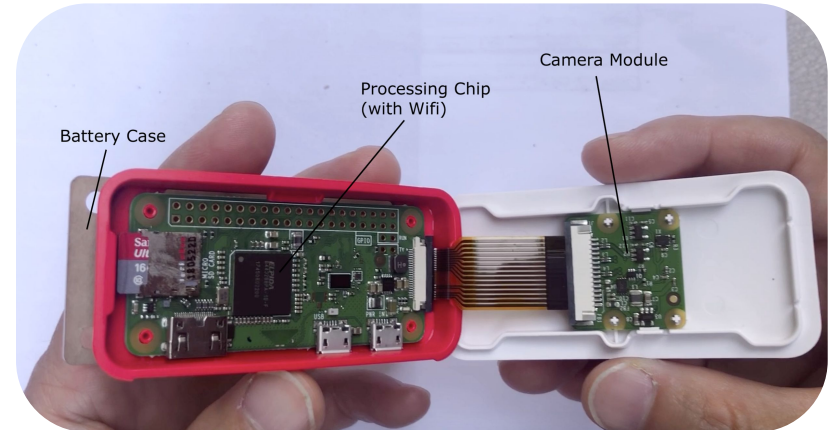
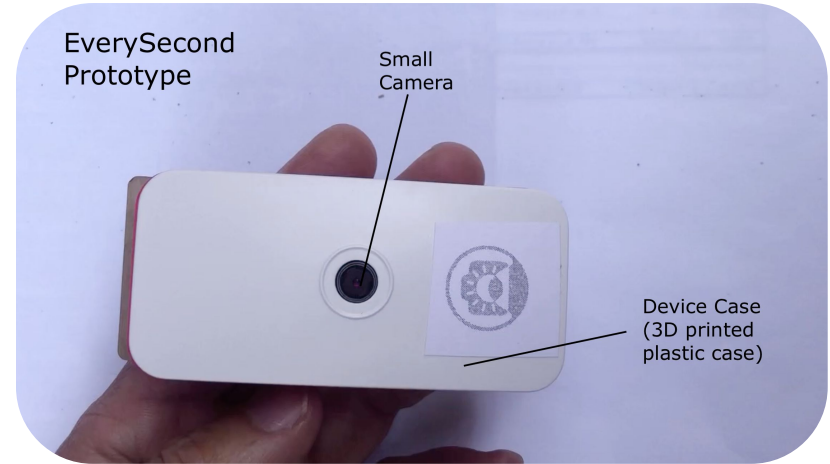
## Security Cameras

- Stationary
- No way to “search” a specific activity
  - Or you could review 10 hours of footage every day...

# Device

## Wearable Device

- Raspberry Pi Zero
- Raspberry Pi Camera
- 3D Printed case
- Rechargeable battery



## Image Capture & Upload



### Image Capture

- Once per second
- :)



### Upload Image

- Google Cloud Bucket
- gsutil function
- gs bucket URL



### Delete Image

- Only after upload
- Reduce device storage

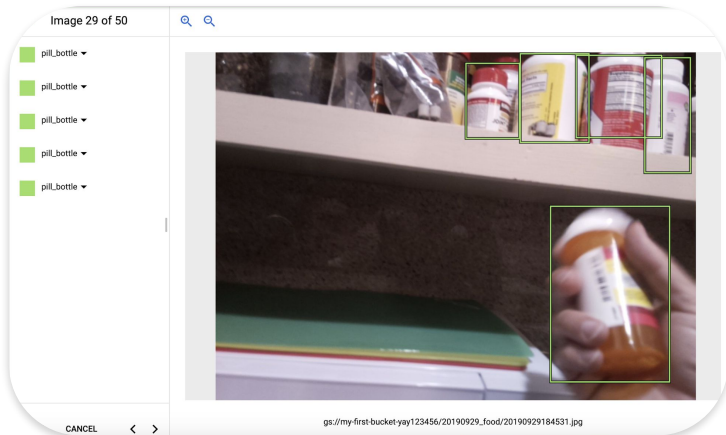
Next step is to recognize the activity in the image, but how?

# Cloud

# Model Training

## Data Acquisition

- Timelapse photos taken on Raspberry Pi
- Hand-labelled bounding boxes (took quite a while!)



## Training

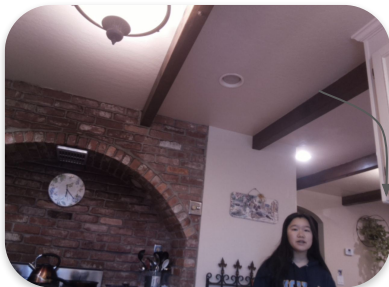
- Google Cloud AutoML
- trained model stored in Cloud

Labels	Bounding boxes		Train	Validation	Test
food	<div><div></div></div>	4483	3977	274	232
person	<div><div></div></div>	1322	1181	74	67
pill_bottle	<div><div></div></div>	797	703	46	48

### All labels

Total images	1,410
Test items	89
Total objects	347
Object to image avg	3.9
Precision ?	82.66%
Recall ?	87.9%

# Upload and Predict



Incoming Photo

Trigger



Cloud Functions



Cloud AutoML Vision

ML Model

Bucket details

OBJECTS CONFIGURATION PERMISSIONS RETENTION LIFECYCLE

Buckets > bucket.everystorage.live > customer001 > rg0001

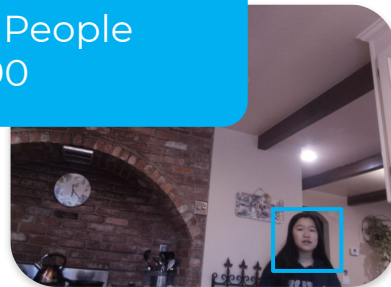
UPLOAD FILES UPLOAD FOLDER CREATE FOLDER MANAGE HOLDS DELETE

Filter by object or folder name prefix

<input type="checkbox"/>	Name	Size	Type	Created time	Storage class	Last modified	Public access	Copy URL	Encryption
<input type="checkbox"/>	20190922192000	212.6 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192000	217.5 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192000	215.9 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192000	221.3 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192000	229.8 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192000	222.9 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192000	230.4 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192011	223.2 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192011	221.5 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192011	235 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192011	218.7 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192011	231.6 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag
<input type="checkbox"/>	20190922192011	222.6 KB	image/jpeg	18 Jan 1970, 2...	Standard	17 Oct 201...	Public to Internet	Copy URL	Google-manag

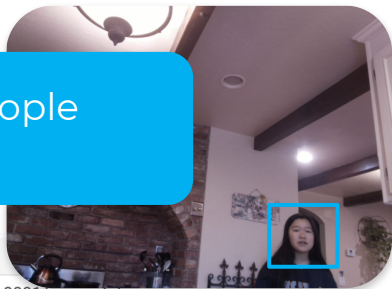
Cloud Storage Bucket

Object: People  
Score: 90



# Datastore

Object: People  
Score: 90



<input type="checkbox"/>	Name/ID ↑	box	deviceID	food	gcsPath	
<input type="checkbox"/>	id=4653491083542528		rpi0001	false	gs://bucket.everysecond.live/customer0001/...	false
<input type="checkbox"/>	id=4653844680146944		rpi0001	false	gs://bucket.everysecond.live/customer0001/...	false
<input type="checkbox"/>	id=4654660791042048		rpi0001	false	gs://bucket.everysecond.live/customer0001/...	false
<input type="checkbox"/>	id=4654724880007168		rpi0001	false	gs://bucket.everysecond.live/customer0001/...	false
<input type="checkbox"/>	id=4654868920795136	normalized_vertices { x: 0.12663100659847...	rpi0001	true	gs://bucket.everysecond.live/customer0001/...	false
<input type="checkbox"/>	id=4655192763006976		rpi0001	false	gs://bucket.everysecond.live/customer0001/...	false
<input type="checkbox"/>	id=4655937772060672	normalized_vertices { x: 0.02395910024642...	rpi0001	true	gs://bucket.everysecond.live/customer0001/...	false
<input type="checkbox"/>	id=4656007800160256	normalized_vertices { x: 0.74455702304840...	rpi0001	true	gs://bucket.everysecond.live/customer0001/...	false
<input type="checkbox"/>	id=4656807939145728		rpi0001	false	gs://bucket.everysecond.live/customer0001/...	false
<input type="checkbox"/>	id=4657241596624896		rpi0001	false	gs://bucket.everysecond.live/customer0001/...	false
<input type="checkbox"/>	id=4657771219779584		rpi0001	false	gs://bucket.everysecond.live/customer0001/...	false

- NoSQL Datastore
- Categories: user ID, device ID, timestamp, img path, prediction labels, bounding box, score
- Composite Indexing for complex queries

## Cloud Computing

- Usually, need your own machine to:
  - Store images
  - Store data
  - Train/host an ML model
  - Host an application
- Now, the entire cloud is your server!
  - Quite easy
  - Free!
  - (thanks Google)



Cloud  
Storage



Cloud  
AutoML

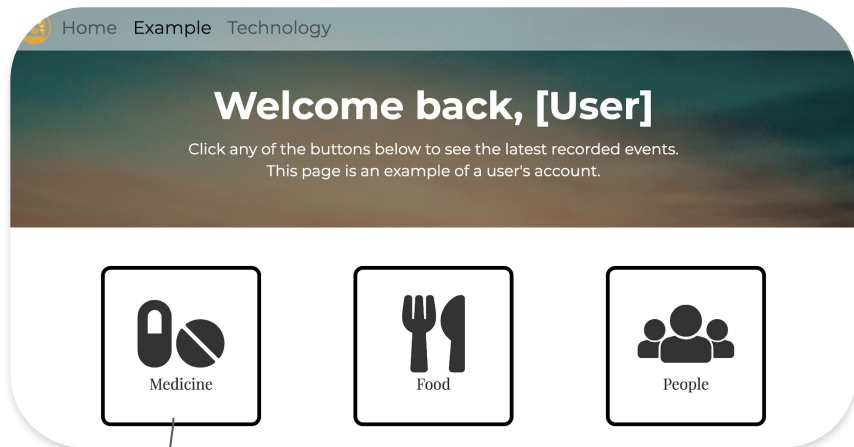


Cloud  
Functions



Cloud  
Datastore

# Web App



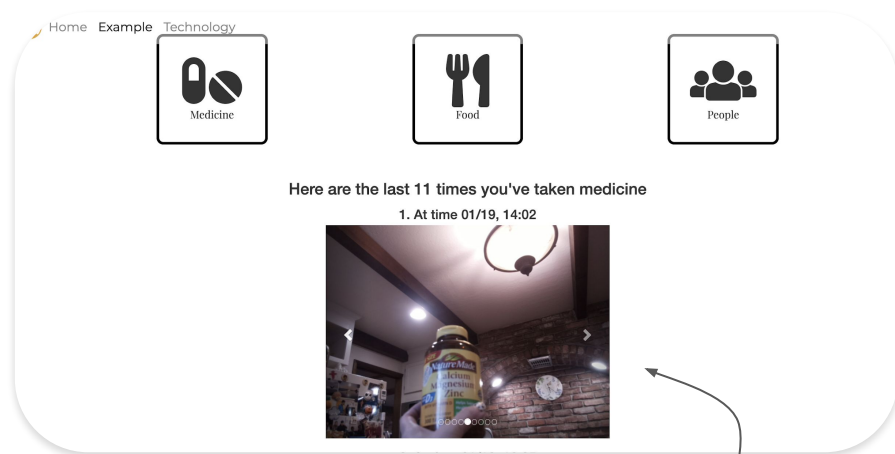
userID: 0001  
medicine: true



Cloud  
Functions



Cloud  
Datastore



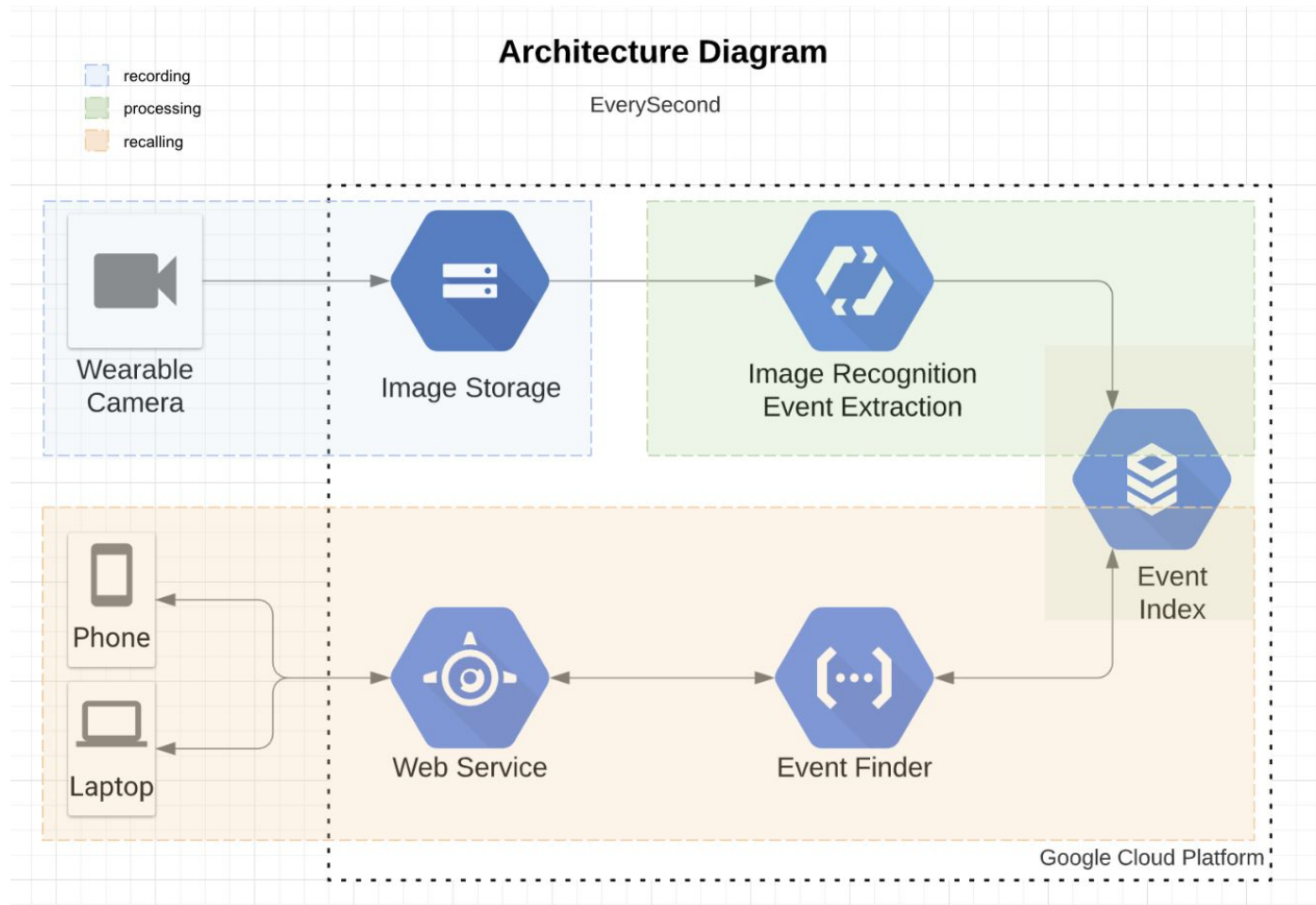
### Event Recognition Algorithm

- Count how many labels per minute
- {minute: label\_counts}
- Find distance between minute keys

## Serverless Computing

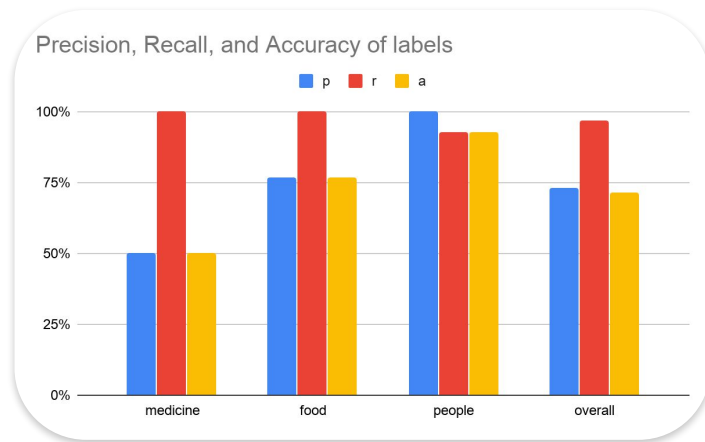
- EverySecond website does not have a web server running
- The main page is just a file in Cloud Storage, which DNS CNAME record points to
- Javascript calls API endpoints, which map to Google cloud functions
- Response has the list of image URL for displaying images

Host Records (A & AAAA)				Add Host
Host	IP Address (IPv4 / IPv6)	FO	TTL (hr:min)	
everysecond.live.	98.35.93.61	<a href="#">off</a>	00:02	
Alias Records (CNAME)				Add Alias
Alias	Points to Host		TTL (hr:min)	
bucket.everysecond.live.	c.storage.googleapis.com.		01:02	
web.everysecond.live.	c.storage.googleapis.com.		01:02	
www.everysecond.live.	everysecond.live.		00:02	



## Experiments

- Worn over course of 3 days
- Tested:
  - Accuracy (precision, recall)
    - In general, recall was better than precision
  - Speed
    - One-by-one uploading vs. batch uploading
  - No network situations



## So... does it work?

- Cons
  - Hardware
    - Power, size, usability, aesthetic considerations
    - Alternate processing options, on-device vs. cloud
  - Privacy
    - Account management system
    - Photos on the cloud
    - Timed deletion
  - Google is not accessible in China 🤖
- Pros
  - Working pipeline & demo
  - Versatile & built with latest technologies
  - Solution to a widespread, relatable problem



# Every Second

A digital short-term memory for the elderly

Thank you!