

# **Smart Beach Mat**

**ENGG4801 Thesis Project**

Presenter: Adam Dorogi-Kaposi  
Supervisor: Alex Pudmenzky

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# Introduction

## What is it?

- Beach mat with a UV sensor
- Allows users to track UV exposure through a smartphone application

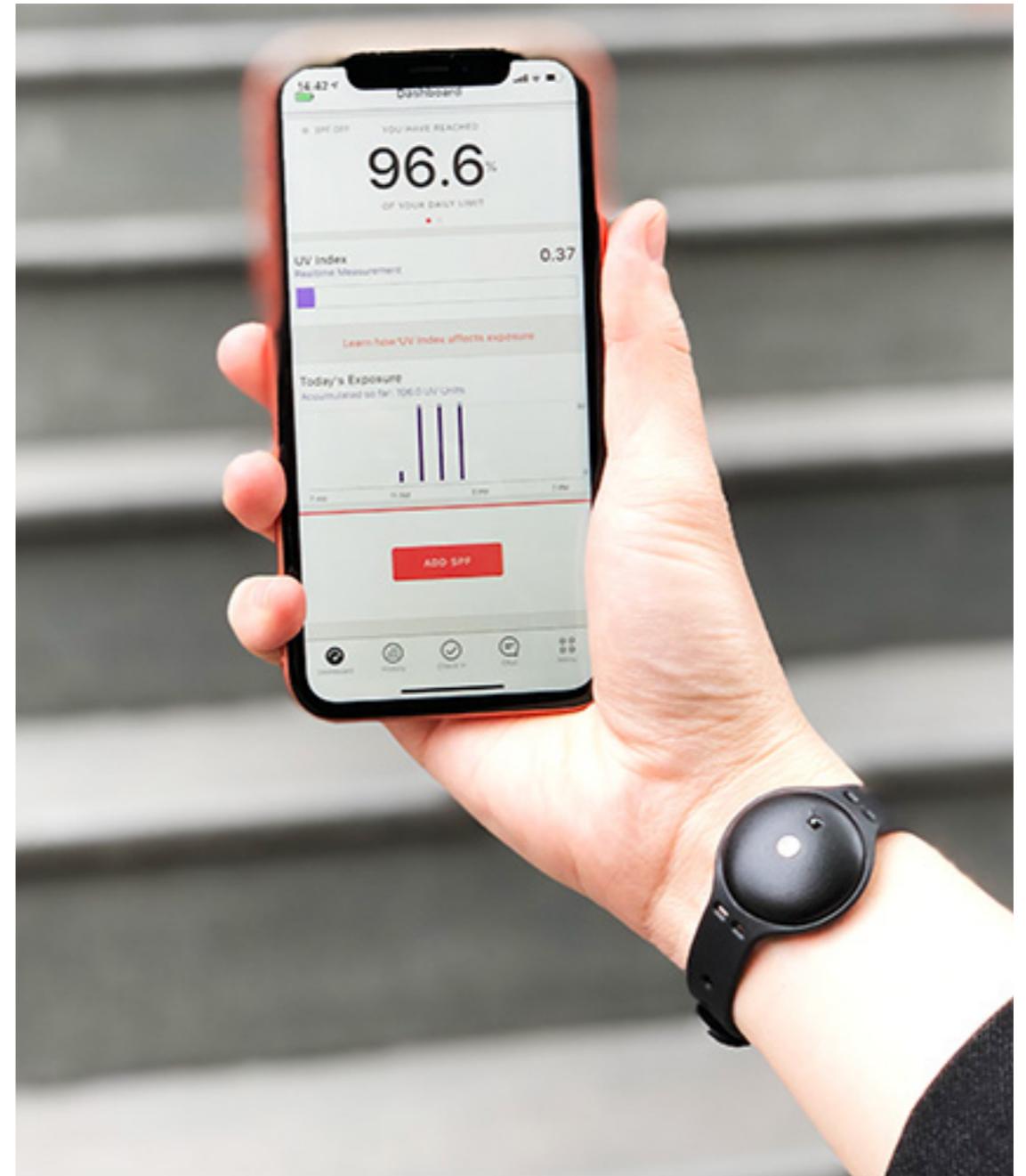
## Aims

- Raise awareness of harmful UV-B radiation
- Give users control to track, visualise, and mitigate their UV exposure



# Related Works Shade

- “Ultra-accurate”, magnetic UV sensor [3]
  - Can be clipped to clothing
  - Accompanied by a smartphone application
- 5-30 times more accurate than other UV wearables [4]



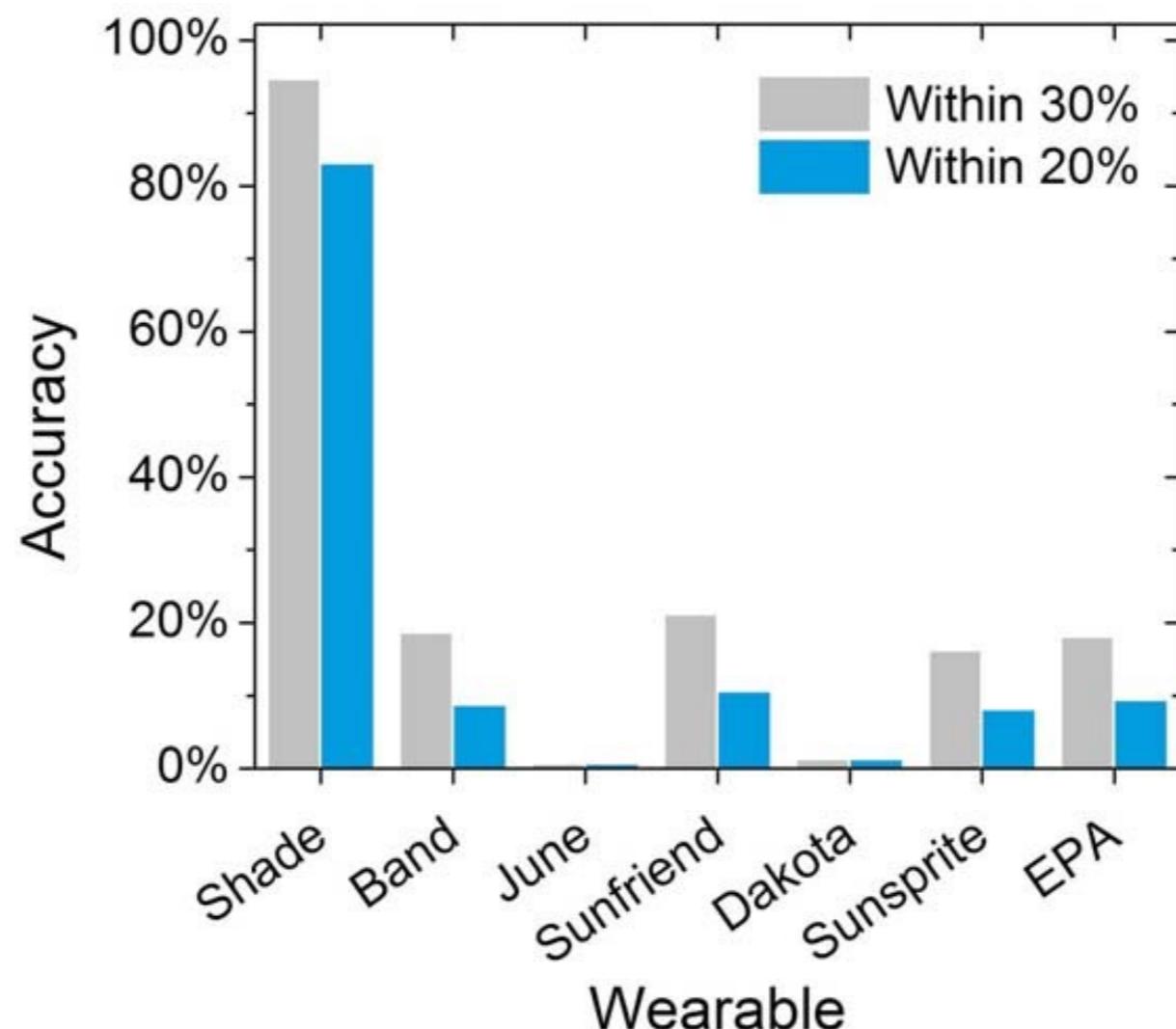
# Related Works Shade

## Comparison of Other Commercial UV Wearables [4]

| Product (Company)               | Measure UVB | Measure UVA | Rejects Visible |
|---------------------------------|-------------|-------------|-----------------|
| X1-4 UVE radiometer (Gigahertz) | ✓           | ✓           | ✓               |
| Shade (Shade)                   | ✓           | ✓           | ✓               |
| Band (Microsoft)                | ✗           | ✗           | ✓               |
| June (Netatmo)                  | ✓           | ✗           | ✓               |
| Sunfriend (Sunfriend)           | —           | —           | ✗               |
| UV Watch (Dakota)               | ✗           | ✗           | ✓               |
| Sunsprite (Goodlux)             | ✗           | ✗           | ✓               |
| EPA UVIndex App                 | —           | —           | —               |

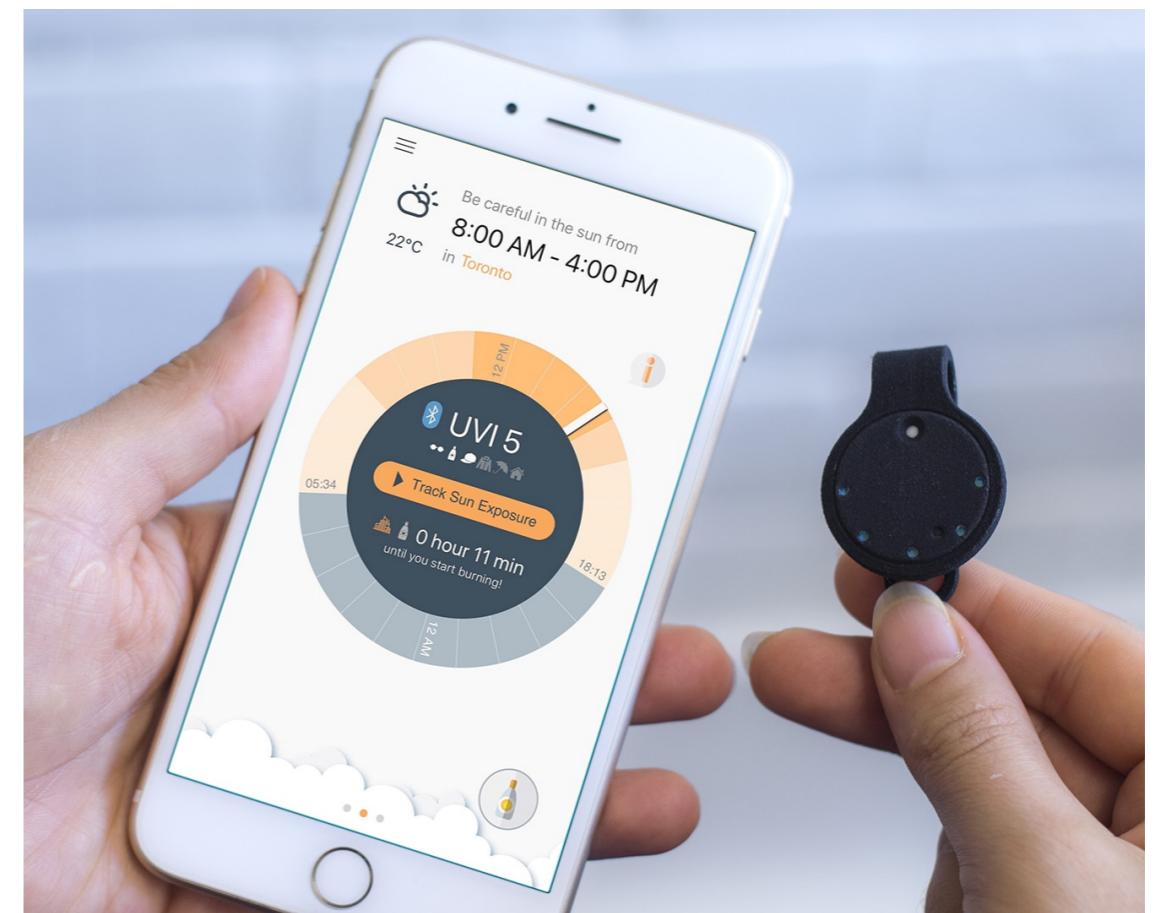
# Related Works Shade

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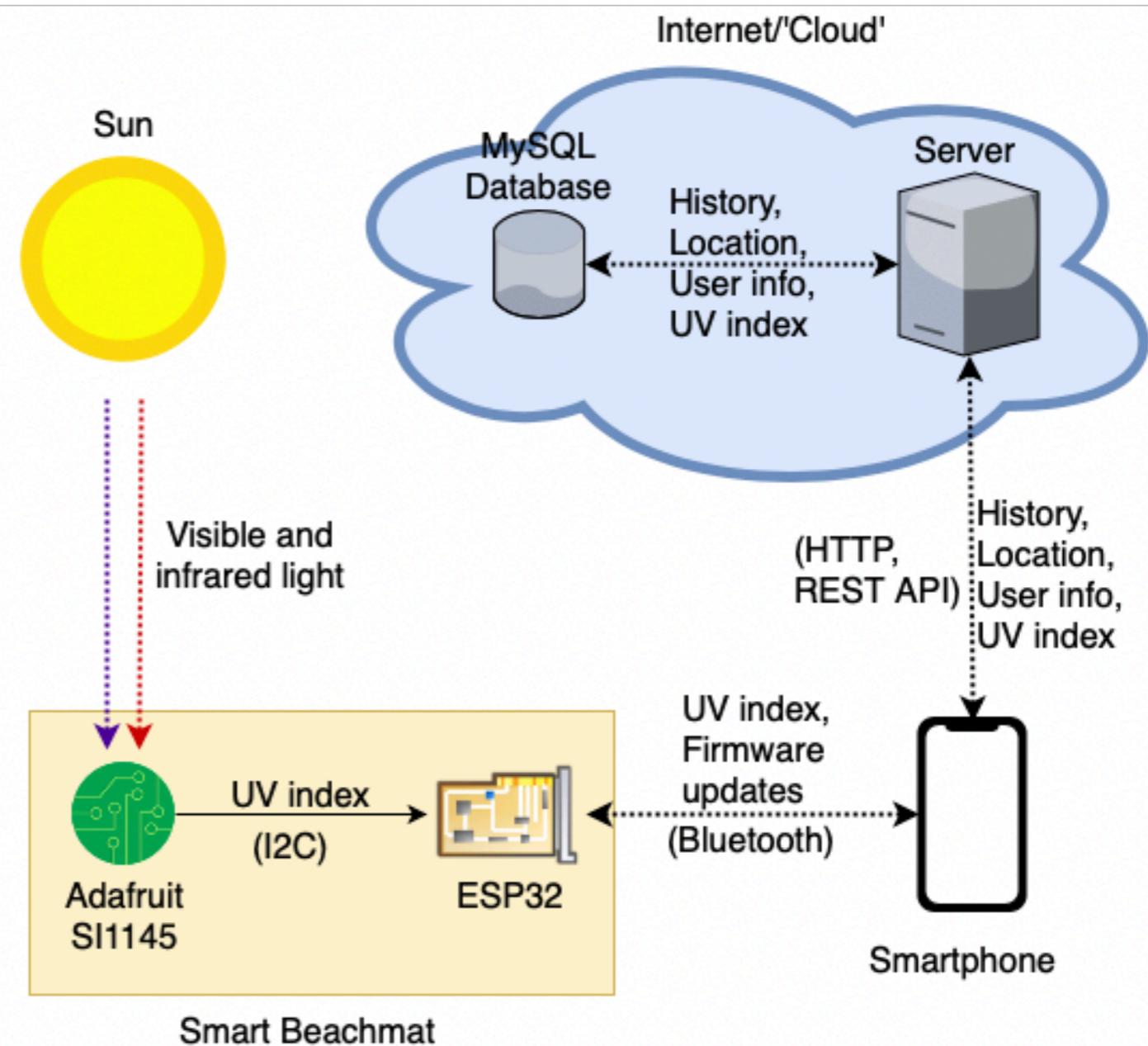
# Related Works QSun

- UV sensing wearable that
  - Tracks vitamin D production
  - Estimates sunscreen amount to prevent sunburn
  - Forecasts daily UV indexes
  - Analyses skin health [5, 6]
- Measures both UV-A and UV-B radiation, similar to Shade
- Claims to be  $\pm 0.5$  UV indexes accurate



# Design

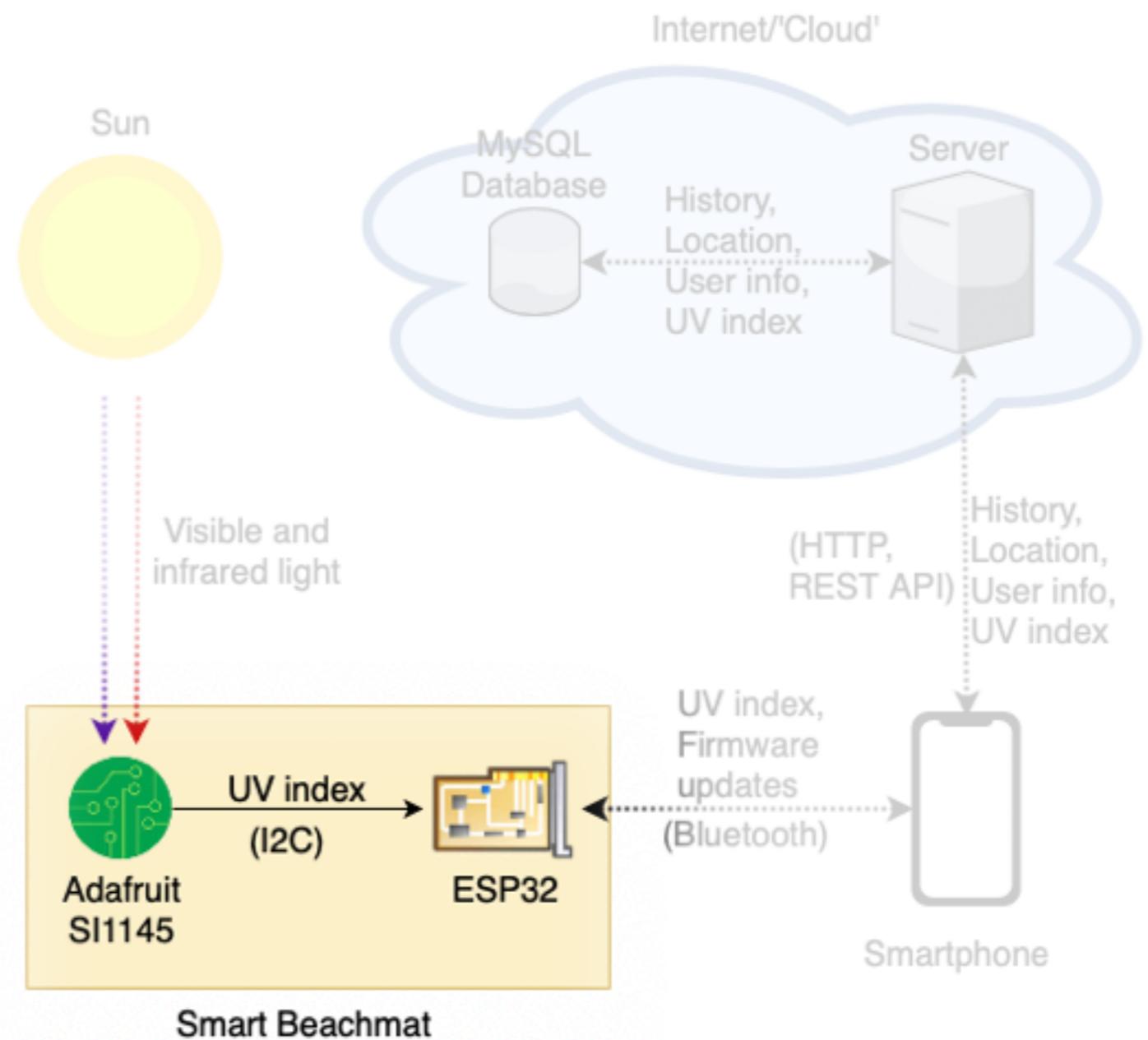
- **Hardware**
- **Software (Frontend)**
- **Software (Backend)**



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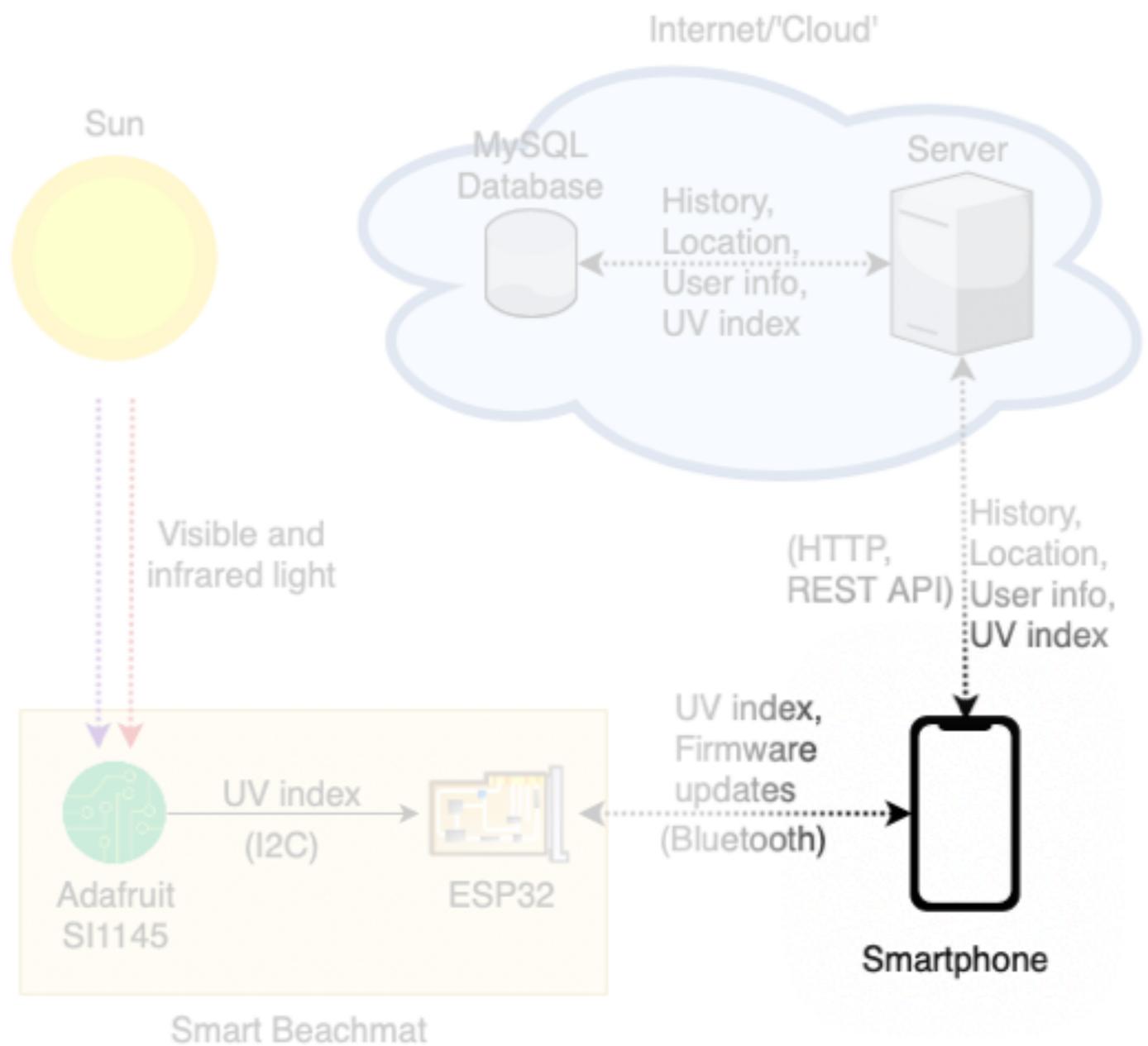
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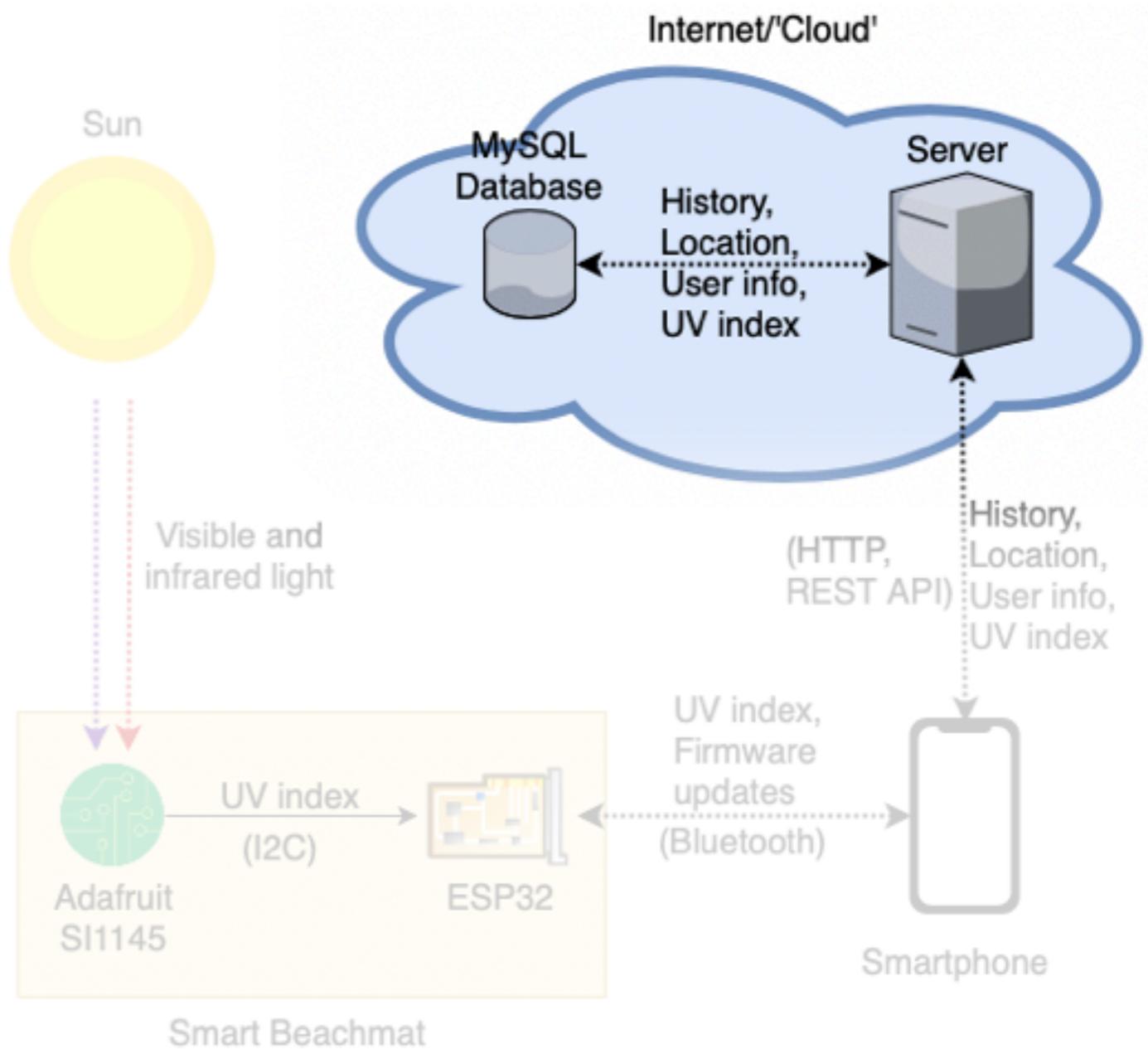
# Design

- Hardware
- Software (Frontend)
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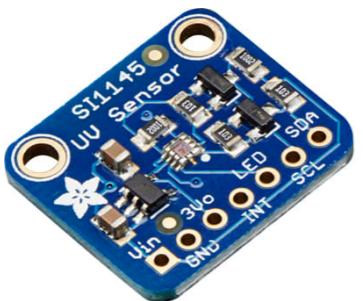
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# Design Hardware

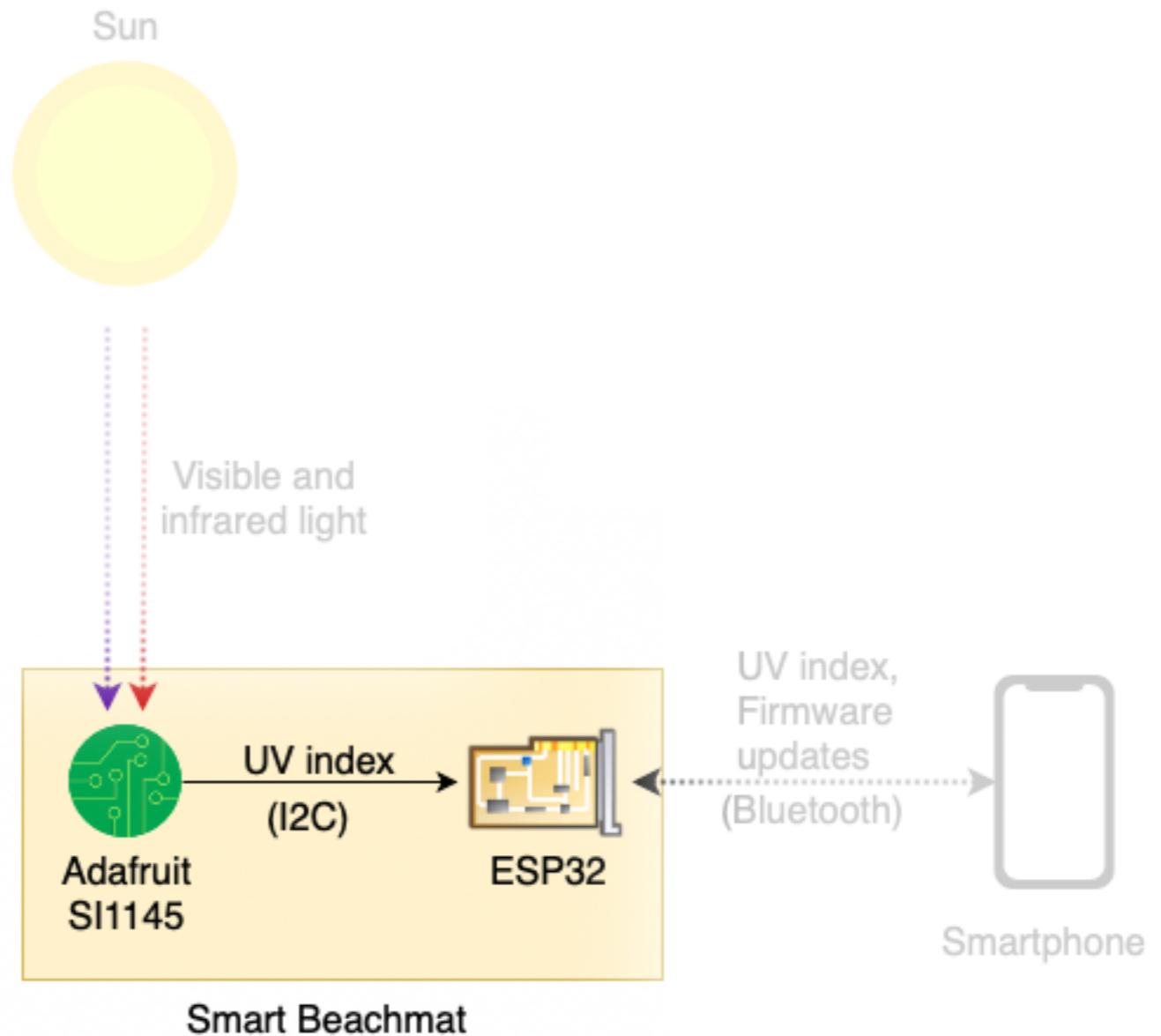
## UV sensor

- Adafruit SI1145



## Micro-controller

- ESP32



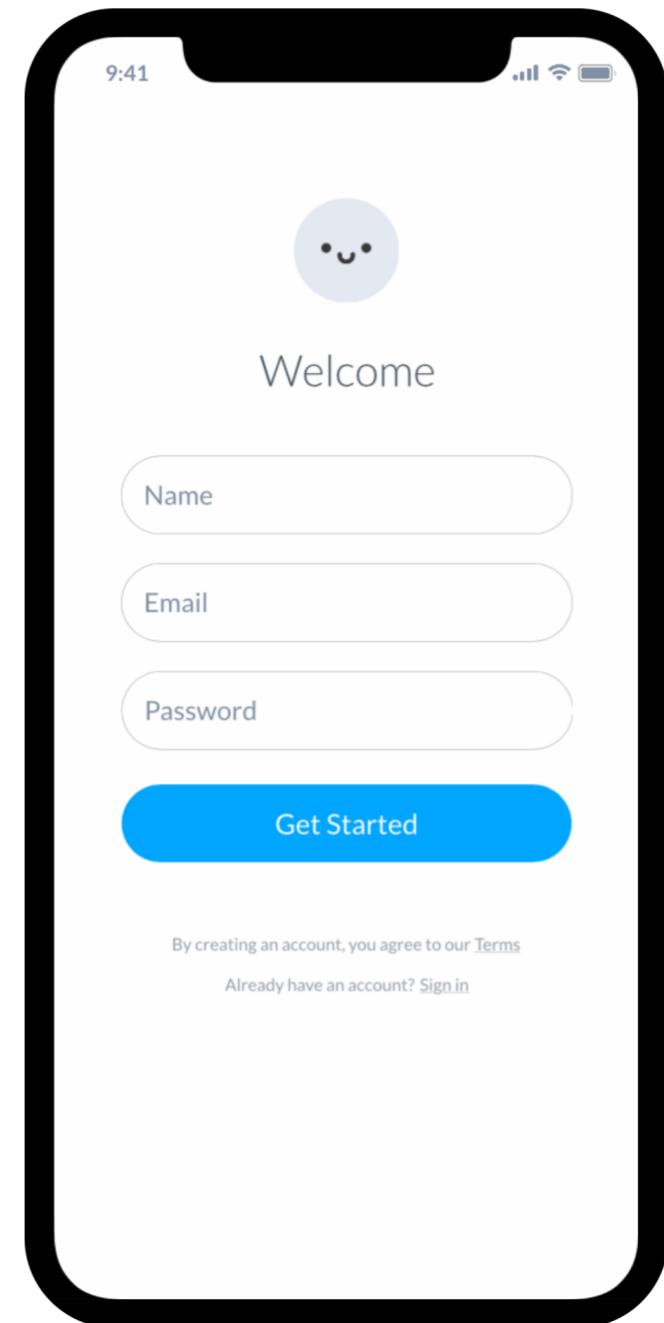
# Design Frontend

## Technologies

- Flutter framework for cross-platform app development
- Communicates with beach mat via Bluetooth LE

## Use Cases

- User can register
- Users can create a profile, to personalise their readings
- User can view the current UV index
- User can access and view their exposure history
- The application can give suggestions for activities when too much exposure is detected



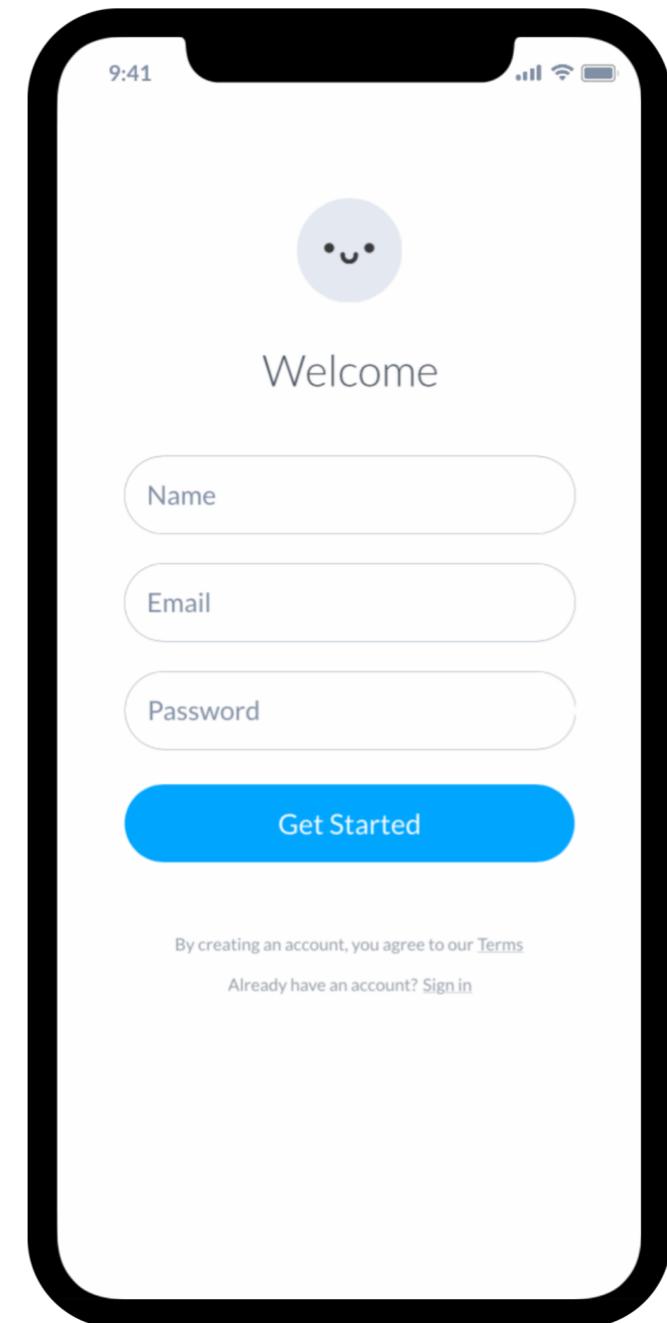
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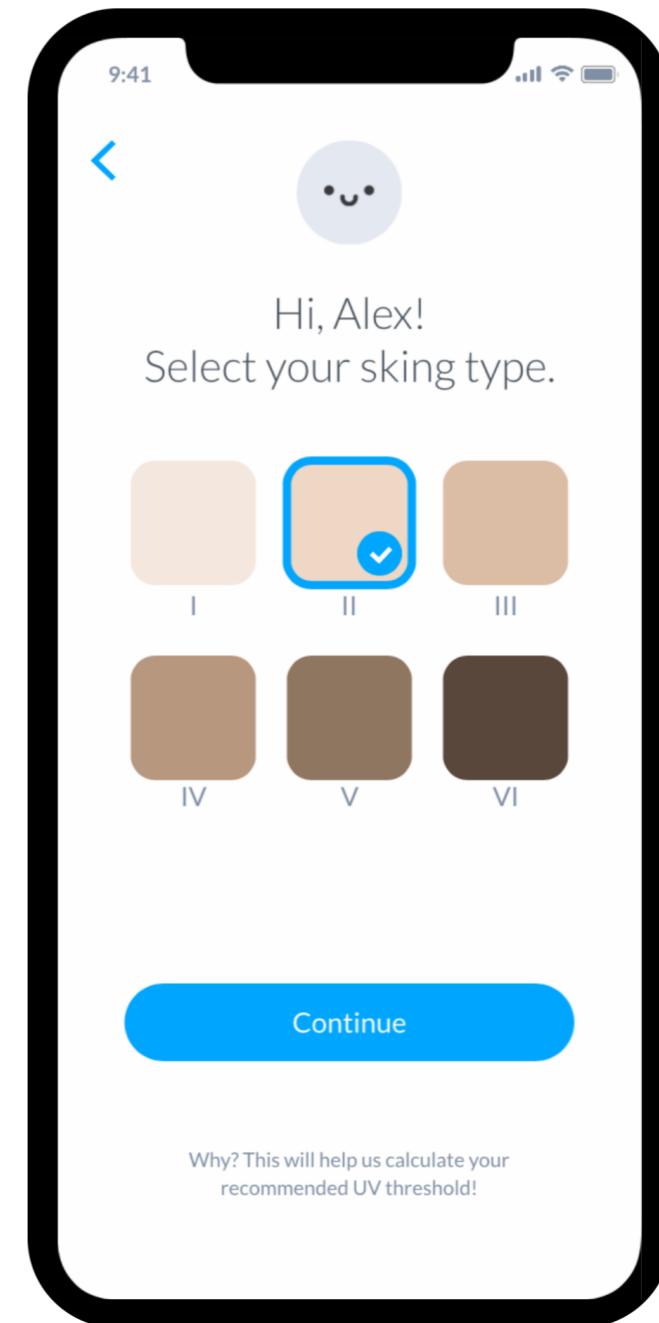
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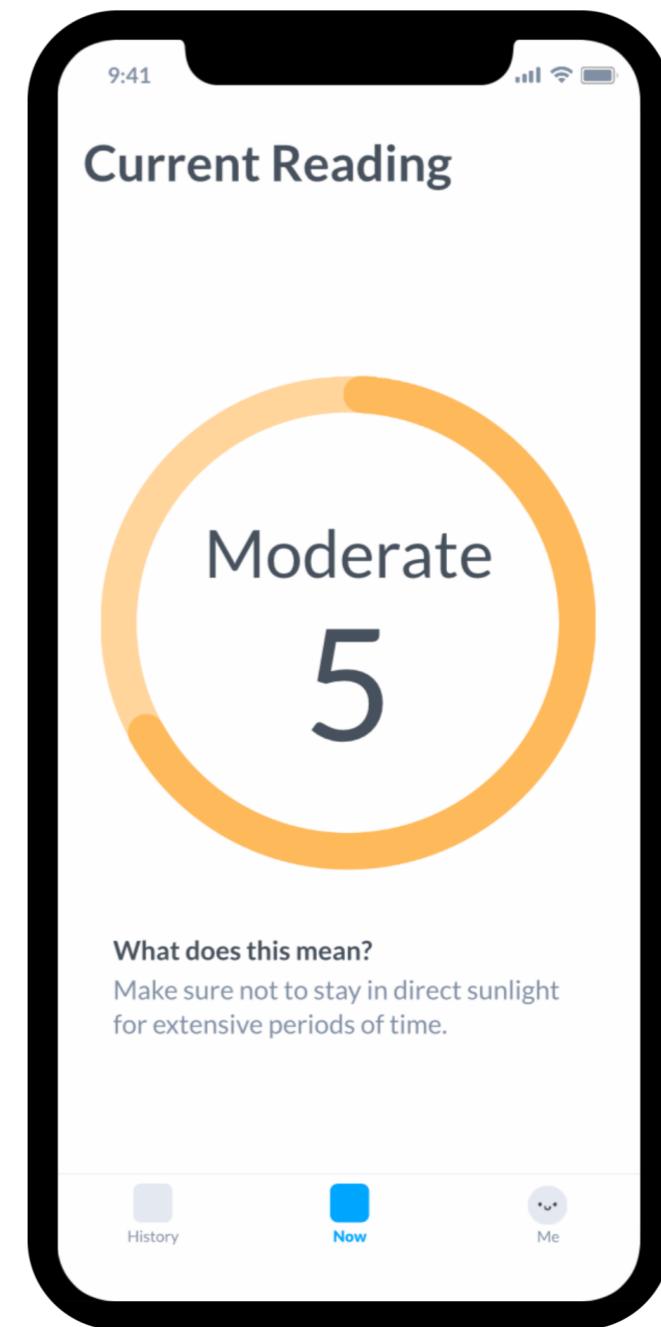
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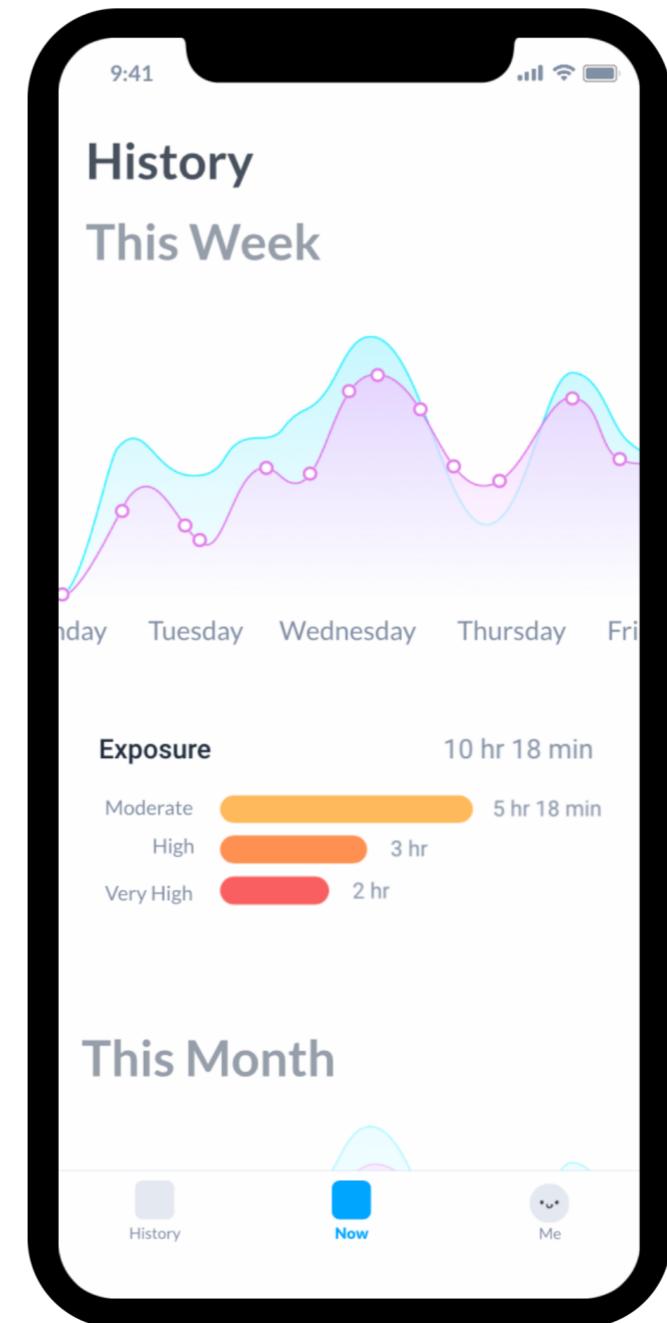
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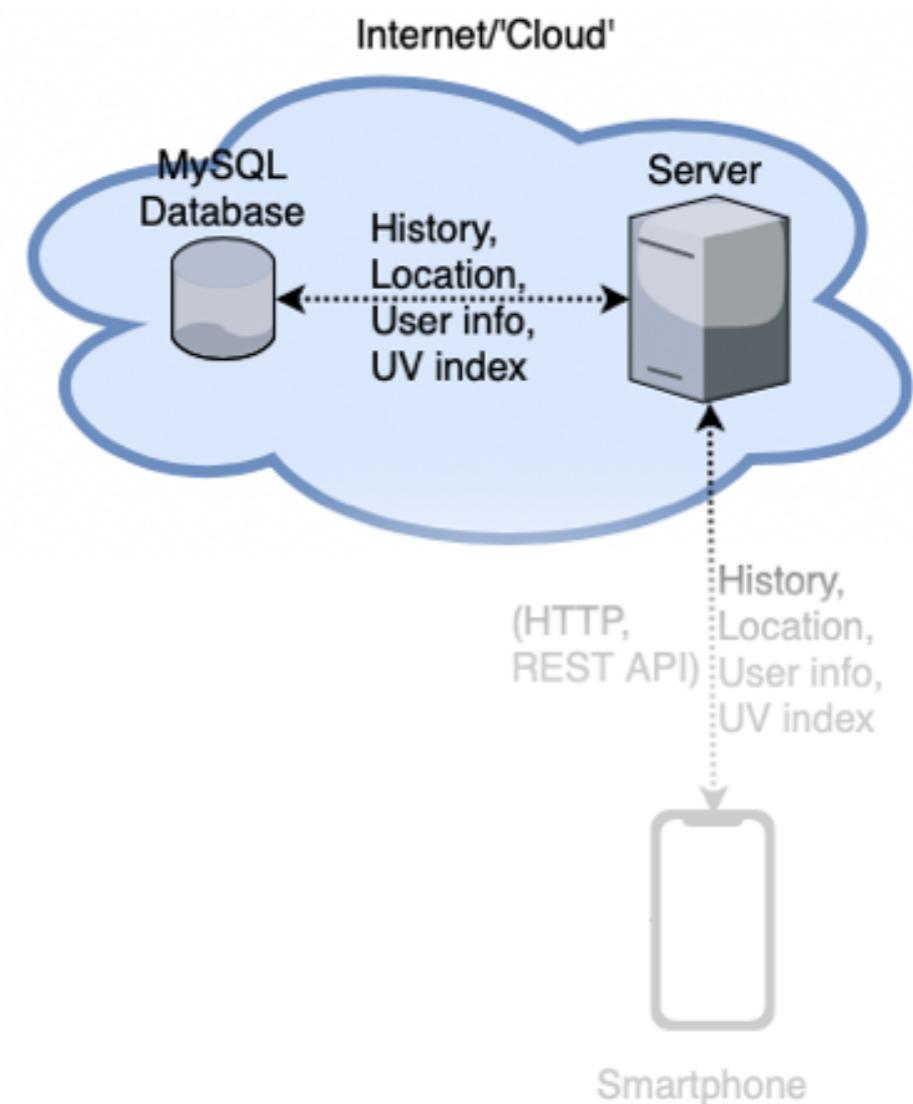
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# Design Backend

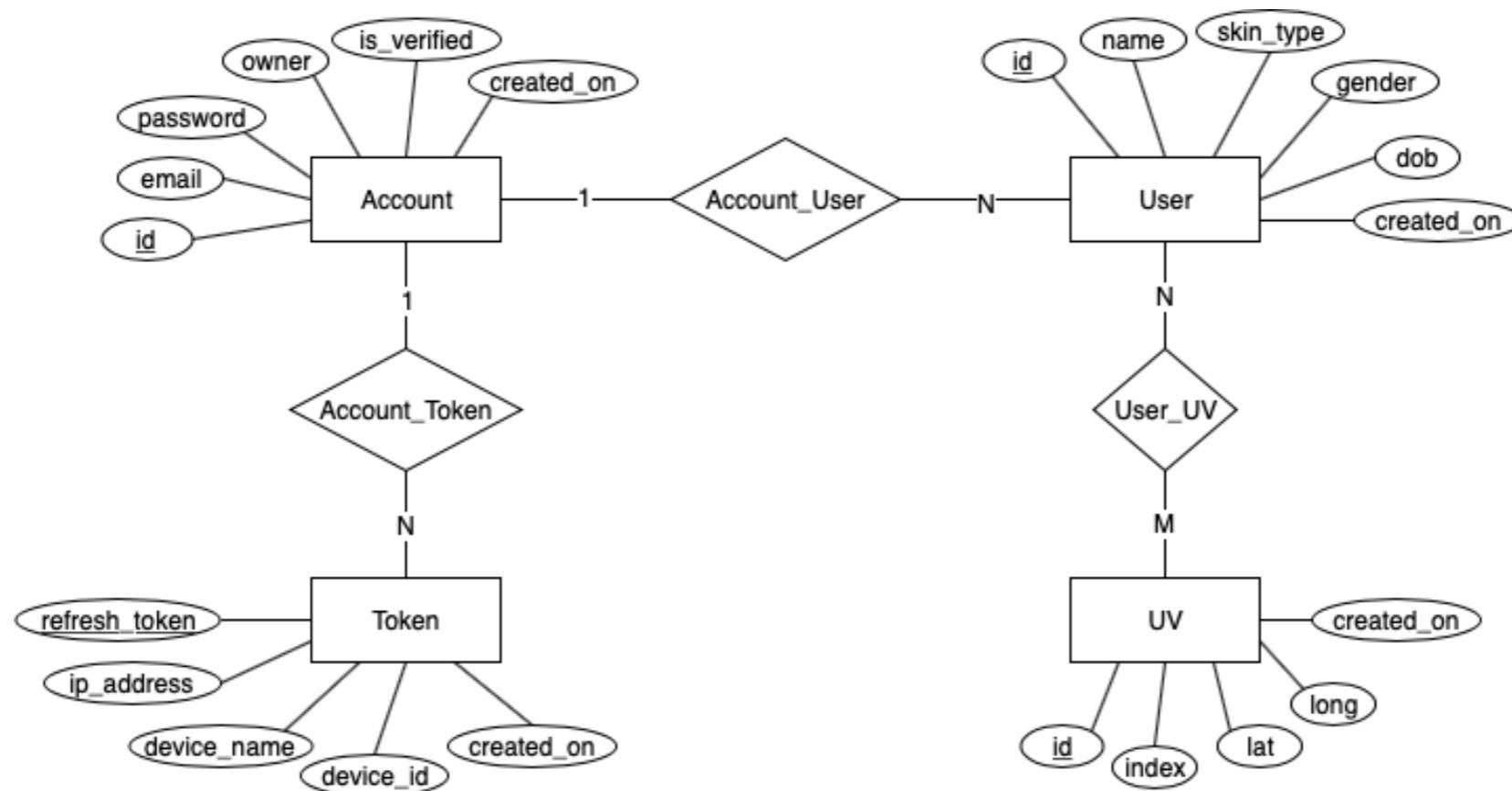
## Technologies

- PHP for backend logic
  - REST API to interact with smartphone application
- MySQL for database storage



# Design Backend

## ER Diagram



Account[[id](#), email, password, owner, is\_verified, created\_on]

User[account\_id, [id](#), name, skin\_type, gender, dob, created\_on]

User\_UV[user\_id, uv\_id]

UV[id, index, lat, long, created\_on]

Token[account\_id, refresh\_token, ip\_address, device\_name, device\_id, created\_on]

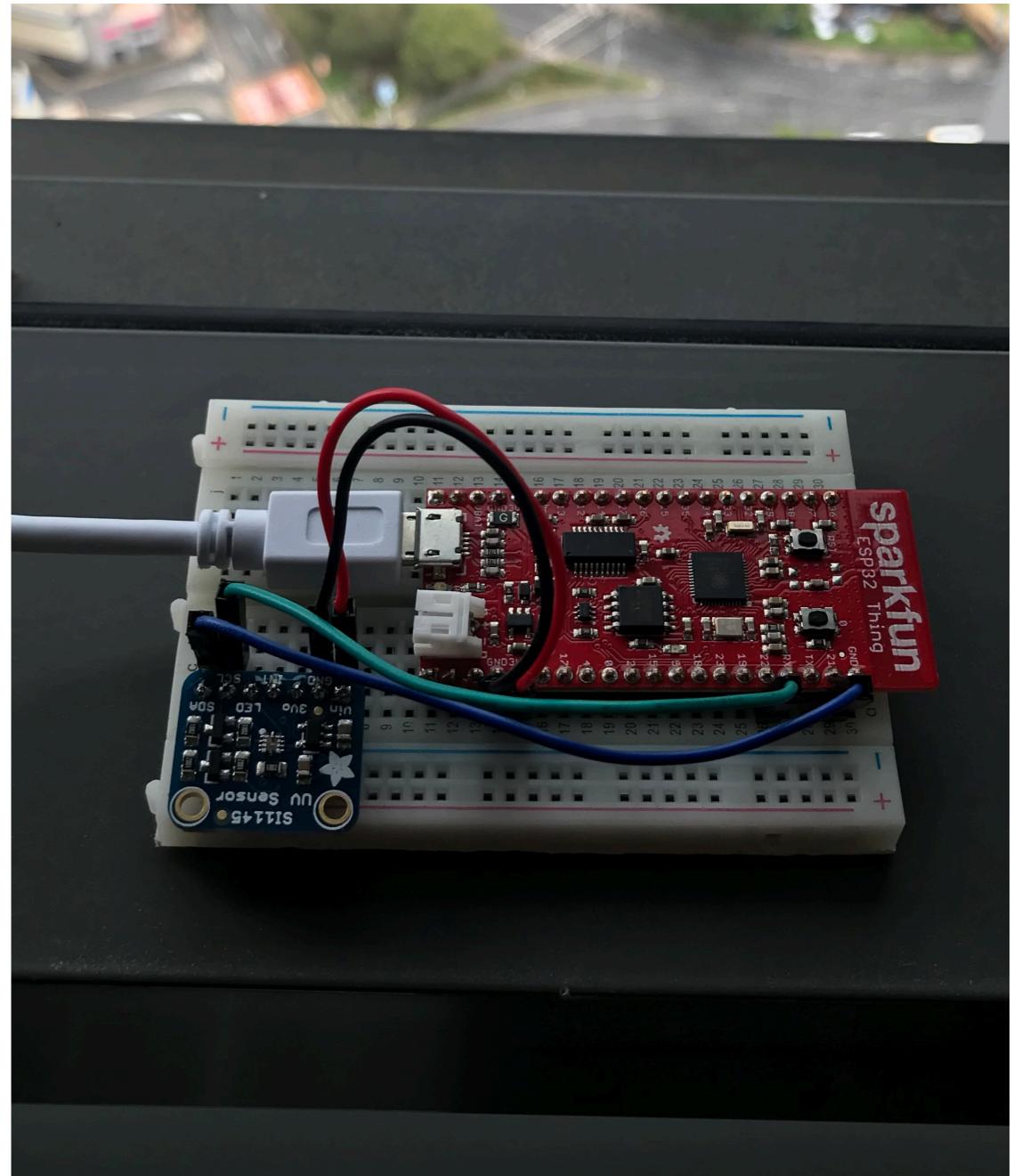
# Design Backend

## REST API Call Example To Create User

|           | HTTP Method              |                                 |                          |                          |
|-----------|--------------------------|---------------------------------|--------------------------|--------------------------|
|           | POST                     | GET                             | PUT                      | DELETE                   |
| /user     | Create a user            | Returns all users of an account | 405 – Method Not Allowed | 405 – Method Not Allowed |
| /user/123 | 405 – Method Not Allowed | Returns a specific user         | Update a specific user   | Delete a specific user   |

# Progress So Far

- UV indexes reading correctly by the UV sensor
- UV indexes transmitted to an iPhone application, via Bluetooth LE
- Database designed and implemented
- REST API designed
- Started implementing REST API



# Progress Remaining

- Finish implementing REST API
- Create frontend mobile application using Flutter
- Finalise and create physical beach mat

# **Questions?**

# References

- [1]Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global Cancer Statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin, in press. The online GLOBOCAN 2018 database is accessible at <http://gco.iarc.fr/>, as part of IARC's Global Cancer Observatory.
- [2]"Department of the Environment and Energy", *Department of the Environment and Energy*. [Online]. Available: <https://www.environment.gov.au/protection/ozone/ozone-science/ozone-layer>. [Accessed: 28- Mar- 2019].
- [3]"Shade UV sensor - Funded by the National Cancer Institute", *Wearshade.com*. [Online]. Available: <https://www.wearshade.com>. [Accessed: 28- Mar- 2019].
- [4]S. Banerjee, "A Comparative Study of Wearable Ultraviolet Radiometers", *Storage.googleapis.com*. [Online]. Available: <https://storage.googleapis.com/emmanuel-public/Shade%20IEEE%20published.pdf>. [Accessed: 28- Mar- 2019].
- [5]"QSun | Wearable Sun Tracker | Balance UV exposure and vitamin D", *QSun | Wearable Sun Tracker | Balance UV exposure and vitamin D*. [Online]. Available: <https://qsun.co>. [Accessed: 28- Mar- 2019].
- [6]"Features to Optimize Skin Health | QSun - Sun Safety Advisor", *QSun | Wearable Sun Tracker | Balance UV exposure and vitamin D*. [Online]. Available: <https://qsun.co/features/>. [Accessed: 28- Mar- 2019].