

## Suite of e-coaches aimed to analyse human behaviour

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17th July 2020

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## Proposal

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# Proposal

- *E-coaches* suite as chatbots.

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- *E-coaches* suite as chatbots.
- Doctors can assign questions to patients.

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- Data analysis.
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- Mental disorders are very common in our society.

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- Mental disorders are very common in our society.
- Doctors have high workloads.

# Context

- Mental disorders are very common in our society.
- Doctors have high workloads.
- Mental diseases are taboo.

# Context

- Mental disorders are very common in our society.
- Doctors have high workloads.
- Mental diseases are taboo.
- No continuous traceability of patient's health status.

# Context

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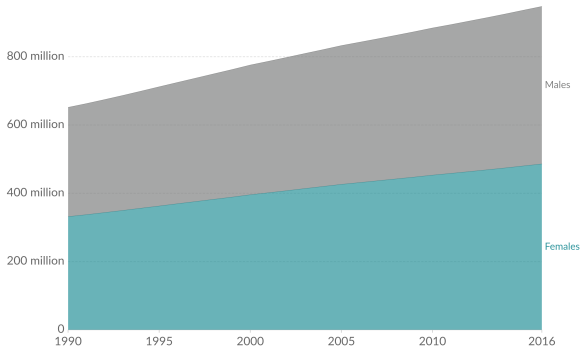
References

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## Number of people with mental health disorders, World, 1990 to 2016

Number of people with mental or intellectual developmental disability disorders, not including alcohol and drug use disorders. This is differentiated by sex.

Our World  
in Data



Source: IHME, Global Burden of Disease (GBD)

CC BY

**Figure:** Number of people with mental health disorders

Reprinted from (Ritchie & Roser, 2018).

# Motivation

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- Technology is becoming increasingly integrated into our lives.

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- Technology is becoming increasingly integrated into our lives.
- Smartphones are used in a daily basis.



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- Technology is becoming increasingly integrated into our lives.
- Smartphones are used in a daily basis.
- Chatbots are becoming growingly becoming popular.



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- **Main goal:**
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  - Questions will be defined by specialists.

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- **Secondary goals.**

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- **Secondary goals.**
  - Graphical web interface for doctors.



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  - Flexible and scalable architecture to add functionality to the system.

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- **Secondary goals.**
  - Graphical web interface for doctors.
  - Flexible and scalable architecture to add functionality to the system.
  - Architecture based on containers to host the different system modules.
  - Implement a system that covers the previous goals.

## Objectives

- **Main goal:**

- *Conversational-agent-as-a-sensor* that asks questions to patients.
- Questions will be defined by specialists.

- **Secondary goals.**

- Graphical web interface for doctors.
- Flexible and scalable architecture to add functionality to the system.
- Architecture based on containers to host the different system modules.
- Implement a system that covers the previous goals.
- Test a beta version of the system to retrieve target audience's feelings about it.

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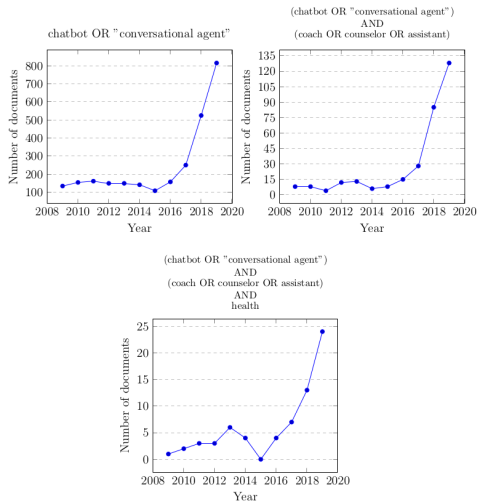


Figure: Search results of different queries performed in *scopus.com*.

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- Areas of application.

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- Coaches: help users to get what they want.

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- Coaches: help users to get what they want.
- Counselors: help users to identify and solve problems.

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## • Text

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Platform	Daily active users (billions)	Free API for chatbots
( <i>Facebook Messenger</i> , 2008)	1.66	✓
( <i>Whatsapp</i> , 2009)	1.5	✗
( <i>WeChat</i> , 2011)	1.083	✓
( <i>Telegram</i> , 2013)	0.2	✓
( <i>Kik</i> , 2010)	0.015	✓
( <i>Discord</i> , 2015)	0.014	✓
( <i>Slack</i> , 2013)	0.012	✓
( <i>Viber</i> , 2010)	0.008	✓
( <i>Line</i> , 2012)	0.00723	✓

Table: Comparison between different chat applications (2019).

# Technology

- Facebook likes can be helpful to predict people's sensitive properties (Kosinski, Stillwell, & Graepel, 2013).



# Technology

- Facebook likes can be helpful to predict people's sensitive properties (Kosinski et al., 2013).
- Whatsapp's end-to-end encryption methods are not secure enough (Rastogi & Hendler, 2017).
- Telegram provides more privacy protection (Sutikno et al., 2016).

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  - Ask questions to the patients.



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- *Must have* requirements.
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  - File with patients' answers.

# Requirements

- *Must have* requirements.
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  - User's enrollment and deletion.
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  - Custom keyboard.
  - User's enrollment and deletion.
  - File with patients' answers.
  - Modularity.
- *Should have* requirements.
  - CC BY-NC-SA 4.0 (*Creative Commons*, 2001) license.

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  - Ask questions to the patients.
  - Custom keyboard.
  - User's enrollment and deletion.
  - File with patients' answers.
  - Modularity.
- *Should have* requirements.
  - CC BY-NC-SA 4.0 (*Creative Commons*, 2001) license.
  - Questions and answers should be modifiable.

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  - Public questions.



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- *Should have* requirements.
  - CC BY-NC-SA 4.0 (*Creative Commons*, 2001) license.
  - Questions and answers should be modifiable.
  - Public questions.
  - Configurable schedule.
  - Interactive charts.

# Requirements

- *Could have requirements.*

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  - Assign questions to all patients.
  - Timezones support.
- *Won't have* requirements.
  - Cross-platform.

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  - Groups.
  - Delete data from users.
  - View and modify profile data.
  - Assign questions to all patients.
  - Timezones support.
- *Won't have* requirements.
  - Cross-platform.
  - Share the retrieved data with third parties.



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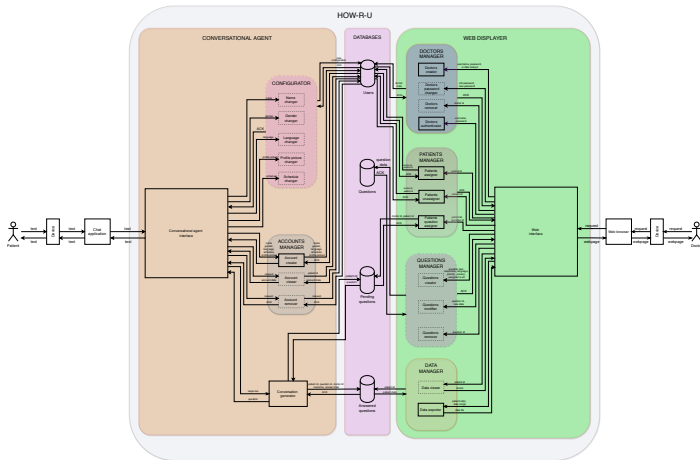
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**Figure:** System architecture. Created using *diagrams.net* (*diagrams.net*, 2020).

# Architecture

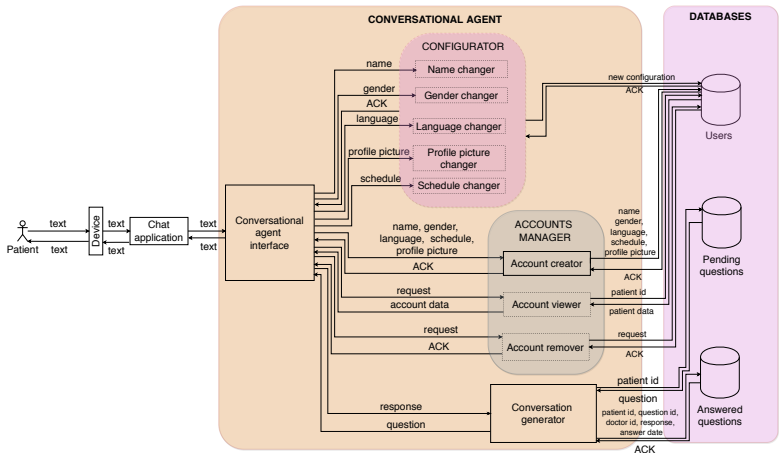


Figure: System architecture (conversational agent and databases).

# Architecture

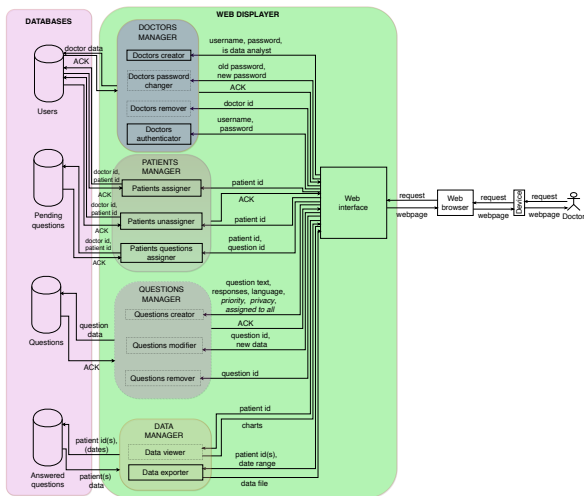


Figure: System architecture (web interface and databases).

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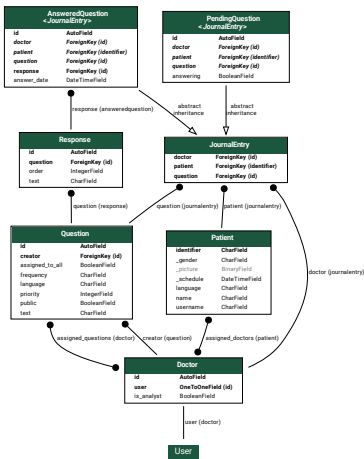


Figure: System class diagram (HOW-R-U classes)

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## ● Handlers.

## Implementation (conversational agent)

### Implementation

- Handlers.
  - Start handler



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  - Start handler
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  - Question handler.
- **Jobs.**



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```
GENDER, PICTURE, LANGUAGE, SCHEDULE = range(4)
@send_typing_action
def start(update, context):
    """
    Shows welcome message and asks for language
    """
    # Check that user is not registered
    try:
        patient = Patient.objects.get(identifier=update.message.from_user.id)
        logger.info( f'User {update.message.from_user.username} tried to register
        ↳ again.')
        update.message.reply_text(text=messages[patient.language]['already_exists'])
        return ConversationHandler.END
    except Patient.DoesNotExist:
        # The user should not exist in DB
        context.user_data['patient'] = Patient(name=update.message.from_user.first_name,
        ↳ identifier=str(update.message.from_user.id),
        ↳ username=update.message.from_user.username)
        logger.info(f'User {update.message.from_user.username} started a new
        ↳ conversation')
        send_welcome_message(patient)
        send_language_selection(patient)
    return LANGUAGE
```

# Implementation (conversational agent start handler)

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```
start_handler = ConversationHandler(  
    entry_points=[CommandHandler('start', start)],  
    states={  
        LANGUAGE:  
        ↪ [MessageHandler(Filters.regex(f'^({Flag.flag("es")}|{Flag.flag("gb")})$'),  
        ↪ language)],  
        GENDER:  
        ↪ [MessageHandler(Filters.regex('^(Male|Female|Other|Masculino|Femenino|Otro)$'),  
        ↪ gender)],  
        PICTURE: [MessageHandler(Filters.photo, picture), CommandHandler('skip',  
        ↪ skip_picture)],  
        SCHEDULE: [MessageHandler(Filters.regex('^[0-1]?[0-9]|2[0-3]):[0-5][0-9]$'),  
        ↪ schedule)]  
    },  
    fallbacks=[]  
)
```

# Implementation (conversational agent PendingQuestionJob)

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```
class PendingQuestionJob(object):

    def __init__(self, context, patient):
        self.patient = patient
        self._create_job(context)

    def _create_job(self, context):
        context.job_queue.run_daily(callback=self.job_callback, time=self.patient.schedule,
        ↪ name=f'{self.patient.identifier}_pending_questions_job')

    def job_callback(self, context):
        pending_questions = self._get_pending_questions()
        for task in pending_questions:
            if not self.is_question_answered(task):
                task.answering = True
                ask_question(task, self.patient)
        send_message(self.patient, "All questions have been answered")
        if was_configurator_running(self.patient.identifier, context):
            reopen_configurator(self.patient)
```

# Implementation (conversational agent)

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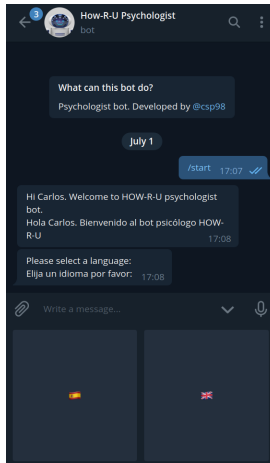


Figure: Agent showing the welcome message and asking for language selection.



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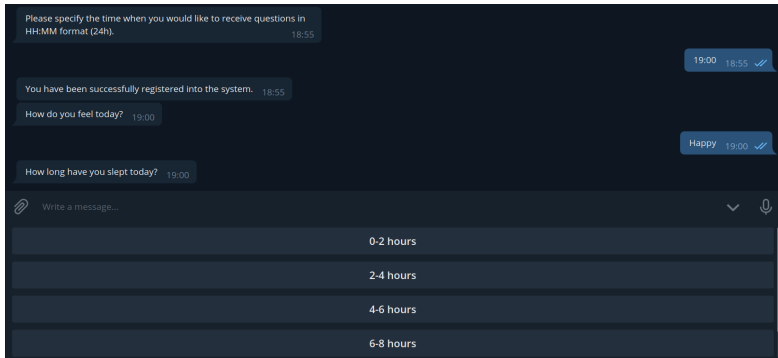


Figure: HOW-R-U conversational agent asking a question to a patient.

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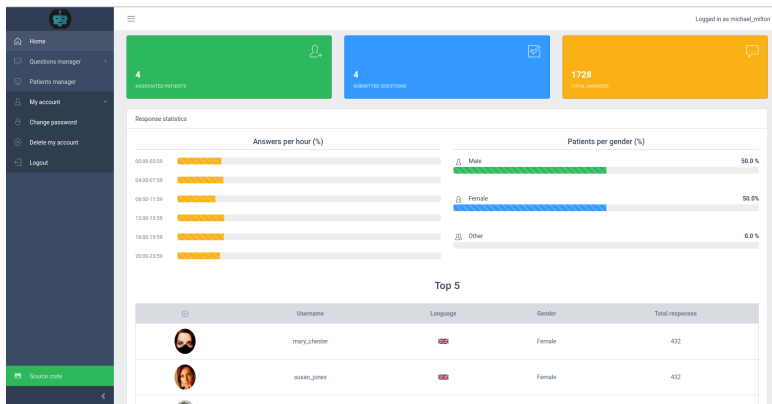


Figure: HOW-R-U homepage.

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```
@login_required(login_url="/login/")
```

```
def index(request):
```

```
    """
```

↳ *Shows the index page, including global parameters (top patients, number of associated patients, answers, gender and time percentages, etc.),*

```
    """
```

```
    doctor = request.user.doctor
```

```
    top_patients = get_top_patients(doctor)
```

```
    doctor_patients = doctor.patient_set
```

```
    number_associated_patients = doctor_patients.count()
```

```
    submitted_questions = Question.objects.filter(creator=doctor).count()
```

```
    total_answers = get_total_answers(doctor)
```

```
    male_percentage, female_percentage, other_percentage = get_gender_stats(doctor,
```

↳ 

```
        number_associated_patients)
```

```
    answers_per_hour = get_answers_per_hour(doctor)
```

```
    context = {
```

```
        "top_patients": top_patients,
```

```
        "number_associated_patients": number_associated_patients,
```

```
        "submitted_questions": submitted_questions,
```

```
        "total_answers": total_answers,
```

```
        "male_percentage": male_percentage,
```

```
        "female_percentage": female_percentage,
```

```
        "other_percentage": other_percentage,
```

```
        "answers_per_hour": answers_per_hour
```

```
    }
```

```
    return render(request, "index.html", context)
```

Question text (empty to get all questions) 🔍 Search

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Logged in as data\_populator

### Modify a question

Question: This is test question number 17

Possible responses:

- response 1
- response 2
- response 3
- response 4

Privacy: Public

Language: English

Frequency: Daily

Priority: 1

Assigned to all: Yes

[Submit](#) [Cancel](#)

HOW4U Dashboard

Forked from [AppSeed](#)

Figure: Questions creator and modifier.

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Logged in as richard\_milton

Search

Export

	Name	Username	Language	Gender	Assigned questions	Last answer	Actions
					Show (3)		
	Mary	mary_chester	GB	Female	How do you feel today? How long have you slept today? Do you feel sad and cry easily?	April 27, 2020, 8:10 p.m.	<a href="#">View data</a> <a href="#">Assign questions</a> <a href="#">Delete patient</a>
					Show (4)		
	Oliver	oliver_morton	GB	Male	How do you feel today? How long have you slept today? Do you feel sad and cry easily? Have you noticed an appetite decrease in the last week?	April 27, 2020, 9:23 p.m.	<a href="#">View data</a> <a href="#">Assign questions</a> <a href="#">Delete patient</a>
					Show (4)		
	Robert	robert_garfield	ES	Male	How do you feel today? How long have you slept today? Do you feel sad and cry easily? Have you noticed an appetite decrease in the last week?	April 27, 2020, 6:10 p.m.	<a href="#">View data</a> <a href="#">Assign questions</a> <a href="#">Delete patient</a>
					Show (4)		
	Susan	susan_jones	GB	Female		April 27, 2020, 10:04 p.m.	<a href="#">View data</a> <a href="#">Assign questions</a> <a href="#">Delete patient</a>

Source code

+ Add a new patient

Figure: Patients manager.

# Implementation (web interface)

The screenshot shows a web interface for a 'Patients manager' dashboard. On the left is a dark sidebar with navigation links: Home, Questions manager, Patients manager, My account, Source code, and HOWRU Dashboard. The main content area is titled 'Assign questions to patient mary\_cheater'. It contains a table with columns: Question text, Possible responses, Frequency, Priority, Privacy, Creator, Language, and Actions. The table lists four questions with their respective response options and actions like 'Unassign' or 'Assign'.

Question text	Possible responses	Frequency	Priority	Privacy	Creator	Language	Actions
Do you feel sad and cry easily?	Yes No	Daily	1	Public	michael_milton (You)	English	Unassign
Have you noticed an appetite decrease in the last week?	Yes No	Weekly	1	Private	michael_milton (You)	English	Assign
How do you feel today?	Sad Tired Happy Very happy	Daily	1	Public	michael_milton (You)	English	Unassign
How long have you slept today?	0-2 hours 2-4 hours 4-6 hours 6-8 hours More than 8 hours	Daily	1	Public	michael_milton (You)	English	Unassign

Figure: Patients manager assign questions page.

# Implementation (web interface)

Select patients to export

susan\_jones  
robert\_garfield  
oliver\_morton  
mary\_chester

Start date

04/01/2020

Please enter a valid date

End date

mm/dd/yyyy

June 2020

S	M	T	W	T	F	S
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	1	2	3	4
5	6	7	8	9	10	11

Today

Submit Reset

Figure: Export page



# Implementation (web interface)

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Patient username	Question	Answer	Date
robert_garfield	How do you feel today?	Tired	2020-04-01 04:12:20
robert_garfield	How do you feel today?	Sad	2020-04-02 05:24:20
robert_garfield	How long have you slept today?	0-2 hours	2020-04-01 12:56:20
robert_garfield	How long have you slept today?	4-6 hours	2020-04-02 11:28:20
robert_garfield	Do you feel sad and cry easily?	Yes	2020-04-01 14:22:21
robert_garfield	Do you feel sad and cry easily?	No	2020-04-02 06:31:21
oliver_morton	How do you feel today?	Very happy	2020-04-01 01:45:19
oliver_morton	How do you feel today?	Happy	2020-04-02 02:59:19
oliver_morton	How long have you slept today?	More than 8 hours	2020-04-01 20:51:20
oliver_morton	How long have you slept today?	2-4 hours	2020-04-01 22:24:20
oliver_morton	Do you feel sad and cry easily?	No	2020-04-01 07:47:20
oliver_morton	Do you feel sad and cry easily?	Yes	2020-04-02 17:26:20
oliver_morton	Have you noticed an appetite decrease in the last week?	Yes	2020-04-01 21:41:20
oliver_morton	Have you noticed an appetite decrease in the last week?	Yes	2020-04-08 21:09:20

**Table:** Example data generated with the *Export* feature.

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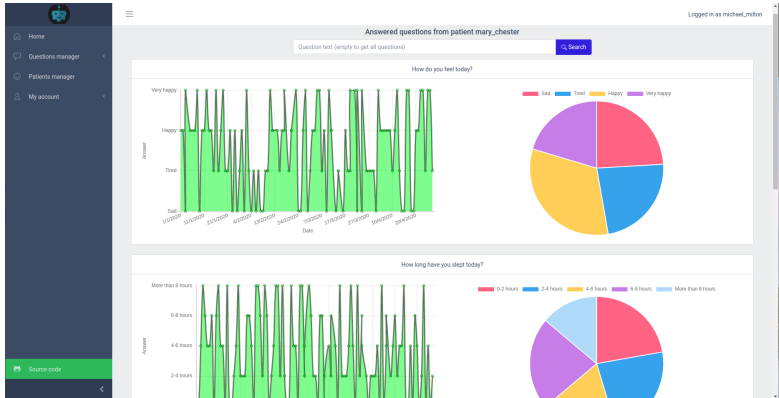


Figure: View data page.

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# Development environment

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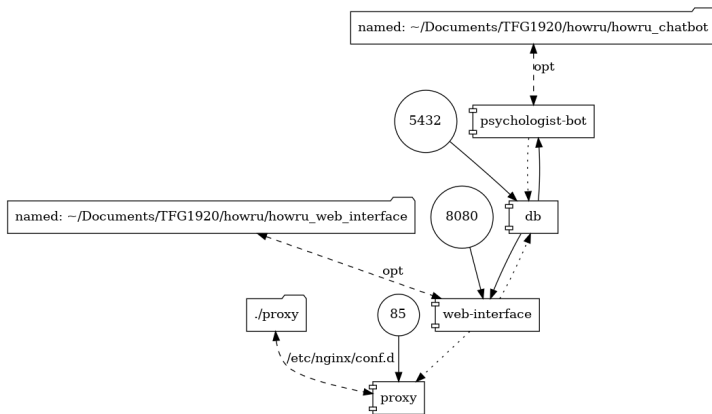


Figure: Docker-compose file schema. Generated by (PSIH, 2016).

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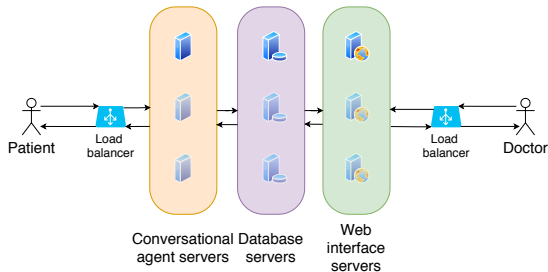
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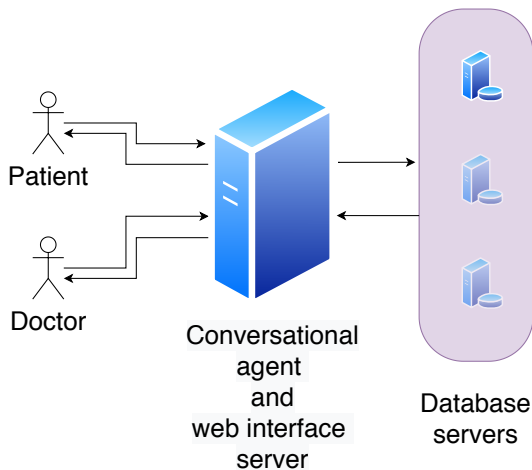
## 5 Discussion and Conclusions

# Production scalable environment



**Figure:** Scalable environment architecture diagram. Created using *diagrams.net* (*diagrams.net*, 2020).

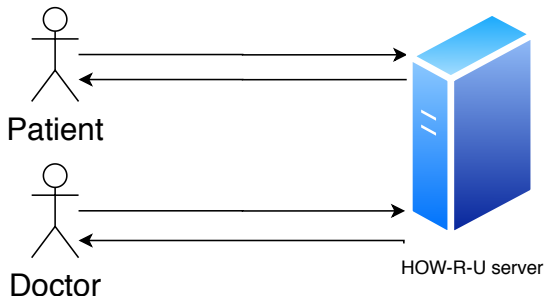
# Production non-scalable environment



**Figure:** Non-scalable environment architecture diagram. Created using *diagrams.net* (*diagrams.net*, 2020).



# Production one-instance environment



**Figure:** One-instance environment architecture diagram. Created using *diagrams.net* (*diagrams.net*, 2020).

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1. Different scenarios.
2. Multiple e-coaches.
3. Intuitive interface.
4. No extra software for patients.

1. Telegram is not used by the majority of people.
2. System deployment requires knowledge on computer science.

1. COVID-19 data analysis.
2. Telegram ensures privacy.

1. Elder people may not know how to use Telegram.
2. If patients do not have Telegram installed, they could install a specific app instead of Telegram.
3. Not all patients have smartphones.

Figure: HOW-R-U SWOT analysis. Based on <http://www.mostlycolor.ch/2015/07/swot-matrices-in-latex.html>.

# Conclusions

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- **Main goal:** *Conversational-agent-as-a-sensor* that asks questions defined by specialists to patients.

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- **Main goal:** *Conversational-agent-as-a-sensor* that asks questions defined by specialists to patients. ✓
- **Secondary goals.**





## Conclusions

- **Main goal:** *Conversational-agent-as-a-sensor* that asks questions defined by specialists to patients. ✓
- **Secondary goals.**
  - Graphical web interface for doctors. ✓
  - Flexible and scalable architecture to add functionality to the system. ✓
  - Architecture based on containers to host the different system modules.





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# The end

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# Time for questions