Proceeding of the 3rd International Conference on Public Health, Vol. 3, 2017, pp. 163-172

ISSN 2324 – 6735 online
DOI: https://doi.org/10.17501/icoph.2017.3220

INTELLIGENT DIGITAL ON BOARDING

Namrata Mishra

Altimetrik India Pvt. Ltd., India

Email: namrata.mishra86@yahoo.com

Abstract: In last few decades on boarding has been evolved from paper based approach to paper less approach and today on boarding can be done anywhere any time with any device. With the emergence of technology and availability of internet on boarding process becomes quite easy. But most of the time patient ends up providing non contextual information. Existing on boarding services give similar experience to all patients despite their age, gender and complaints. This paper is proposing a context aware digital on boarding solution for the patients to personalize patient's on boarding experience. Proposed solution understands patient's context with the help of workflow based questionnaire. Basis of questionnaire is patient's gender, complaint and age group. This solution generates summary based on the patient's response and publish summary which can help doctors in diagnosing the problem. This solution can be integrated to the existing hospital information system to provide better on boarding experience to the patients. Health Research Institutes can do health behaviors analysis of patients using data collected by system. This solution can be used by health workers in remote areas to understand the patient's problem by asking contextualized questions populated by the system and hence they can provide primary care to the patient.

Keywords: digital on boarding, context aware intelligence, work flow based questionnaire, natural processing language

Introduction

On boarding is the management of the early stages of a relationship between a business and a customer. The hottest industry of the moment -the tech industry- is obsessed with the client on boarding experience and has been using it as a competitive differentiation strategy for a long time now.

Health care industry is also moving towards customer (patient) centric. And hence industry is bound to provide better on boarding experience to the patients. Not many people enjoy filling out paperwork and our patients are probably not the exception. Most of them are already using the internet for most things, like applying for jobs, investing, renewing their driver's license, shopping and even looking for partners.

In last few decades on boarding has been evolved from paper based approach to paper less approach and today on boarding can be done anywhere any time with any device. With the emergence of technology and availability of internet on boarding process becomes quite easy.

Through digitization users have well on boarding experience, they fill forms with their convenience. But

- Most of the existing digital on boarding platform gives static experience to the patients.
- Hospital on boarding services gives similar experience to all the patients despite their age, gender and complaints.
- While on boarding hospital services, patient ends up providing very basic information or non-contextual information. All the contextual information they have to provide to the doctors and then doctors will diagnose problem and start with the treatment.

- Existing patient on boarding process is very time consuming because the information needed to on board patient is not fixed. While on boarding patient, different set of information is needed based on gender, age, and complaints.

Solution Approach

Intelligent digital on boarding is a context aware process which provides workflow based questionnaire for the input provided by the patient and hence gathering the information based on the patient's context.

The process include reading and making sense of the patient's input mapping it to the rules and relations of the question tree and then publish the most appropriate question to the user.

The process also prepares the summary based on the user's input.

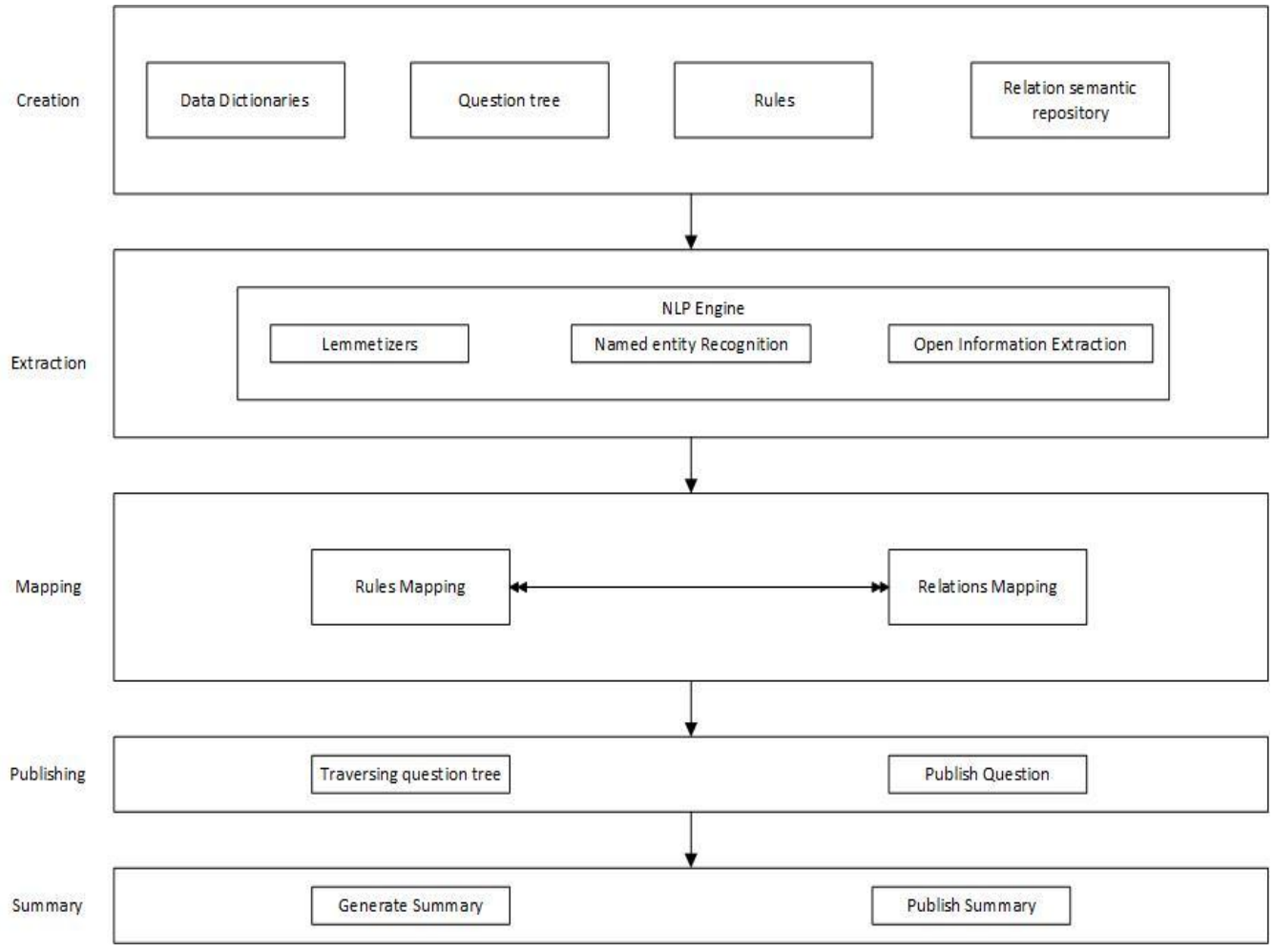

Figure 1: Figure depicts the five different phases of the solution.

Creation phase:

To make sense of user's input system needs knowledge base. The process is creating the different kind of data dictionaries, question tree, rules and relations among the questions to establish knowledge base.

- Data Dictionaries:

When patient registers a complaint it usually contains four things body part, its condition, or any disease name and duration of the complaint.

For Example:

I have fever: This contains disease name FEVER

I have headache: This contains body part (Head) and its Condition (ache)

The process creates data dictionaries for body part, conditions and diseases. To create data dictionaries process uses web crawlers to crawl WebMd knowledge base, UMLS knowledge base etc.

Table 1 Sample data dictionary for body organs

Body parts	Description	Department
Eye	The eye is a slightly asymmetrical globe, about an inch in diameter.	Ophthalmology

Table 2 Sample data dictionary for condition of body parts

Condition	Description	Severity
Pain	Highly unpleasant physical sensation caused by illness or injury.	Low/Medium/High

While process creates data dictionary for disease name it will add symmetrical meaning or layman terms for the diseases with the help of experts.

Table 3 Sample data dictionary for diseases

Disease Name	Description	Body Organ Mapping	Symmetrical Meaning Word
Fever	a medical condition in which the body temperature is higher than usu al and the heart beats very fast.	Whole body	Have temperature, have high temperature, down with temperature, have flue etc

- Rules

Other than the three data dictionaries there will a set of riposte value which contains the keywords/ information from the user's input which will not fall under the above said categories

For example:

User input is:" He is having pain in right eye from last two days".

Body Part: EYE ; Condition: Having Pain ; Riposte set value: right ;Duration: last two days

Rules will be defined by experts. Rules will be combination of

Body part +Conditions [AND/OR/NOT] /Disease + Age + Gender+ Riposte value+ Duration.

Rules will be stored in the form of hash maps.

Rule: Map<Key, List<Set>>

- Question tree

Question tree contains questions and relation among these questions.

Each question has a rule (defined in creation phase) associated with that, the question will be published only after validating the rule and verifying the relation between question.

Question tree will be created with the help of experts.

/R_x Is the relation between the questions.

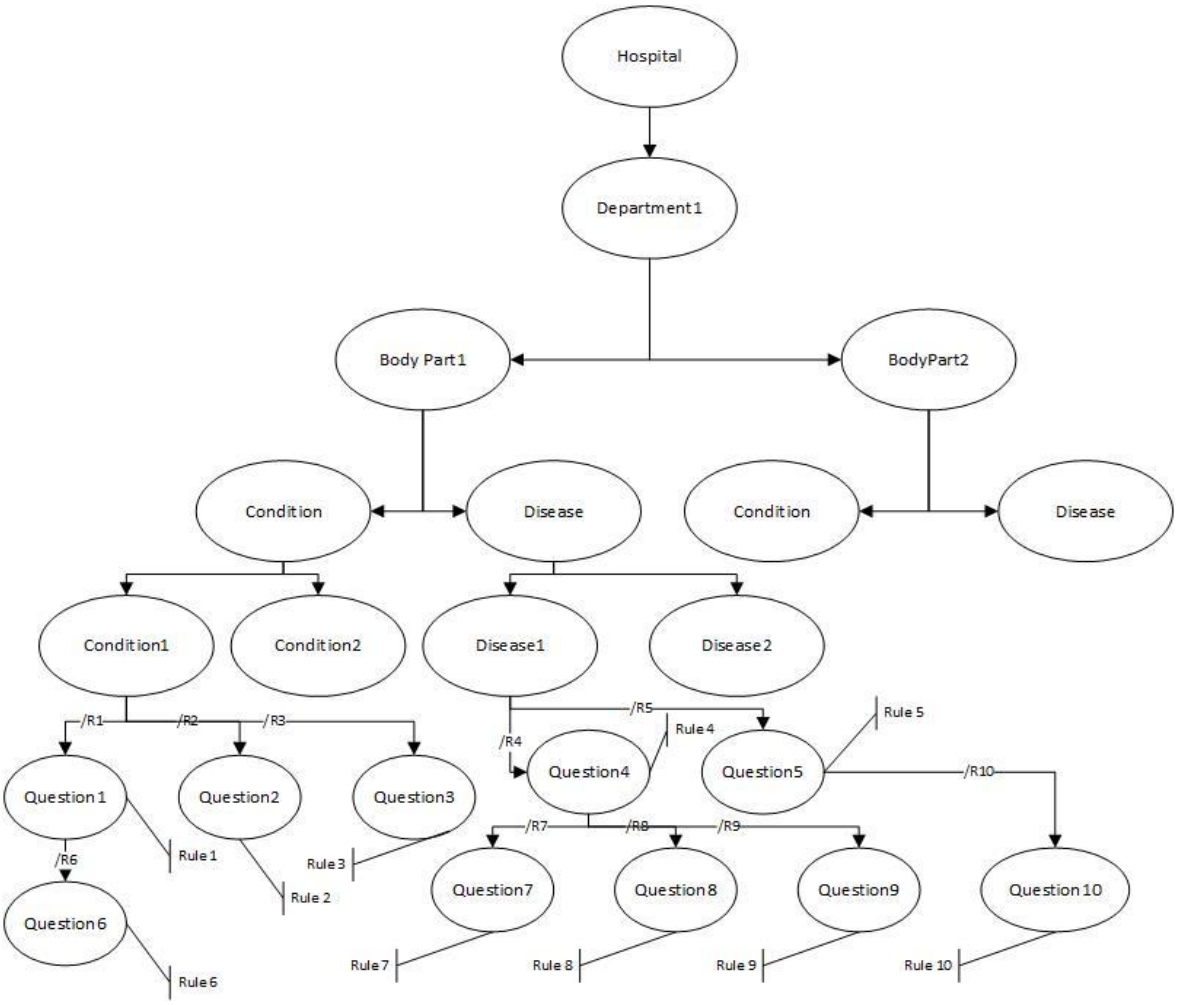

Figure 2: Sample format of question tree

- Relations

Question tree contains relation symbolized as ***"/R_x"*** between disease and the questions related to that disease or between condition and question related to that condition. There is a relation between two questions also.

The relations defined in question tree will be of form

Relation = <Set Name: set value>

Where Set Name can be any of the following:

Body Part, Disease Name, Department Name, Doctor Name, Duration, Condition or Riposte set value.

Relation can contain one or more sets separated by ";".

For example /R1= {<Duration: 1 week> ;< Condition: have cough>}

The process creates comprehensive semantic repository for relations with the help of experts. For each relation there will be a possible symmetrical meaning.

Table 4 Sample Relations with their symmetrical meaning words

Relation #	Relation	Symmetrical Meaning Words
R1	1 week	Last one week, past one week etc
R2	Comes & goes	On and off etc

Extraction phase:

Creation phase establishes the knowledge base for the system. The extraction phase of process includes Natural language processing techniques to extract meaning full information from the patient's input. The process uses three different natural processing language techniques lemmatizer, named entity recognition and open information extraction tool.

- Lemmetizer uses data dictionaries as the vocabulary and extract body part, disease name and department name.
- Named entity recognition extract doctor name, hospital name, date and time.
- The information extracted by open information extraction will be wrapped and compared with the data dictionaries and mapped to the condition and riposte set value.

Hence the output of the extraction phase is the different sets as body part, disease name, department name, doctor name hospital name, duration, condition and riposte set value.

Mapping phase:

Extraction phase results in different types of sets , to make sense of those set, mapping phase maps e sets to the relations with the help of rules and comprehensive set of relations created in the creation phase.

- Rules Mapping

The format of rules is the set of hash maps, so the process compares the output sets of extraction phase with the rules and map to the most probable rule.

- Relation Mapping

The output set of the extraction phase will be compared to the relation data dictionary and its symmetrical meaning words and hence most probable relation will be mapped.

Post mapping phase the output is the one rule and one relation.

Publishing phase:

This phase include traversal of the question tree and publishing the most probable question.

- Tree Traversal

Traverse question tree with department, body part, condition, disease, time duration, rule and relation as input using breadth first search algorithm for the first time. Store question and change root node value of the tree as that question.

- Publish question

Send the stored question as the response to the user interface for publishing the question.

Record user's input and repeats extraction phase and mapping phase. In publishing phase traverse tree with rule and relation as input using breadth first search algorithm for the first time. Store question and change root node value of the tree as that question and publish the question.

Repeat the process until the leaf node of the tree.

Summary phase:

While traversing the question tree, the process is storing the traversal path

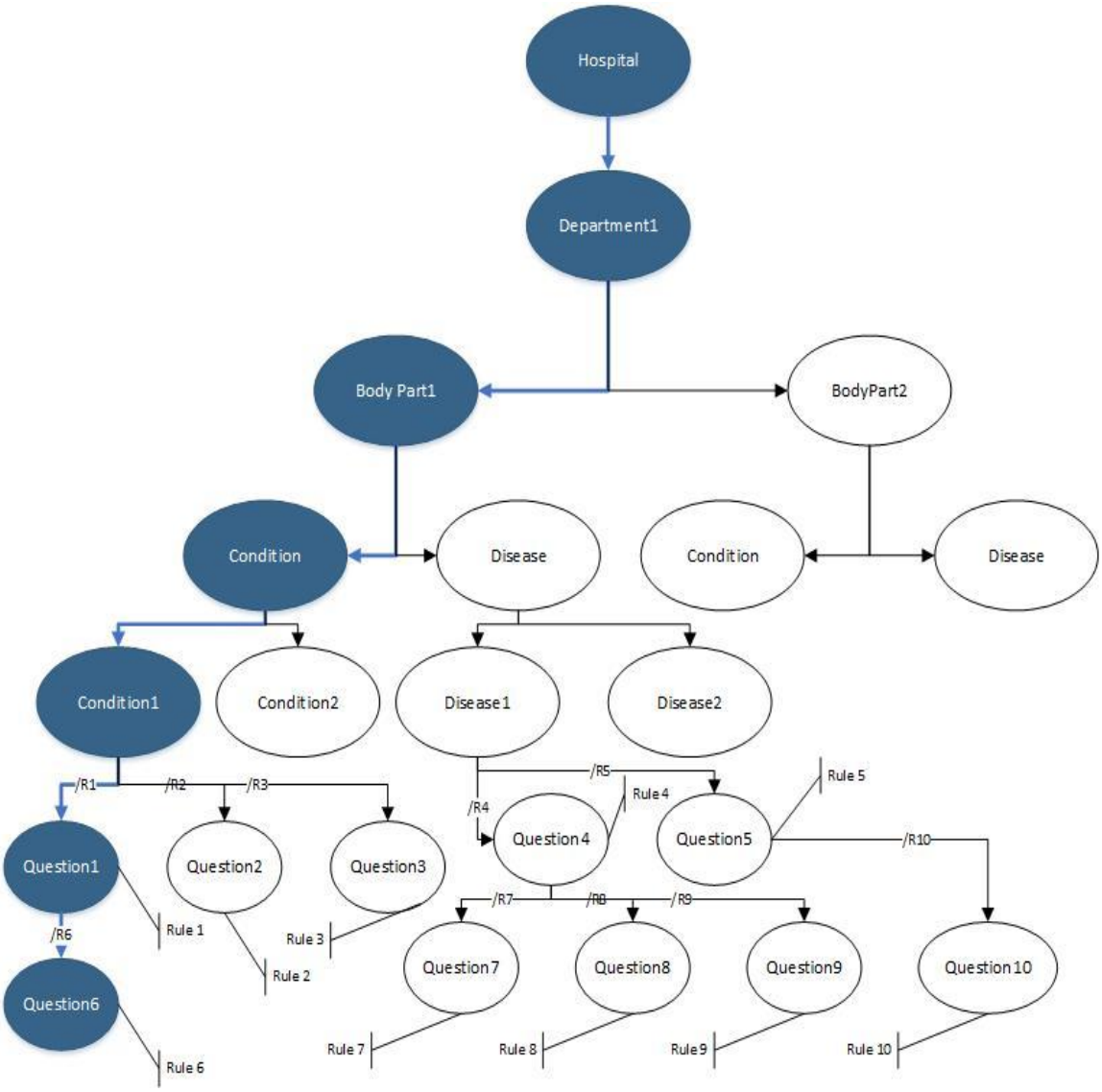

Figure: 3 Highlighted portion of the figure is the traversal path.

The format of the question tree contains the body part its condition/disease (if any) and the based on conditions/disease and the relations (extracted from the user's response) questions will be selected.

This traversal path will be helpful in generating the summary. The summary will be prepared in the following format:

Patient Name + Body Part +Condition/Disease + [Information extracted from questions and their relations]

Extracting information from the questions & relation tree path:

- Replace interrogative words from the questions with the relation of the question to the next question.
- Replace pronouns of the questions with the word "patient".
- Apply Open information extraction technique of Natural language processing (refer extraction phase for more information).
- Merge the extracted information of all the questions one by one.
- Remove duplicate data from the merged data.
- Append the merged data in the summary format.

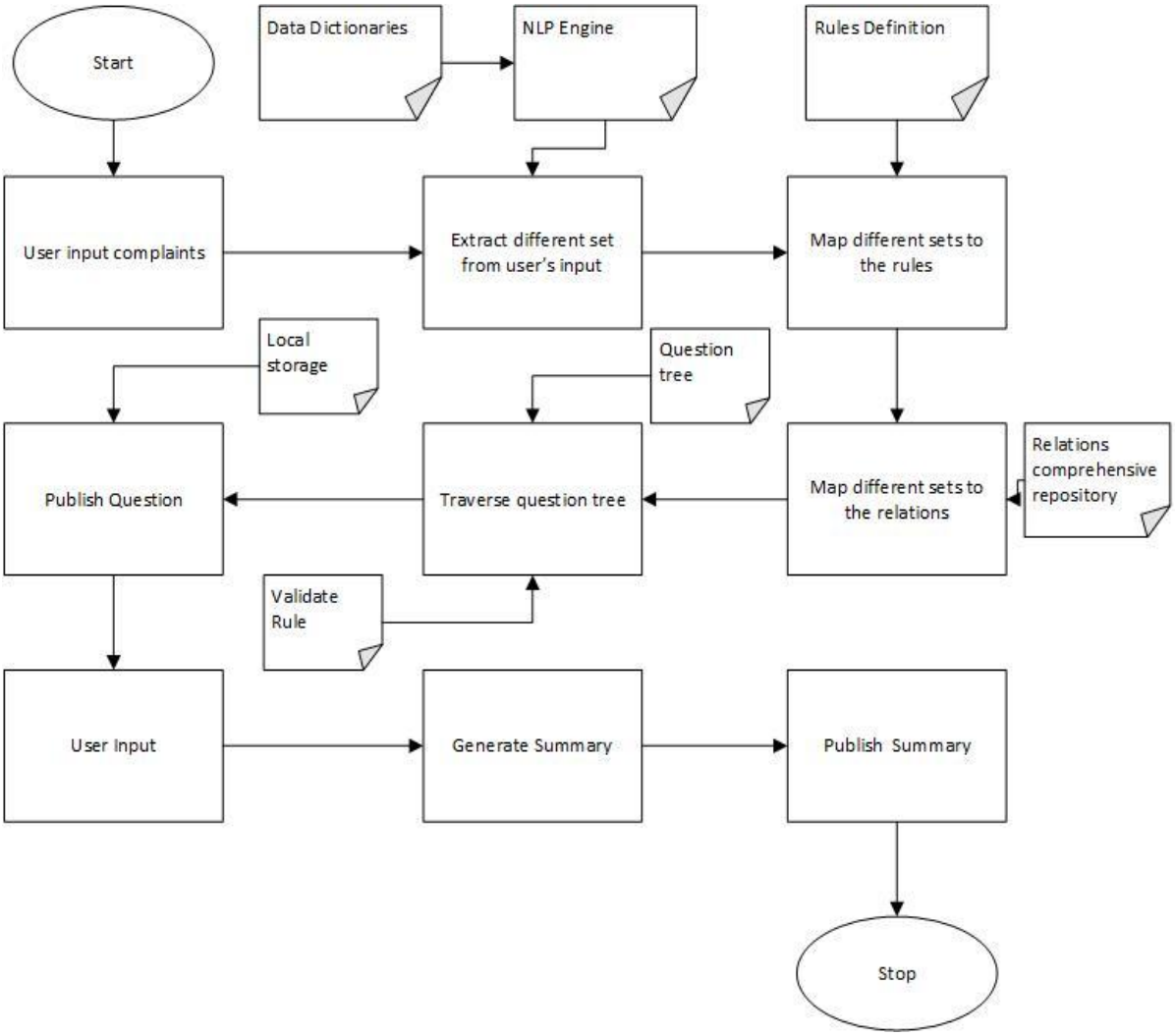

Figure 4: *is depicting the sequential flow of entire process*

Result

This platform is more relevant to the users on boarding any service online. It could be through website or mobile app.

I run this solution for a patient on boarding hospital services for chest pain using this platform.

Chest pain generally originates from one of the organs in the chest (heart, lung, or esophagus) or from the components of the chest wall (skin, muscle, or bone). Occasionally, organs close to the chest, such as the gall bladder or stomach, may cause chest pain. Pain in the chest may also be the result of neck pain that is referred to the chest, called referred pain.

Reason for chest pain could be heart attack, angina or any other. But if it is case of heart attack or angina delayed treatment can result in death of patient.

With the help of this platform user will able to provide all the required information related to chest pain on the way, so that after reaching to the hospital treatment can be started without delay.

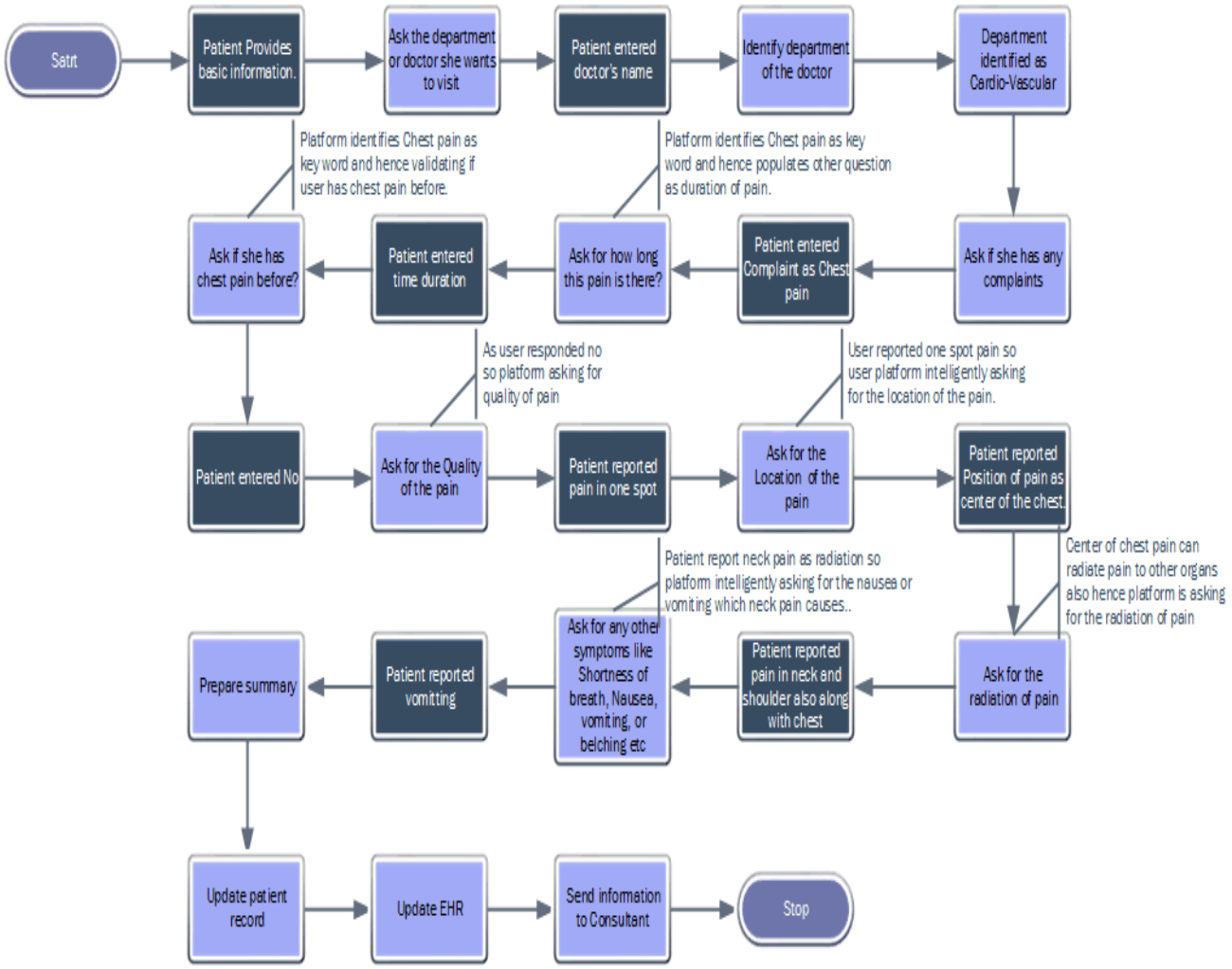

Figure 5: Figure shows the work flow based questionnaire system asks for a patient on boarding hospital services with chest pain as the chief complaint.

Business Usage of this approach

- **Hospital Information System**
  - This solution can be integrated to the existing hospital information system to provide better on boarding experience to the patients.
- **Health Research Institutes**
  - Research Institutes, through the data collected from the system, can do health behaviours analysis of patients.
- **Insurance Companies**
  - Insurance Companies can customize plans based on the patient's need.
- **Health Care Worker:**
  - Health care workers usually working in remote areas with very less facilities of consultant and they are not equipped with all the knowledge and hence sometimes they are not able to ask relevant questions to the patient about their complaint and hence patient has to bear the pain until they will get connected to the doctor and then patient explain complaint to doctor, this entire process take so much of time but with the help of this solution health care workers can ask the questions populated by the system based on user's input and hence the time to treat patient can be reduced significantly.

Conclusion

People can on boarding any service at anytime from anywhere through any device. People sometime don't use some of the service because their on-boarding process takes lot of time to provide information which is non-contextual.

The primary goal of this platform is to ask for context aware information for on boarding process which in turn will reduce on boarding time and gives user personalized experience.

This platform promotes culture of citizen developer and reduces cognitive overloading.

Future work

- In future the system could provide the recommendations of the test which could be required based the complaints provided by the patients.
- In future the system could trend the disease out-break in any specific region and learn to ask questionnaire based on the travel of the patients.
- In future there could mobile app for the same and could sync with the patient's travel details and provide notifications to the patients based on the disease outbreak in that region if any

References

ConceptNet, An open multilingual open graph (2014, Nov 4) Retrieved from http://conceptnet.io/

Chirstopher D. Manning & Hinrich Schutze. , (1999) Foundation of Statistical Natural Processing[Web Version]Retrieved fromhttp://ics.upjs.sk/~pero/web/documents/pillar/Manning_Schuetze_StatisticalNLP.pdf

Improve Patient On boarding (2014) Retrieved fromhttps://intakeq.com/improve-patient-onboarding

Abbas Saliimi Lokman, Jasni Mohamad Zain, Fakuli Sistem Komputer & Kejuruteraan Perisian, (2015), Designing a Cahtbot for Diabetic Patients, Retrieved from https://www.researchgate.net/publication/266872926_Designing_a_Chatbot_for_Diabetic_Patients

Sameera A. Abdul-Kader,(2015)Survey on Chatbot Design Techniques in Speech Conversation System, IJACSA , Vol. 6, No. 7, 2015

Eric Brill, (1995) Transformation-based error-driven learning and natural language processing: a case study in part-of-speech tagging, Computaional Linguistic Volume 21 Issue 4, December 1995

Natural Language Processing with Deep Learning, Retrieved from http://web.stanford.edu/class/cs224n/