Automated System for the Management of Electrical – Solar Production Equipment

Chaieb Chiheb
Department of Computer Sciences Technologies
ISET de Sousse
Sousse, Tunisia
Chaieb.chiheb@gmail.com

ABSTRACT**:** *Our objective is to develop an information system automated for the management of production of the electrical energy from the solar energy. This system consists of two softwares. The first one is a mobile application which communicates with a remote server in which is stored a database memorizing all the information of the process of electric production from the solar energy. This information concerns the production of the solar equipments installed at the customers and also the possible complaints declared by the appearance of an incident noticed on the equipment. The second application is installed on the server, has for role to communicate with its equipments via internet to get back all the data of production shown by inverters. These data got back since equipments solar (inverters) will serve to update the database of the server. The application of the server has the capacity also to generate alerts further to an electric production on an inverter not in compliance with the normal state. The database will be remotely exploited by the first mobile application to consult at a distance the state of these equipments, the possible complaints of the customers, the curves of productions of energies of these equipments, refreshment of the local data with the data of the server etc...*

Keywords: Component, Application Mobile, System Mobile, Energie Soalire, Onduleur Numérique, Serveur Distant

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1. Introduction

Renewable energies are energies whose source is unlimited and non polluting and whose exploitation causes less ecological damage, such as for example the sunning, the wind, the movement of water etc..

The photovoltaic solar cells are semiconductors able to directly convert the light into electricity. The photovoltaic inverters are incourtournable for a connection with the networks of the solar panels. They make it possible to adapt the outgoing D.C current of the generator towards an alternative course. At our days the technology of these inverters evolved with the integration of computer equipment their making it possible to be connected on a computer network and to exploit the data which they provide.

They also make it possible to control the general operation of the installation and indication of certain anomalies and transmission of the data, indication of output posting of error messages. The company New Energy recipient of our project uses the solar inverters Sunny Boy classed leadership for the systems of small and of average cuts. They allure by their exceptional output, their simplicity and their reliability here the image of this kind of inverter:

Figure 1. Inverter

2. Problematic

The problems noticed at the level of the current manual information system are diverse, among them we shall quote:

• Absence at the administrator of the information about the immediate states of inverters(solar equipment which convert solar energy to electric energy) installed at the customers.

• Absence of a strategy of follow-up of the productions of energy to compare their profitabilities and efficiencies.

• With a significant number of the customers and who demand incidents, the manager of the company will be overwhelmed..

Of this fact we envisaged the development of an automated system for managing the solar equipments, the follow-up of their immediate production of energy, to be able to answer in time the complaints of the clientele and to detect automatically failure of production to warn the administrator of it of the system. This system will allow customers to entering and using web to follow the energy production of their equipment and send their eventual complaints observed.

3. System Description

The equipments of production of the electrical energy concerned by our automated system are mainly photovoltaic inverters and solar panels which transform the solar energy into an electrical energy. The inverters which we treat are interfaced via the port RJ45, and consequently we can get back a lot of exploitable information by our system. Indeed according to the data sheet of these inverters, the latter can store the quantity of the immediate produced energy and also the accumulation of the total production since their putting on. This information on the production of the energy, to which is added information of identification and localization of the equipment will be registered in a database of the server and which will be exploitable in his/her turn by our system that we aim at developing it.

The administrator of this automated system will be capable of consulting since his portable equipment, the state of the inverter, and its immediate electric production and of answering the complaints of the customers having noticed of the anomalies of functioning of their inverter installed in their house. On the other hand during a new installation the administrator will store this new information at first on his mobile device in local and will activate the update of the "*central*" database stored in the server as soon as it will be possible for him, when he will be covered by internet. These tasks will be performed by the first module of our system, which is a mobile application.

The second module of this automated system developed on the server will have for role to feed the central database with the data concerning the production of inverters installed at the customers and this by connecting automatically with every inverter for the reading of these data. These inverters will be connected to internet and recognizable via their IP address, which corresponds to a recognizable and localizable customer. The same module installed on the server can detect certain anomalies of functioning of solar equipments as the absence or the insufficiency of the electric production in spite of the presence of the favorable parameters of production (good period of sunshine, favorable ambient temperature, inverter on the march etc.) And this by making appeal to Web services to know for example the climatic factors ambient of the equipment. In this case an alert is declared in the central database and which will be indicated for the mobile application at the administrator from his connection on the server.

The schema after describes our the kernel of our automated system is bellowed in figure 2.

The third module consists of a dynamic website available to customers to enable them to communicate with the company to file their claims, receive answers, reminder of payment terms, follow the energy production of their equipments, data update etc..

On this website also will be published all the technological innovations that refer to the Photo voltaic system distributed by the company,

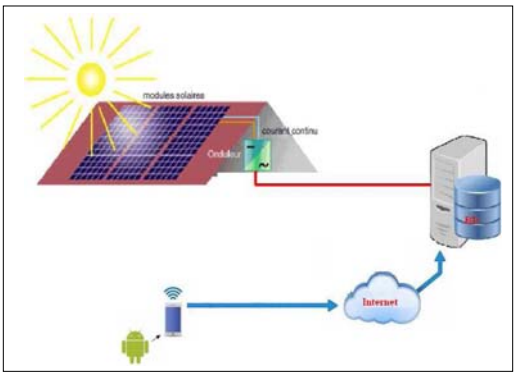


Figure 2. Schema of the Based System

4. System Specification

As we described it previously, our automated system consists of three modules:

★ **A mobile application** installed on the mobile device of the administrator allowing him to realize the following actions:

- Creation of a new installation in the local BD
- Answer the alerts sent by the customers this by consulting the central BD of the server.
- Follow the immediate production of equipments
- Updated by the local database towards the central database and vice versa.
- Allow to transfer the data protected in the mobile device towards the external server
- Allow to transfer the data of the external server towards the mobile device

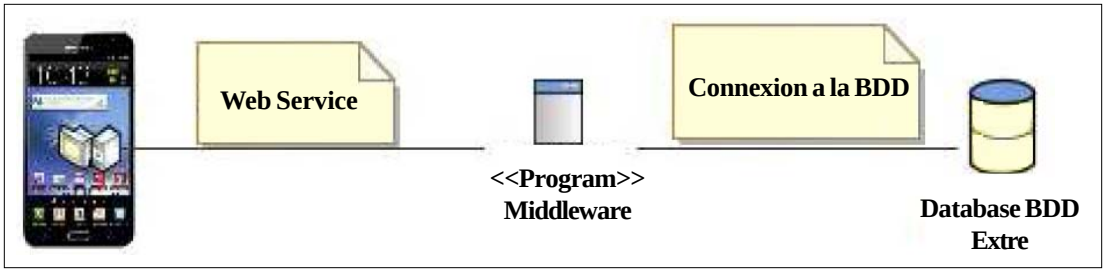


Figure 3. The Mobile application

★ **A real-time application** installed on the server allowing to realize the following tasks:

- Maintain the central database which stores all information of the system
- Detect the failures of production of the electrical energy: an on-line inverter and in the presence of the good weather conditions, does not produce enough energy is considered failing.
- Provide to use Web services to get back information the geographical ambient climatic position of the equipment, the factors temperature, period of sunshine etc.
- Warn the distant administrator in the presence of the alerts.
- Set in charge of the complaints sent by the customers.

★ **Dynamic web site** intend for the customers aim them to consult some of data from the central data base and send their claims , receive responses for their queries, see news of technologies, receive delay of payment, alert dysfunction, production history,

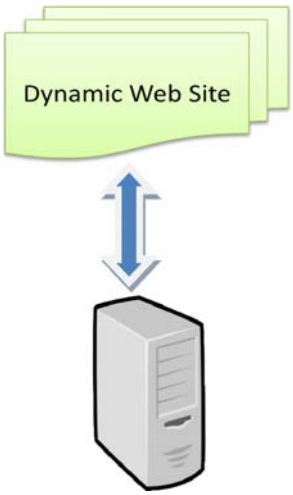


Figure 4. Server

So our system will be composed of these three modules and its architecture will be presented by the schema bellow.

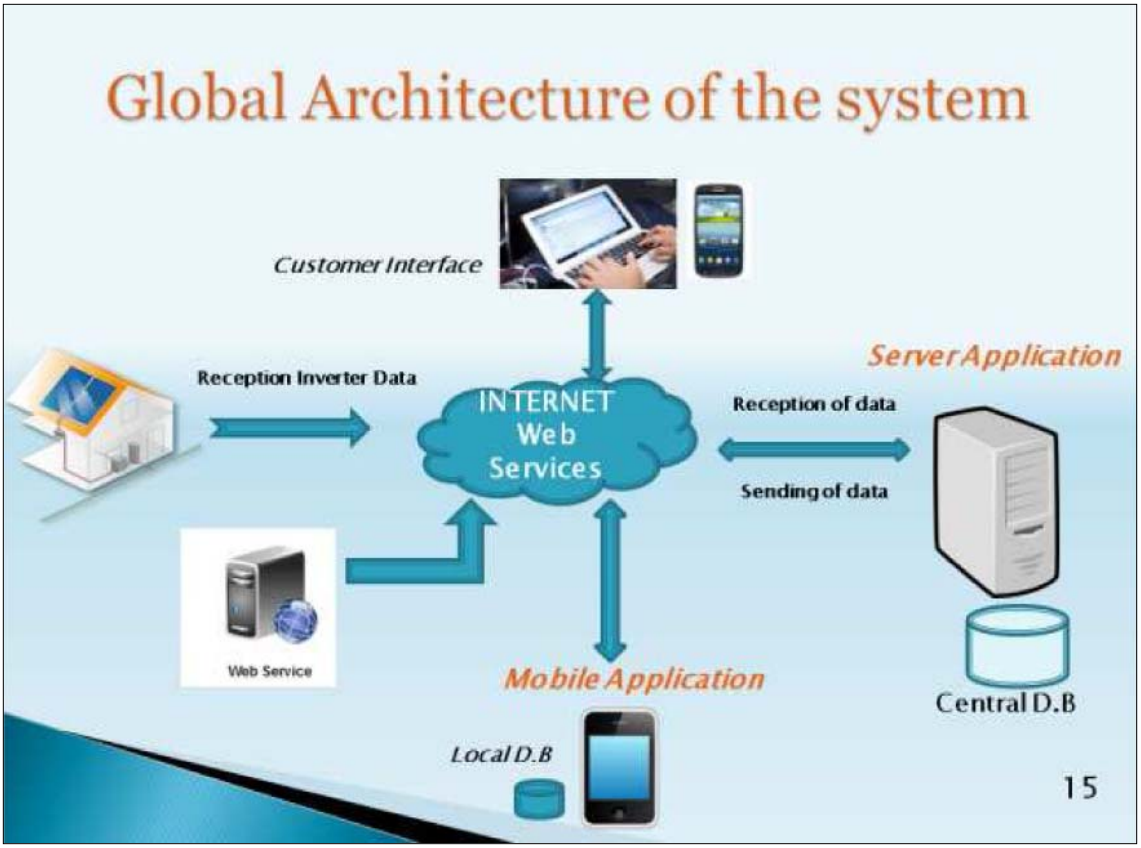


Figure 5. Global Architecture of the system

5. System Modelisation

For the design of our system, we have chose UML. In what follows, we present the most significant UML diagrams for this stage of the first module witch the mobile application. These diagrams are the uses cases diagram, the class diagram and the sequences diagram.

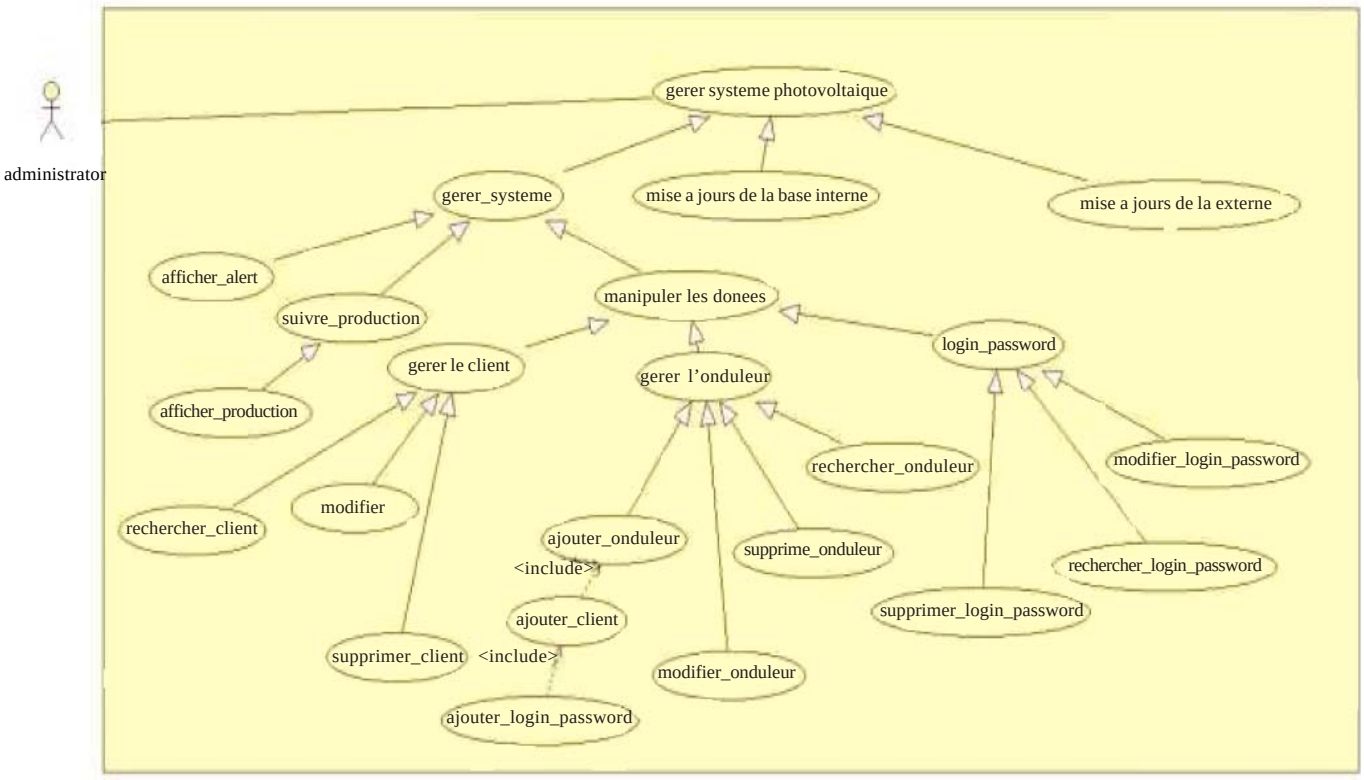


Figure 6. Use case diagram of the mobile application

3.1 Uses Cases Diagram

This diagram describes the principal functions of the first module of the system. These functions are carried out by the main actor who is the administrator of the system. The principals functions are:

- To manage basic information's

• creation new installation

• consultation given station

• management customers

- To manage the station (solar equipment)

• follow-up of production

• consultation Alarms

• manage the Server

- To update the local database

- To update the Server database

3.2 Class Diagram

This diagram traduces the logic data base in figure 7.

Table Onduleur
(*id_ond, marque,UDC,UAC,FAC,IAC, Statut, Adresse, Da*
te_Instanl, Prix, Prod_th,Val1, Id_client #) ;
Table Client (*id_client, nom,*
Prenom,Tel, adresse, E_mail, Val) ;

Table alerte (*Code_Alert, Niveau, design, Val*2);
table detection (*Id_detect, Date_detect, Id_ond #, Id_Alert#*);
table Login/Pasword (*Id,User,Password,Val*6);
table Production
(*Id_prod#, Date_Prod, tempurature, E_produite,E_total,V al*2);

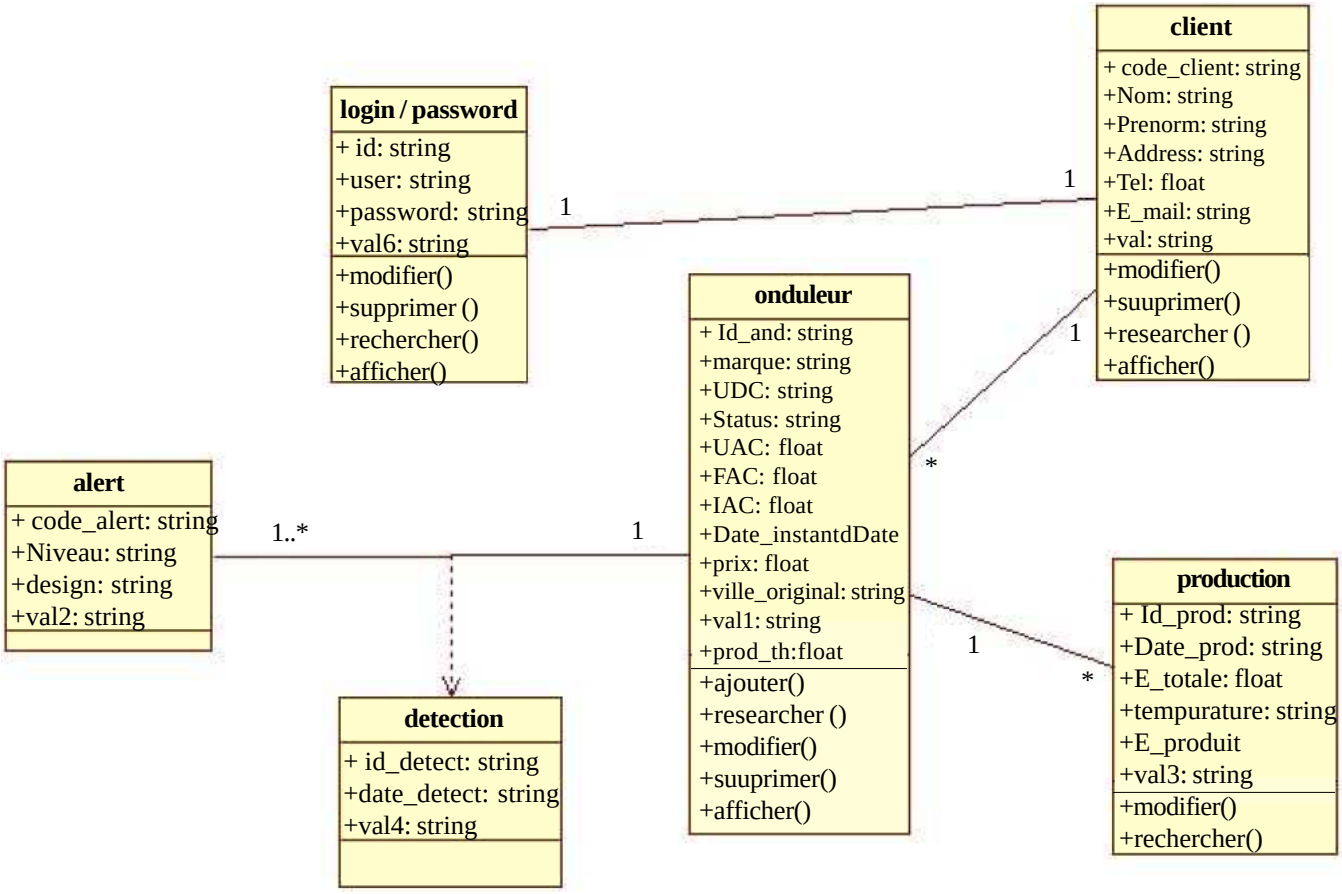


Figure 7. The class Diagram

This data base will be installed at the server. The manager can charge part of this database on its portable equipment by making recourse to filters. The local database will contain same the tables with the same structures as those of the server.

3.3 Sequences Diagram
We have chosed one sequence digram from others.

For the second module we present its organization of general operating in Figure 8.

6. Development Environment

Our system to be developed being composed of two modules:

- A first module which constitutes a portable application under Android equipped with a local database implemented under My-SQL/ SQL Lite. This application is intended to the manager of the company. he uses it to locally record the data of a new installation in his android equipment, to consult alarms emitted by the customers, to follow in real time the energy production of any solar station. this same application communicates with the database of the server to synchronize itself.

- A second module which constitutes a server application making it possible to recover automatically and periodically all the

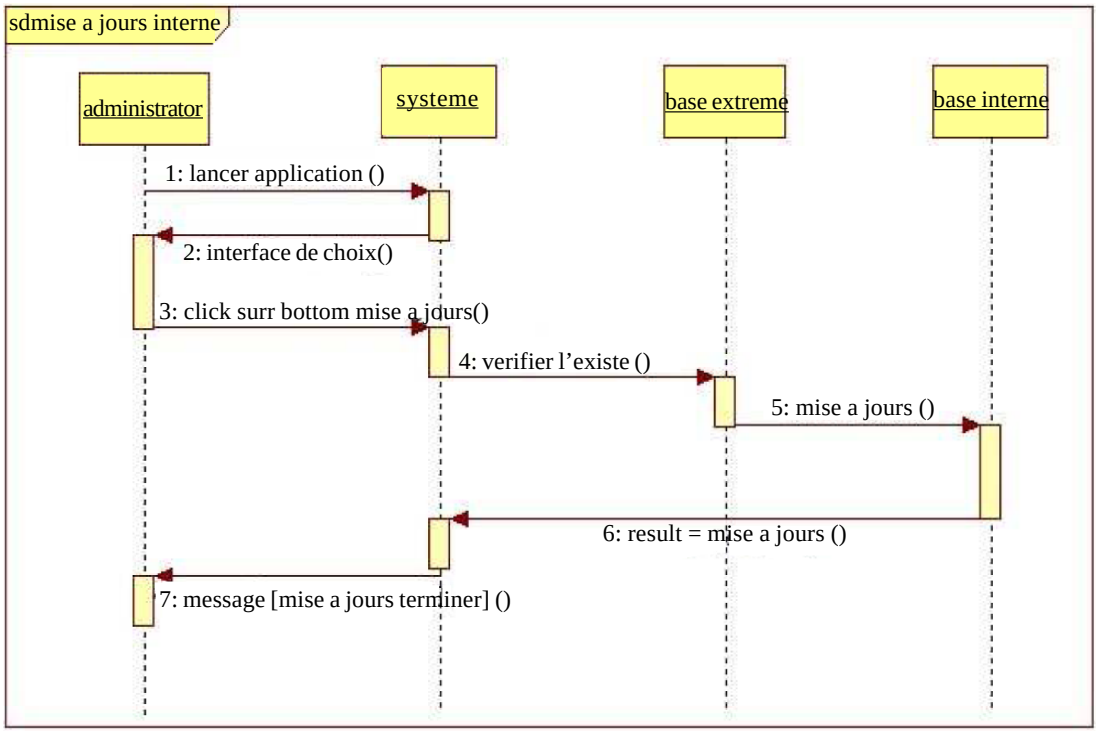


Figure 7. The Sequence Diagram

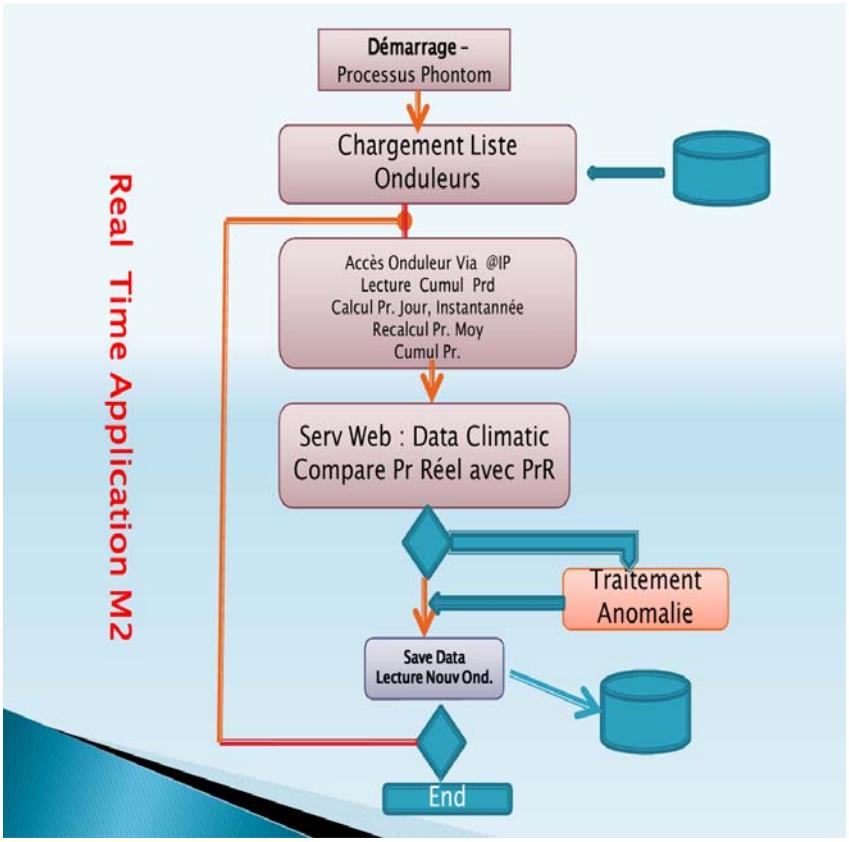


Figure 8. General operating Organization of the real time application

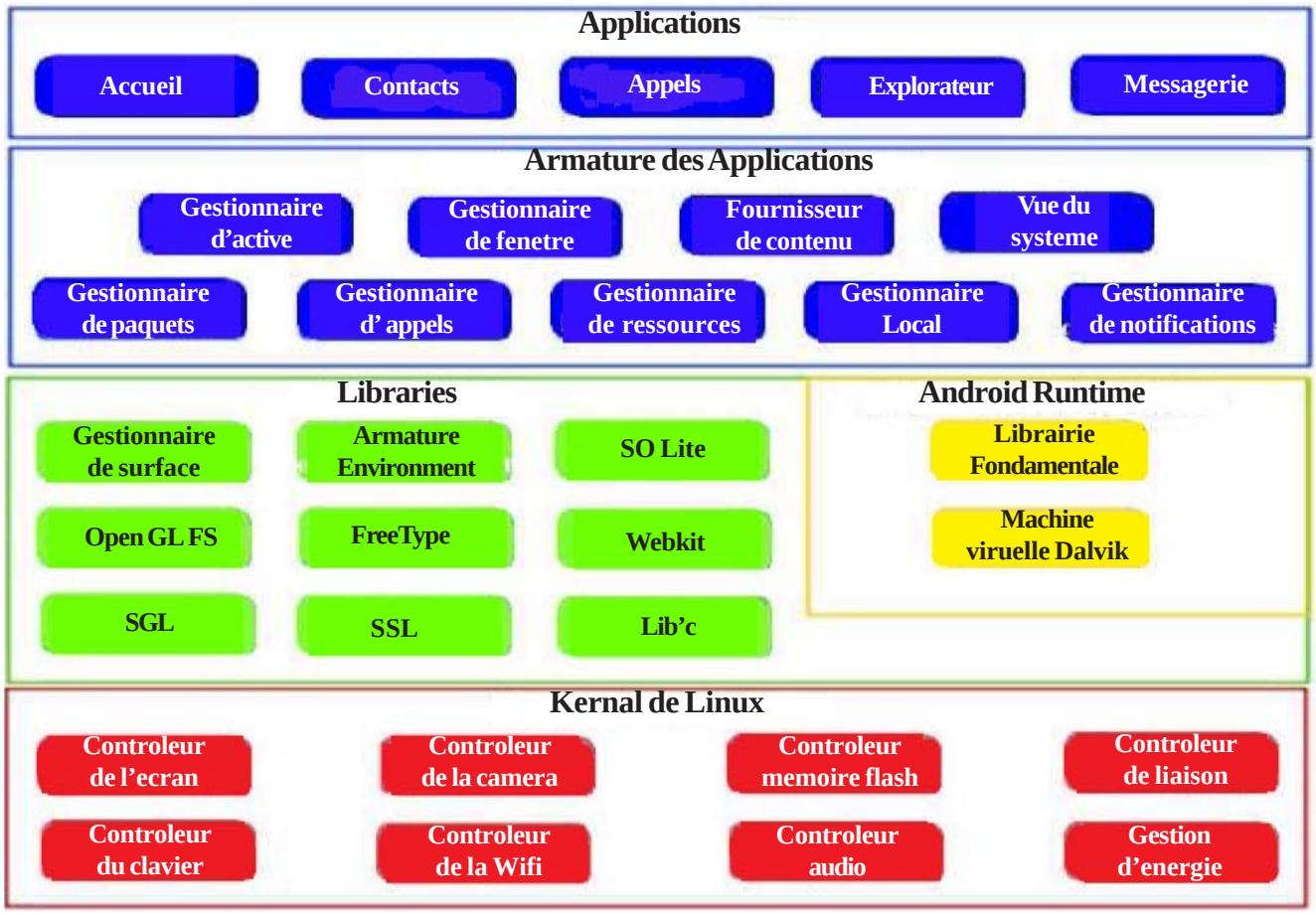


Figure 9. Mobile Application used an Android Application

Android Interface

Starting Interface

Management interface

Consulting state of an Inverter

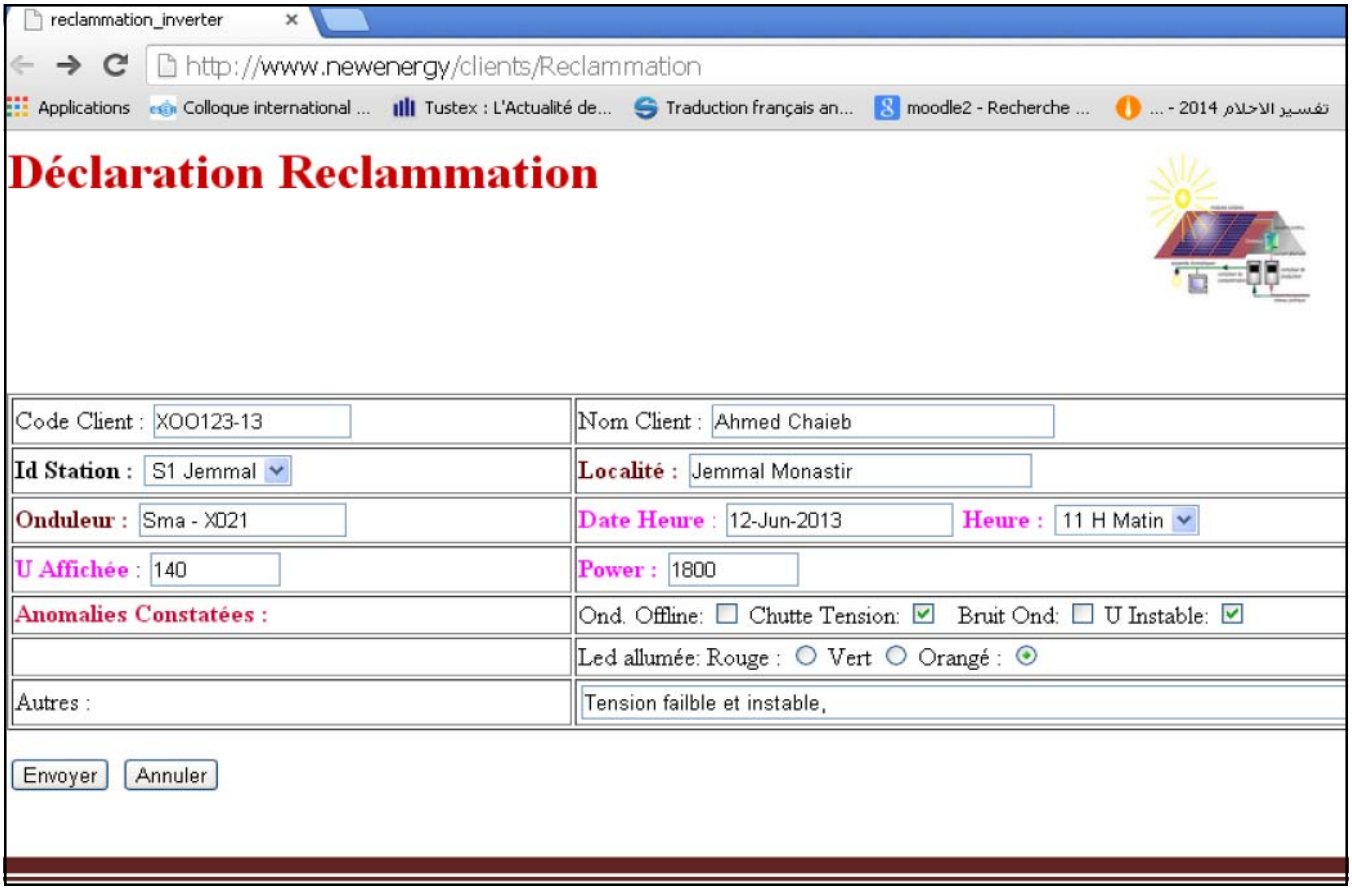
Managing an Inverter

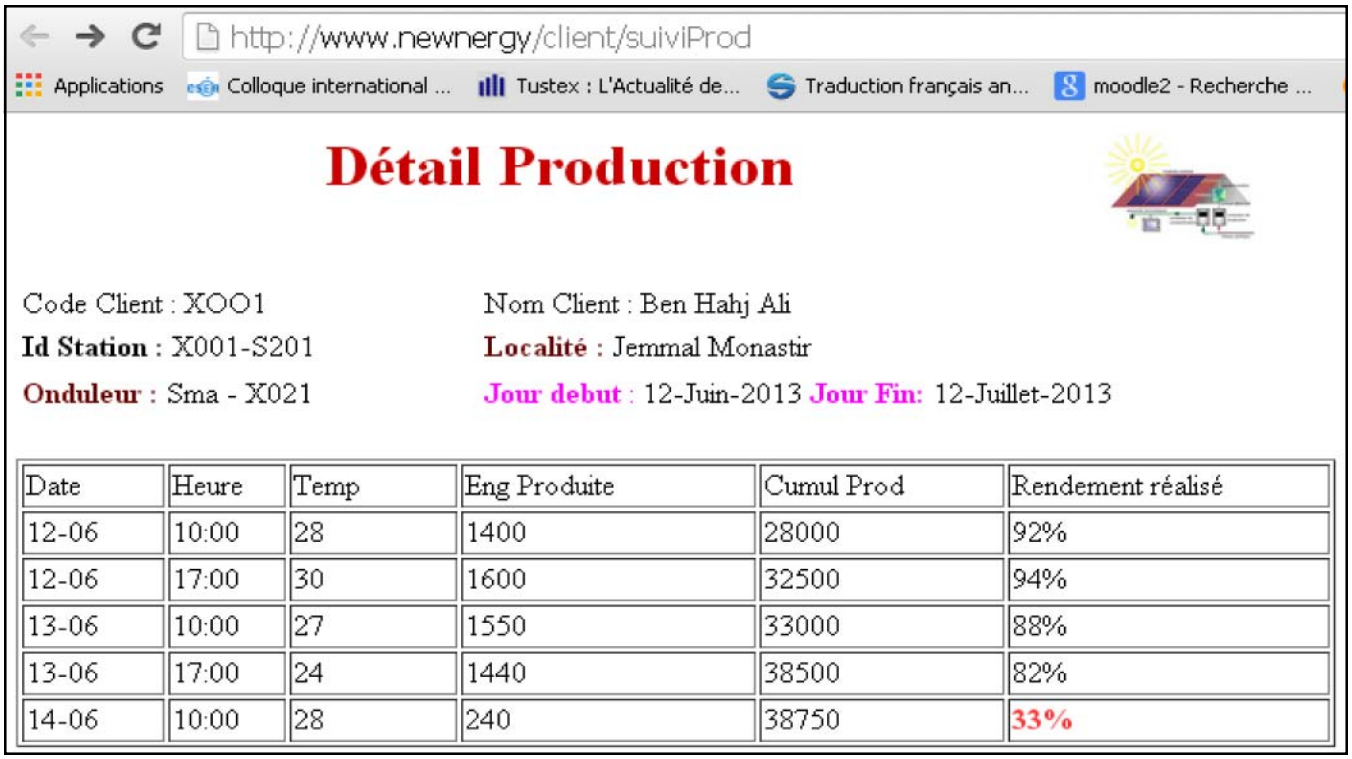
Figure 10. Android Interfeace which are realized for Mobile Application

data relating to the energy production for each station connected on the network. Each installation being referred and being identified by an IP address. These data serve to update the database server. In this database also, the alert customers will be recovered initially on the basis of the server database. For this purpose the customers use a Web site to send their alarms. in the second time these alarms will be forwarded to the portable equipment (bases local) of the manager of the company. Indeed this last since its portable will be connected on the waiter to recover these alarms. its portable application will enable him to identify and locate the target station.

To develop the first mobile application we have use an Android platform as shown Figure 9.

These are example of some android interfaces witch are realized for this mobile application as shown in Figure 10.





Date	Heure	Temp	Eng Produite	Cumul Prod	Rendement réalisé
12-06	10:00	28	1400	28000	92%
12-06	17:00	30	1600	32500	94%
13-06	10:00	27	1550	33000	88%
13-06	17:00	24	1440	38500	82%
14-06	10:00	28	240	38750	33%

Figure 11. Detailed production Interface

A lot of other interfaces of the mobile application are developed but not appear in this paper.

For the dynamic web site we have chose to present some of interfaces shown in figure 11.

7. Conclusion

This modest work constitutes a way adequate to manage the solar stations and also allow to communicate at a distance with the customers and can react in real time to solve any kind of failure of the system. To develop this system, we have decomposed it into two applications, one mobile application and a server application witch communicate together and each one has its own database. The local database in certain situation synchronizes the database of the server and in other situation it is the reverse.

The strong points of the server application are varied, owing to the fact that it manages a central database towards which will be conveyed all the data of all the stations of the company, and also it makes recourse to services Web to recover ambient information of the station like the instantaneous temperature, the sunning during the recording of the production of the station and the data which allow to geo-locate the station. The customer can access to this database from a mobile application or sample web interface, aim him to send his claims, consult a lot of information about inverter production (history, immediate) and get response for him claims.

8. System prospect

Work more on the server application and enrich it with The integration of web services, add more controls on data received from remote customers inverters and push to automatic detection of system malfunctions.

We hope that this modest work contributes in the evolution of the technology of development of the computer systems where they find their scope of application, which is for our case a company of installation of the solar stations for the production of electricity.