

International Journal of Advance Research in Computer Science and Management Studies

Research Article / Survey Paper / Case Study

Available online at: www.ijarcsms.com

Modelling for Licence Management System Using Fingerprint based Mobile Biometrics

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Abstract: Modelling captures the design decisions mandatory for a complete system specification and creates a concrete picture of the entire system. The idea is to develop a paper on modelling for managing driver, licence and vehicle information by the numerous traffic officials to replace the annoying existing system of licence verifications. It comprises of minutiae detection on the driver's fingerprint image followed by OCR on the number plate of driving vehicle and displaying the corresponding records from the database. For detecting vehicle thefts, an SMS for verification and validation for any attempted malicious acts of robbery in cases of mismatch between the vehicle information and corresponding owner information followed by data analytics upon the offenses information for numerous driving patterns using it for effective road management.

Keywords: modelling; interface; service; driver; official.

I. INTRODUCTION

Modelling is an important aspect of the software development life-cycle. Implementation requires a solid modelling document that it can rely upon. This paper hopes to do the same. The system mentioned here is to ease the system of road travelling without the use of licence papers via a biometric authentication (here fingerprint) for displaying personal and licence related information and number plate for vehicle information using which the identity of both the person and his vehicle can be revealed. In case of fraudulent vehicles or doubt of the same, an SMS is sent to the owner of the vehicle registered specified in the database for deciphering the correct identity. In addition to this, analytics is also supported for pattern recognition.

The modelling proposed here is drawn using Visual Paradigm 12.0 Professional Edition. This paper hopes to present a concrete system model to ease the understanding of the problem faced and the solution to it. Additionally, Service oriented architecture based modelling is also described along with database modelling which includes E-R diagram. The flow of the system is described using data flow diagram

II. BUSINESS MODELLING

1. Business Process Diagram

This is one of the foremost graphical representations used for modelling the system described as shown. The Business Process Diagram consists of 4 Pool processes- Driver, Server, Official and Database. The system starts with the official logging on the system. If the login is a success, the server process is dynamically created for that particular session otherwise a network error is thrown. An acknowledgment is sent to the client prompting the setting up of the stage for fingerprint extraction followed by the driver providing his fingerprints on the android device held by the official.

Here, both the fingerprint image and the number plate for OCR processing after capture are sent to the server for further analysis. Once the image is received by the server in wait stage, both the images are sent (number plate and fingerprint to

Cygwin for minutiae detection). Once the respective processing is done, they are sent to the database for record retrieval by performing a “lookup” and sent back. Also, the records are periodically extracted for analytics as shown in Fig.1.

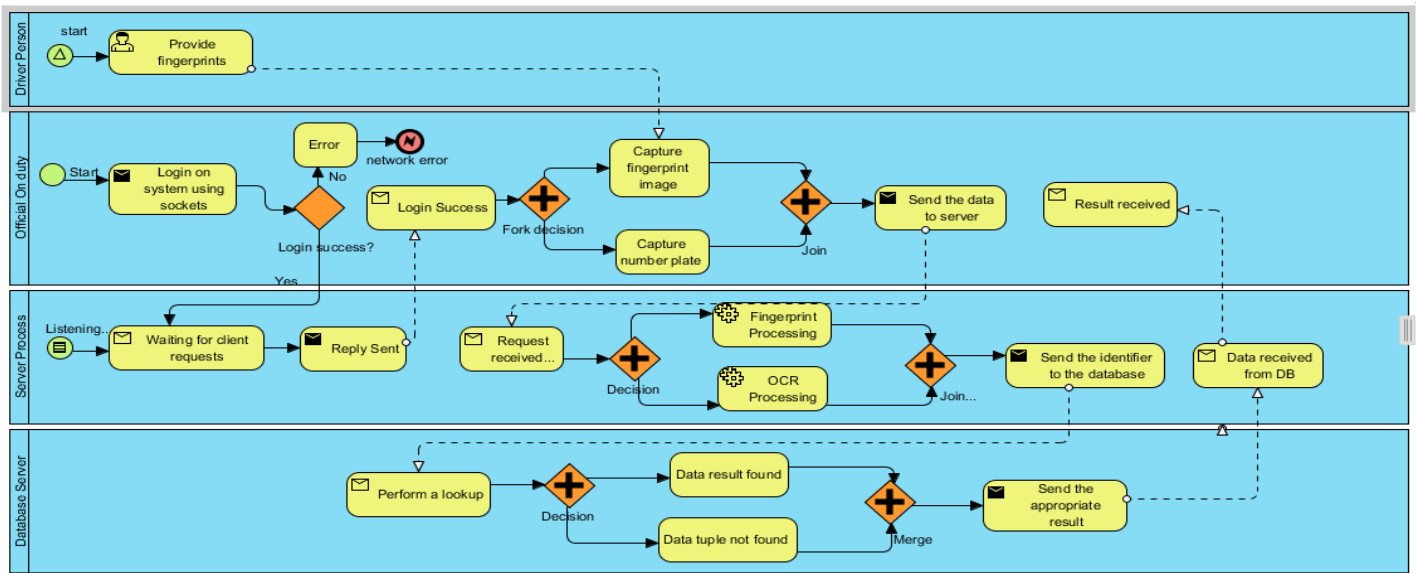


Fig.1 Business Process Diagram depicting the business flow

The different types of tasks involved in the process communication are:-

1. Send: The client process sends a message to the server process denoted as *black mail* symbol. This communication is initiated by the client to the server for requesting a service.
2. Receive: This is sent by the server process to the client process in reply to the request. It is denoted by *blank letter* symbol. It is either in form of an acknowledgement or results sent after performing required execution.
3. User: The person having the particular responsibility for each related action assigned. Here, it is the driver providing images.
4. Services: These are provided by the server maybe for providing the necessary functionality to the users of the system.

2. Conversation Diagram

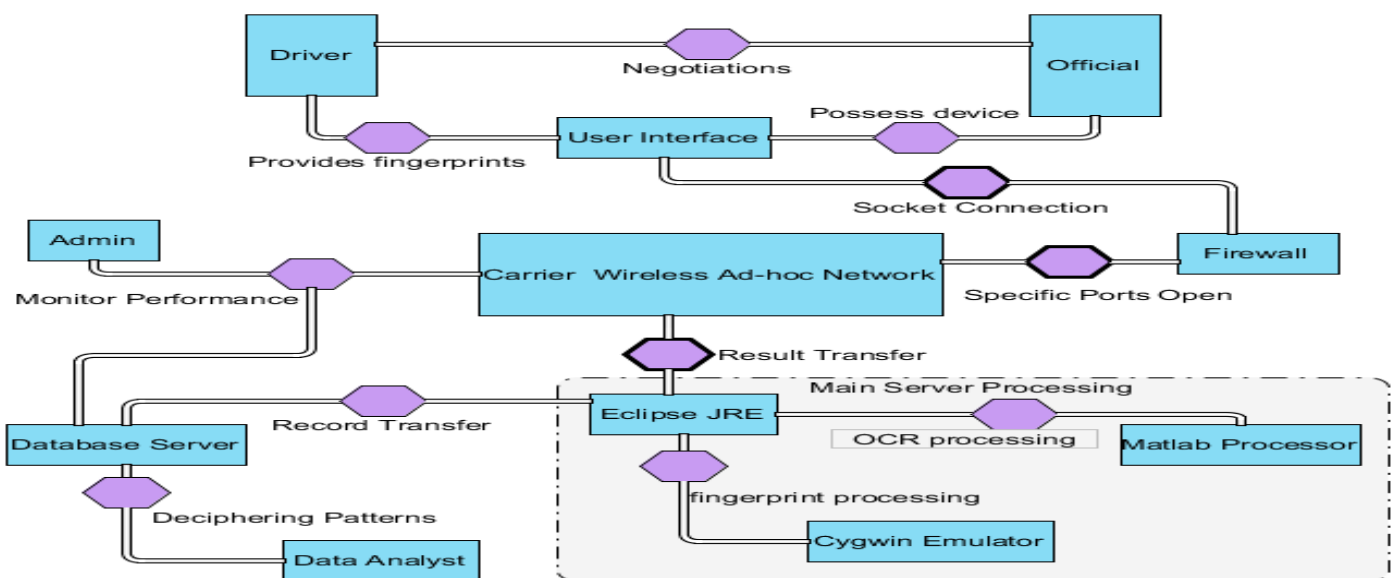


Fig.2 Conversation Diagram showing the interactions between the elements

The conversation diagram consists of the UI mediating the interactions between the driver and official. This interface then interacts via the ad-hoc wireless network using sockets. Only the specific sets of ports are open which allow multimedia image

transfer. The firewall causes any other port connection to be blocked. Meanwhile, the admin monitors the performance of the database and overall system functioning. The data analyst is responsible for deciphering useful patterns. Main server processing includes the Eclipse performing execution using functionality of the Cygwin emulator and MATLAB and displaying back the results retrieved as shown in Fig.2.

3. Event Driven Process Chain

It consists of firstly official login on the system and the driver providing the fingerprints via the supporting hardware Scanner and Android Tab. Once the fingerprint is captured, it is sent to the server along with the number plate via the socket connection. Once the image has been received to the other server side, server processing commences. There are 2 phases- Minutiae and feature extraction along with number plate extraction requiring complex algorithms for processing which are Bozorth3 and MATLAB processing. The identifier serves as the identifying key for further record traversal and retrieval. Analytics for deciphering patterns is the responsibility of the analyst and the admin for monitoring and maintenance as shown in Fig.4.

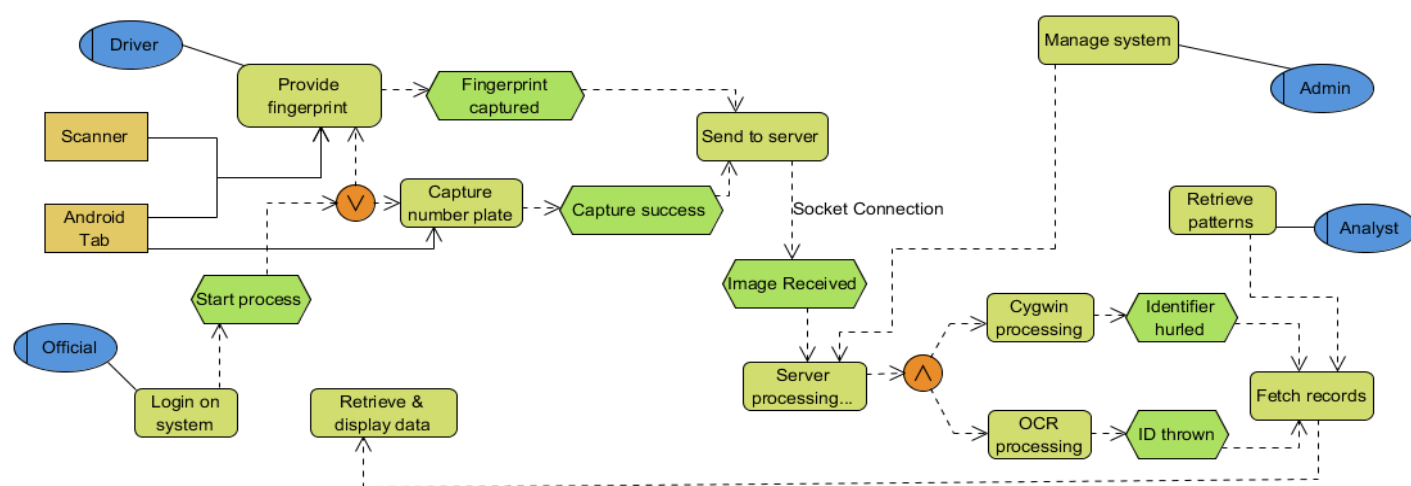


Fig.3 EPC Diagram depicting the process collaborations

III. WORKFLOW MODELLING

1. Data Flow Diagram

The DFD describes how the system flow is administered and managed when this particular system is put into execution. The main pertinence of using this diagram is to determine the imminent point of impact where the majority of the system functionality is performed or is being assisted to. Knowing this will help in conforming to the system requirements and greater cohesion is achieved with minor or no impacts to the flow of the program logic.

It consists of the driver providing the required images to the official wherein on capture, the official sends the data over the network. This is received by the waiting server process of the JRE environment. After appropriate execution, they require access to the respective databases. As for offenses, they are inserted and updated accordingly by the official on the field whenever required. As shown in Fig.3; this nebulous data can be used for extracting conclusive and definitive patterns.

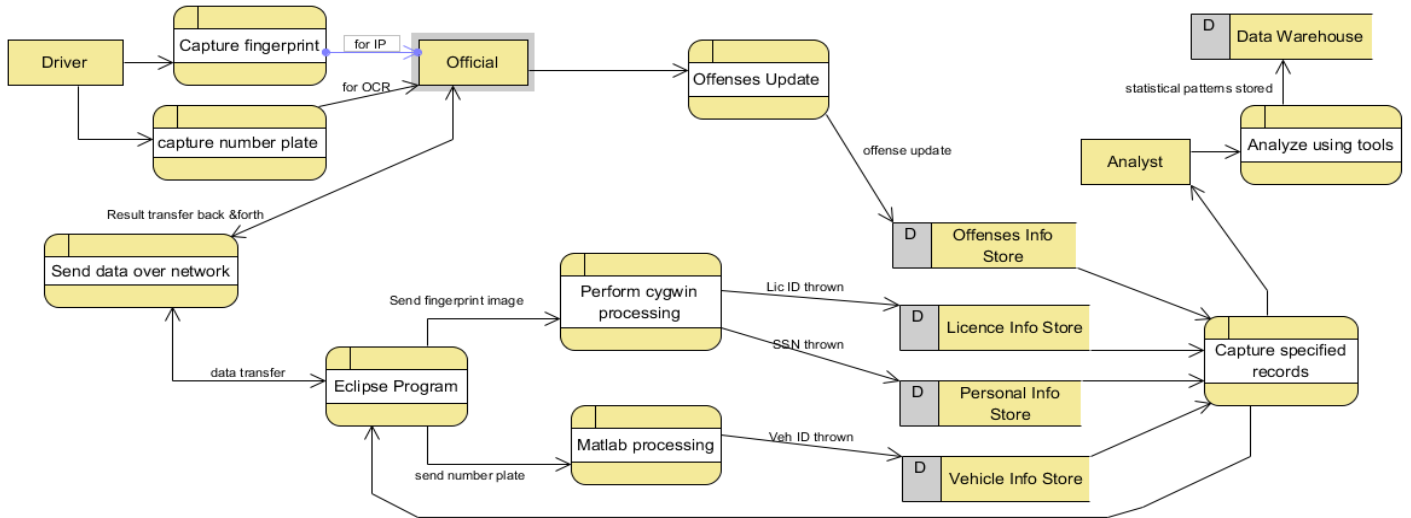


Fig.4 Data Flow Diagram showing the flow processes

It is done using mining tools (Weka) in the form of statistical graphs, bar charts, pie charts and other visual representation. Thus, the DFD is one of the most eminent diagrams explaining the structure and cohesion of the system architecture explained above.

2. Mind Mapping Diagram

The mind-mapping diagram consists of the main idea i.e licence system; based upon which the different sub-ideas are generated as in a mapping tree. Firstly, the hardware acquisition is involved of acquiring android device and scanner for getting fingerprints. The next step involves getting onto the system login where the official logs onto the system server via socket authentication.

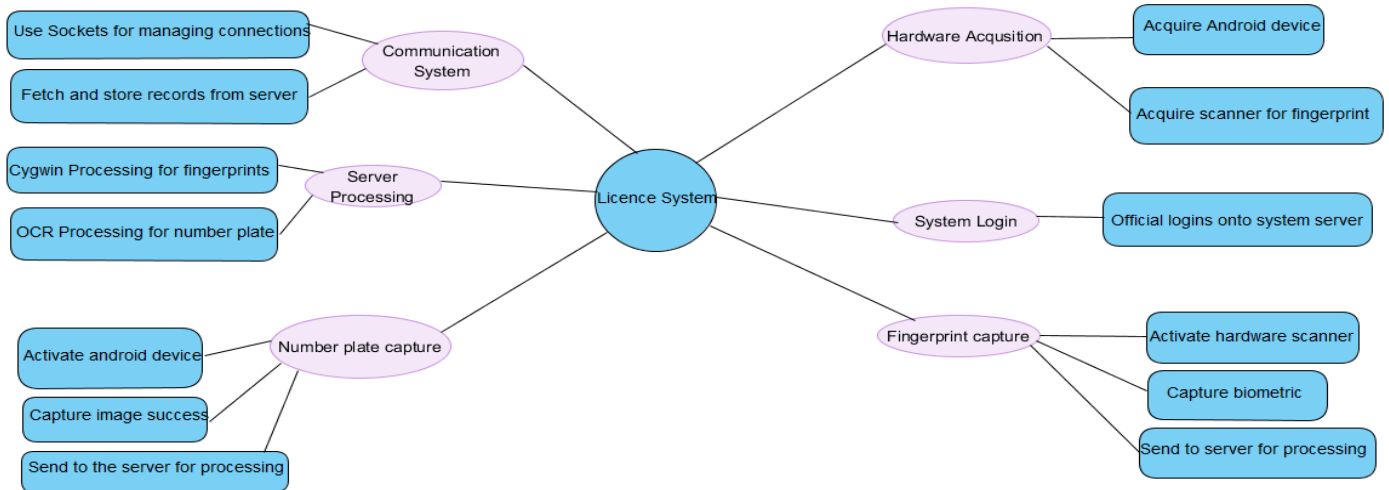


Fig.5 Mind Mapping Diagram describing the disparate branching in the system

The third step involves capturing the fingerprint starting with activating the device. The fourth step involves capturing number plates for determining the vehicle information. Once camera is activated, it captures the number plate. The fifth step comprises of sending both the fingerprint and number plate to the server for OCR processing. The fingerprint using Cygwin and OCR processing using matlab displays the appropriate result which is sent to the recipient. This is managed through socket providing open ports which can be utilized for maintaining and traversing of data and records to-and-fro.

IV. SERVICE ORIENTED ARCHITECTURE MODELLING (SOAML)

1. Service Interface Diagram

This diagram provides an insight about how the services are provided by the various interfaces. It comprises of driver and official as consumer and provider of Service Interface (Licence Management) with various parameters of their own. Similarly, Cygwin Emulator and Eclipse are consumer and provider of “fingerprint processing” followed by the Service Interface “Database System Management” by admin and specialist who are the provider and consumer respectively.

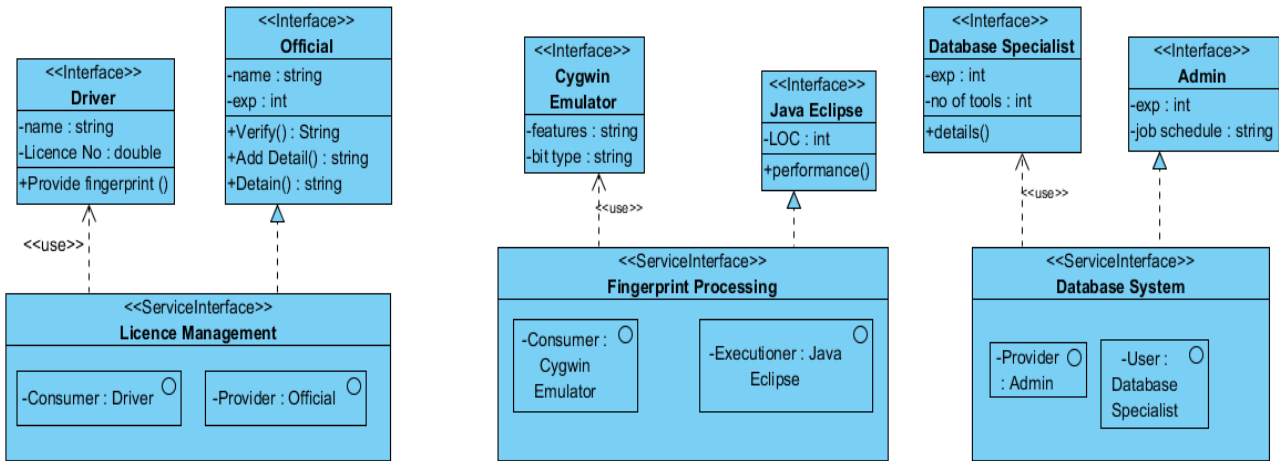


Fig.6 Service Interface Diagram

2. Service Participant Diagram

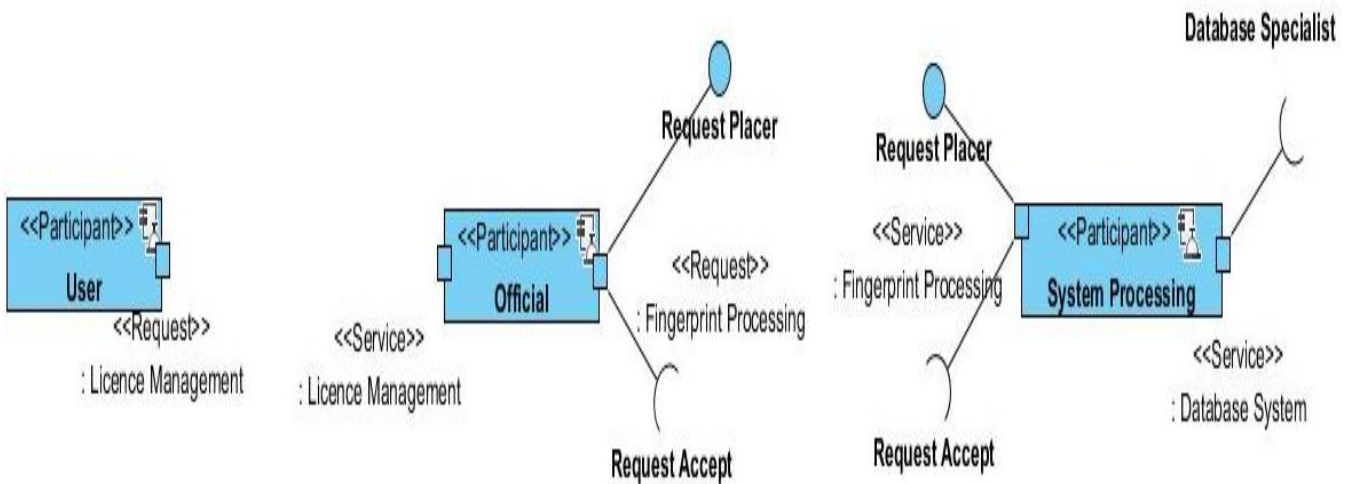


Fig.7 Service Participant Diagram

The service participant diagram comprises of the Participant which are the User, Official and System processing engine. The user and official are mutually involved in the service of licence management and authentication. In the interim, the official sends a request to the server engine for processing of the sending record. This request when gets processed and sent back to the recipient in the form of processed and valuable information which is then used by the official for further analysis with the user.

3. Service Architecture Diagram

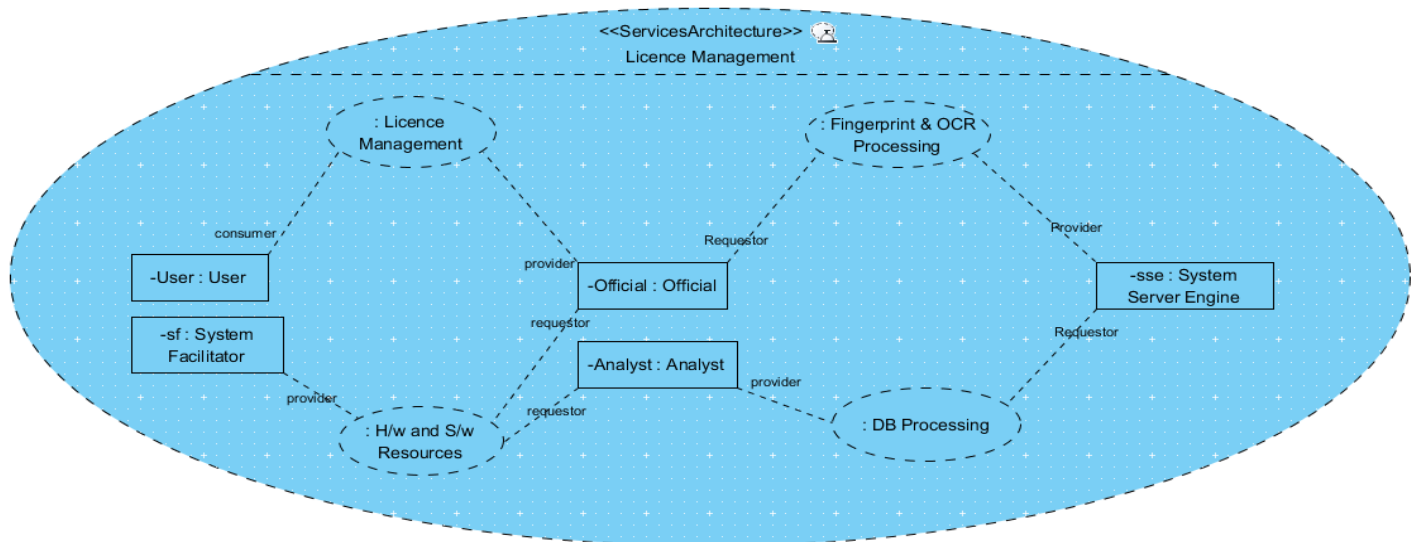


Fig.8 Service Architecture Diagram depicting the architectural elements

This diagram depicts the service architecture where it consists of 3 participants – user, official and system server engine. Firstly, the system server engine provides fingerprint and OCR processing as the provider interfaces to the required requestor-the official or the person hitting the server machine with requests. It also acts as the requestor interface for database processing from DB server.

Meanwhile, in the process; the analyst acquires the necessary resources in the form of processing power and response time, other indicators to perform analysis and other operations on the DB data. Thus, he represents provider interface for DB processing while acting as requestor interface for resources. Also, the system facilitator acts as the provider of resources for easy flow and also acts as the general administrator of the system. Lastly, the official is involved in licence management provider interface whereas the consumer acts as the consumer interface by consuming the services. The following is depicted in a short table as listed below:-

| | Licence Management | Fingerprint and OCR Processing | DB Processing | H/w and S/w Resources |
|----------------------|--------------------|--------------------------------|---------------|-----------------------|
| User | Consumer | NA | NA | NA |
| Official | Provider | Requestor | NA | Requestor |
| System Server Engine | NA | Provider | Requestor | NA |
| Analyst | NA | NA | Provider | Requestor |
| System Facilitator | NA | NA | NA | Provider |

Table 1 General Relationship between participants and Roles/ Interfaces

| | Requestor | Provider | Consumer |
|--------------------|-----------|----------|----------|
| User | — | — | Y |
| Official | Y | Y | — |
| System Engine | Y | Y | — |
| Analyst | Y | Y | — |
| System Facilitator | — | Y | — |

Table 2 Tabular display of the different elements' roles achieved in the system

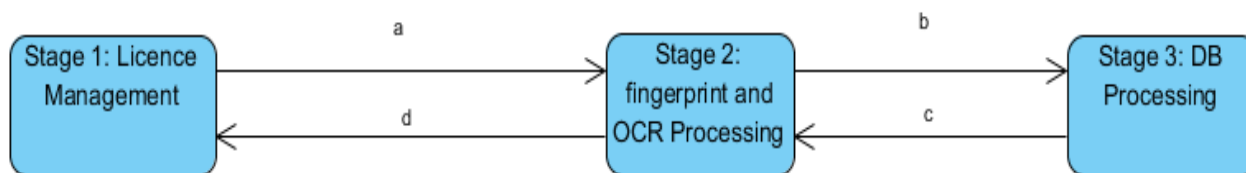


Fig.9 Brief Diagram describing the interactions explained above

a. The user and official perform the first step of managing licences and the biometric stage takes place over here. In short, the data gathering and aggregating is this stage accompanied by sending it over the server for further analysis.

b. In this stage; the system using Cygwin and eclipse does the required job and sending it to the db for record extraction.

c. The record extraction takes place and analyst condenses the data into meaningful patterns and sends the result back to the server.

d. This record is sent back and the official uses this information for appropriate purposes.

4. Service Contract Diagram

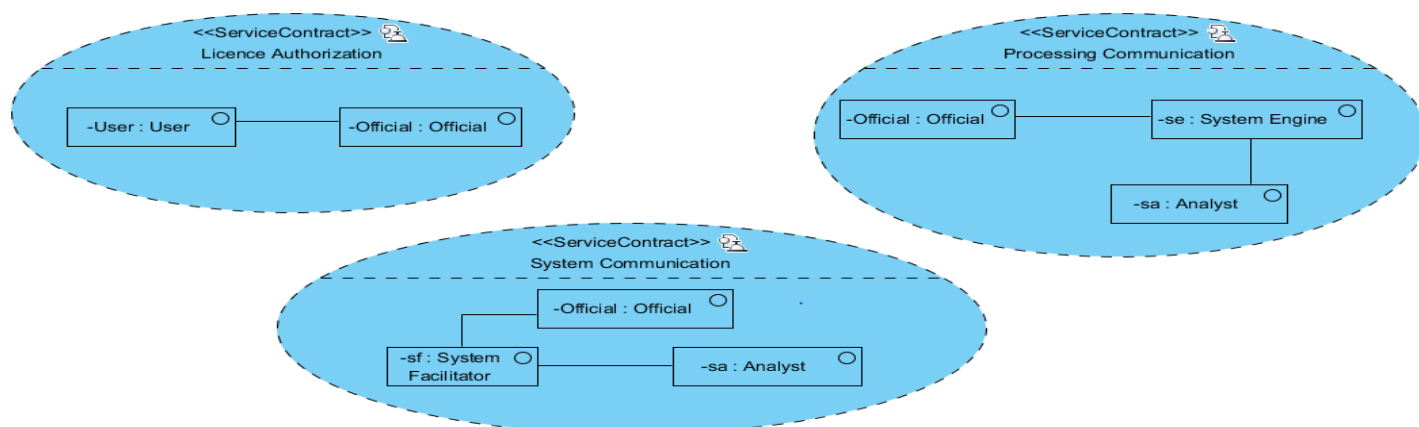


Fig.9 Service Contract Diagram

The service contract diagram depicts the interrelationship between the different components by specifying them as form of “service contracts”. These contracts are individual components that perform a particular role in the system. Here, there are 3 contracts namely- Licence Authorization, System Communication and Processing Communication.

In the first case; the user and official are engaged in checking and verification processes. This stage is the preliminary stage in the system. It is dependent on the next 2 stages for final output. The second stage i.e; Processing involves official interacting with the server which in turn interacts with the analyst for its communication. The result is then sent to the server and finally to the official. Lastly, in the third case; the system facilitator facilitates the interaction of the analyst and official by distributing the required accessories for proper operation of the system.

V. CONCLUSION

The modelling aspects have been profoundly delineated and the individual elements explained explicitly. The importance of modelling is clearly evident as it provides the backbone for any major analysis and evaluation. The modelling aspects defined in this paper depict how the licence system can be improved drastically to a more software-oriented approach. The modelling involving business, workflow coupled with service oriented architecture pores over the diverse aspects which otherwise would not have been consummate. It starts right from a bigger, diverse picture and then uncovering each minute detail in a top-down fashion. Thus, this paper aims to provide a highly concrete design specification of the newer innovative system and the vast conclusive representations to support the same.

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