

Middle East Technical University
Computer Engineering Department

CENG 491 - REQUIREMENTS ANALYSIS REPORT

DIGITAL POSTER with INTERACTIVE BLUETOOTH

By

redCat



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1. INTRODUCTION

1.1. Project Definition

Nowadays, information access and data transmission had became very easy, there are many of devices invented to make our lives easier. It is not a luxury to have such devices, moreover they became our daily life.

As it is known commonly, traditional posters are inexpensive and widely used because of their ease of installation. However, traditional posters provide only visual information for the users and are lack of displaying other poster contents such as date or place information. In this project, we will implement a digital poster displaying a color poster image to an VGA monitor and send the necessary poster information to cell phones or Personal Digital Assistants (PDAs) supporting bluetooth functionality. In this Project, we will be designing and programming necessary hardware required making the color poster image visible on the LCDs. Besides, users will be able to receive necessary poster event data via cell phones with this product. The poster we are going to implement can be used in subway stations, hotels, lifts, boardrooms, classrooms, shops, supermarkets and public areas or aboard various forms of transportation, like taxi, train. It will be used for advertisements; campaign, seminar, concert, competition, etc posters.

1.2. Project Scope and Goals

In this Project we aim the followings:

- To integrate Bluetooth device to a XSA-3S1000 Board
- To program XSA-3S1000 Board using VHDL
- In the range of the Bluetooth device be able to find cell phones or PDA's supporting Bluetooth functionality and transmit the necessary data to them.
- To enable cell phone or PDA users record the event data of the poster as a calendar event.
- Admin will be able to upload the digital image and the event data in few steps, which will be stored in XSA-3S1000 Board, and finally transmitted to people, who can be

interested in that.

- To display poster image to VGA monitor
- To provide the admin with ease to use

In this project, we have focused on these topics:

- To organize a complete project
- To program the PDA in a user-friendly manner
- To make XSA-3S1000 communicate with admin and passers-by using integrated Bluetooth device.
- To enable passers-by record the event data as a calendar event.

1.3. Application Areas

DigiPost may be widely used in both advertising and marketing industries:

- Travel industry is all about distributing data. Travel promotions should be announced very quickly, because the update times are very frequent. Controlled from a central location, the company can relieve in total cost of designing, printing, shipping, and hanging of a poster plus the man hours. Thus the usage of DigiPost would provide scalability and cost effectiveness.
- During presentations, you may come up with a competition in your area, and the audience may receive the due date and the topics to their palms via bluetooth.
- Weather conditions may be displayed on them wherever needed, and received by people via their cell phones.
- Passengers may receive auto advertisements from the Digital Posters during their journey on the road, or while waiting for a flight.
- Competitions; instant win or to provide unique entry code for web site access
- Promote pop bands through ring tones and wallpapers

1.4. Bluetooth Technology

Bluetooth wireless technology is the simple choice for convenient, wire-free, short-range communication between devices. The key features of *Bluetooth* technology are robustness, low power, and low cost. The *Bluetooth* specification defines a uniform structure for a wide range of devices to connect and communicate with each other. It is a globally available standard that wirelessly connects mobile phones, portable computers, cars, stereo headsets, MP3 players, and more. A fundamental *Bluetooth* wireless technology strength is the ability to simultaneously handle both data and voice transmissions. This enables users to enjoy variety of innovative solutions such as a hands-free headset for voice calls, printing and fax capabilities, and synchronizing PDA, laptop, and mobile phone applications to name a few.

The Main Features of Bluetooth:

- Operates in the 2.4GHz frequency band without a license for wireless communication.
- Real-time data transfer usually possible between 10-100m.
- Close proximity not required as with infrared data (IrDA) communication devices as Bluetooth doesn't suffer from interference from obstacles such as walls.
- Supports both point-to-point wireless connections without cables between mobile phones and personal computers, as well as point-to-multipoint connections to enable ad hoc local wireless networks.

1.5. Xilinx FPGA Bboard XSA -3S1000 Technology

The controller device including FPGA board with bluetooth controller that we use in our project has following features;

- XC3S1000 FPGA
- XC9572XL CPLD
- 32 MByte SDRAM
- 2 MByte Flash
- 100 MHz oscillator
- Parallel port

- Keyboard/mouse PS/2 port
- 512-color VGA port
- 7-segment LED
- Pushbuttons and DIP switches
- 84-pin prototyping interface (65 free I/O pins)

The XSA-3S1000 board from XESS has one million gate Spartan 3 chip. It has a 9 VGA output connector as well as a PS/2 keyboard or mouse connector. It has 32MBytes of SDRAM and 2 MBits of Flash. The Flash memory is bank selectable.

XESS use a CPLD to act as a download controller which connects to the printer port (parallel port). They have a rather clever method of downloading FPGA configuration, Flash Program Code, or SDRAM Code. They offer SDRAM controller IP so that your applications can access the SDRAM.

The other good feature of this board is the large number of header pin outs. The large number of uncommitted I/O pins made the board ideal to interface to switch banks and LED display panels as well as other PDP-8 bus devices

1.6. Semantic Web, XML, RDF

The Semantic Web is a web of data. It is about two things: common formats for interchange of data and language for recording how the data relates to real world objects. It is an extension of the current Web, providing an infrastructure for the integration of data on the Web. Its aim is describing things in a way that computer applications can understand. The Semantic Web describes the relationships between things (like A is a part of B and Y is a member of Z) and the properties of things (like size, weight, age, and price).

XML (Extendible Markup Language) was designed to describe data and to focus on what data is. It was created to structure, store and to send information. It is a complement to HTML in a way that: XML was designed to describe data and to focus on what data is while, HTML was designed to display data and to focus on how data looks. Here you see an example of XML document:

```

<PARTS>
  <TITLE>Computer Parts</TITLE>
  <PART>
    <ITEM>Motherboard</ITEM>
    <MANUFACTURER>ASUS</MANUFACTURER>
    <MODEL>P3B-F</MODEL>
    <COST> 123.00</COST>
  </PART>
  <PART>
    <ITEM>Video Card</ITEM>
    <MANUFACTURER>ATI</MANUFACTURER>
    .
    .
  </PART>
</PARTS>

```

RDF (Resource Description Framework) is a markup language for describing information and resources on the web. It provides a model for data, and syntax so that independent parties can exchange and use it. RDF was designed to provide a common way to describe information so it can be read and understood by computer applications. RDF documents are written in XML. The XML language used by RDF is called RDF/XML. By using XML, RDF information can easily be exchanged between different types of computers using different types of operating systems and application languages. We will be using the VEVENT component of RDF in our project. A "VEVENT" calendar component is defined by the following notation:

```

eventc      = "BEGIN" ":" "VEVENT" CRLF
              eventprop *alarmc
              "END" ":" "VEVENT" CRLF
eventprop   = *(
              ; the following are optional,
              ; but MUST NOT occur more than once

              class / created / description / dtstart / geo /
              last-mod / location / organizer / priority /
              dtstamp / seq / status / summary / transp /
              uid / url / recurid /

              ; either 'dtend' or 'duration' may appear in
              ; a 'eventprop', but 'dtend' and 'duration'
              ; MUST NOT occur in the same 'eventprop'

              dtend / duration /

              ; the following are optional,
              ; and MAY occur more than once

              attach / attendee / categories / comment /
              contact / exdate / exrule / rstatus / related /
              resources / rdate / rrule / x-prop
              )

```

2. PROCESS

2.1. Team Structure

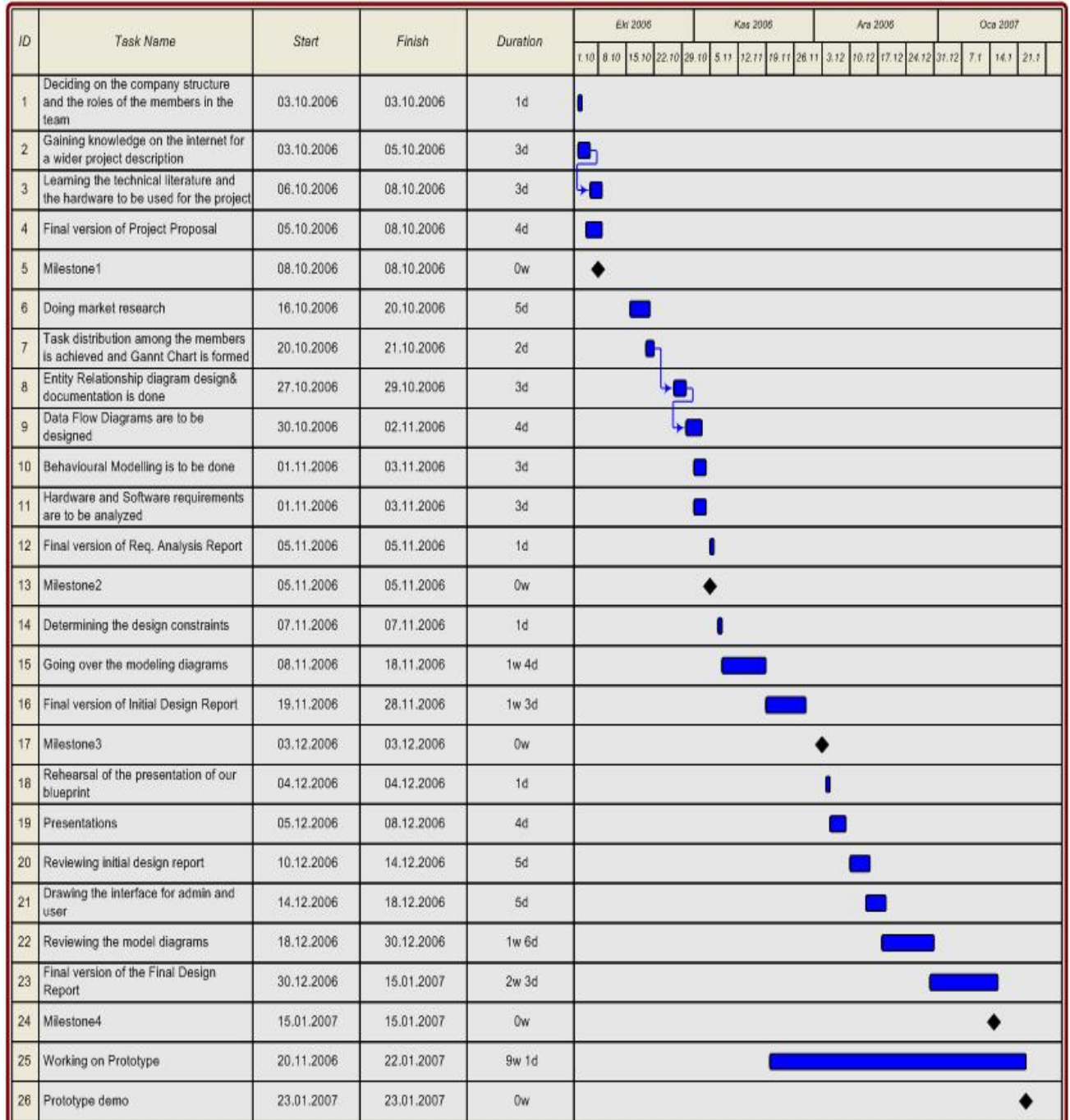
Our team has very qualified members in programming and software design. Moreover, all the members have enough and nearly the same experience in hardware design. As a result, we decided to have a decentralized team structure. However, to prevent possible conflicts and future coordination problems, we decided to choose a team leader, which implies our team structure to be Controlled Decentralized.

2.2. Process Model

Our project has certain steps which are predefined. These steps are requirement analysis, initial design, detailed design, implementation and testing. Since deadlines of these steps are determined linear process model best suits to a Project.

3. PROJECT SCHEDULE

3.1. Gantt Chart



4. PROJECT REQUIREMENTS

The most important part of the project works is determining the requirements. The requirements analysis must be done carefully to get project maintenance. Therefore, during the development of the project, it must be guaranteed that no unexpected events and requirements should occur. In order to avoid failure, requirements must cover all our needs. For our project, requirements are divided in five main issues.

4.1. System Requirements

4.1.1. Hardware Requirements

Determining hardware is the most important part of the requirement analysis for our project. Our hardware requirements are;

Developer computers' minimal requirements:

- ❖ Intel P4 CPU or compatible
- ❖ 512 MB RAM
- ❖ 30 GB HDD
- ❖ 32 MB Video Card

Other hardware:

- ❖ Display device with VGA port
- ❖ Bluetooth cards
 - One of them for the computer
 - The other one for serial to bluetooth converter card
- ❖ Bluetooth cell phones or PDA's
- ❖ Serial-Parallel port converter cable
 - BELKIN F3H982EA06 etc.
- ❖ Xilinx FPGA board (field-programmable gate arrays)
 - XSA-3S1000 Board

4.1.2. Software Requirements

We will use several tools for different phases during development of the project. These development phases are;

- ❖ Documentation Part
 - Analysis
 - Design
- ❖ Development Part
 - Implementation
 - Testing

Documentation Tools

Microsoft Office 2003 Word

Adobe Acrobat Professional

SmartDraw and Microsoft Office 2003 Visio for the drawing and creating diagrams

Development Tools

Windows XP or Win2K

XSTOOLS utilities and Xilinx 8.1i Design tools – programming tools for FPGA board

ChipScope – real-time debug and verification tools for FPGA board

VHDL or VERILOG (design-entry language)*

Java, C/C++ for administrative tasks, simple GUI implementation

RDF (Resource Description Framework) – for keeping event data as a calendar event in the cell phones or PDAs.

* We have not decided yet. Both language can describe the behaviour and structure of electronic systems. There is no experience about these language for all group members. We are still studying on which language most appropriate for our project.

4.2. User Requirements

4.2.1. Functional Requirements

The controller device including FPGA board with bluetooth controller that we use in our project has many features; They are mentioned above section 1.5.

- XSA – 3S1000
- Bluetooth Device (Bluetooth device connected with Parellel port)

Those features add different functionalities to our controller. This way, controller device can be used for accomplishing different tasks. For example, we expect to use SDRAM for loading poster's image and event data, and a poster change can occur if it is wanted without changing the program. We will be able to achieve this purpose since 2 MByte Flash gives the resources for building a complete, soft-core RISC microcontroller system. Within this scope it is a good idea to manipulate a device using a computer or PDA. In other words user must have the capability of programming device and loading poster image data with the help of using Graphical User Interface .This interface should have following functionalities ;

View configuration

This functionality gives administrator the chance to view which image, event data is loaded to controller, interchange time between posters, etc. After viewing, he has an ability of changing these. For this purpose controller device should send data to administrator computer via bluetooth devices.

Change/load configuration

This functionality determine behaviors of our controller program such as interchange time of poster images, sending time of event data between two succeeding processes.

Change/Delete/Load image data and event data

As we mentioned above, after viewing data on device if there is, user is able to change data by loading appropriate poster image data and its event data. For this phase, user computer will send these data to controller in order to save its memory by using with the help of Bluetooth devices. The most important part of these functionalities is that serial port converting to

parallel port. We expect to use simple parallel/serial converter cable. Received data should be loaded to RAM by our controller program. After succeed in loading, controller sends these data to display device via using VGA port connection.

Pick Up Nearby Bluetooths

If there is any event data, our system should search nearby bluetooth devices for sending requests to send calendar event data to these PDAs or cell phones.

Send request detected Bluetooths

If controller device finds new bluetooth device, it sends request to establish new connection to send calendar event data.

Send data (such as calendar event data)

After succesfull connection, controller device starts to send data which related to request.

4.2.2. Nonfunctional Requirements

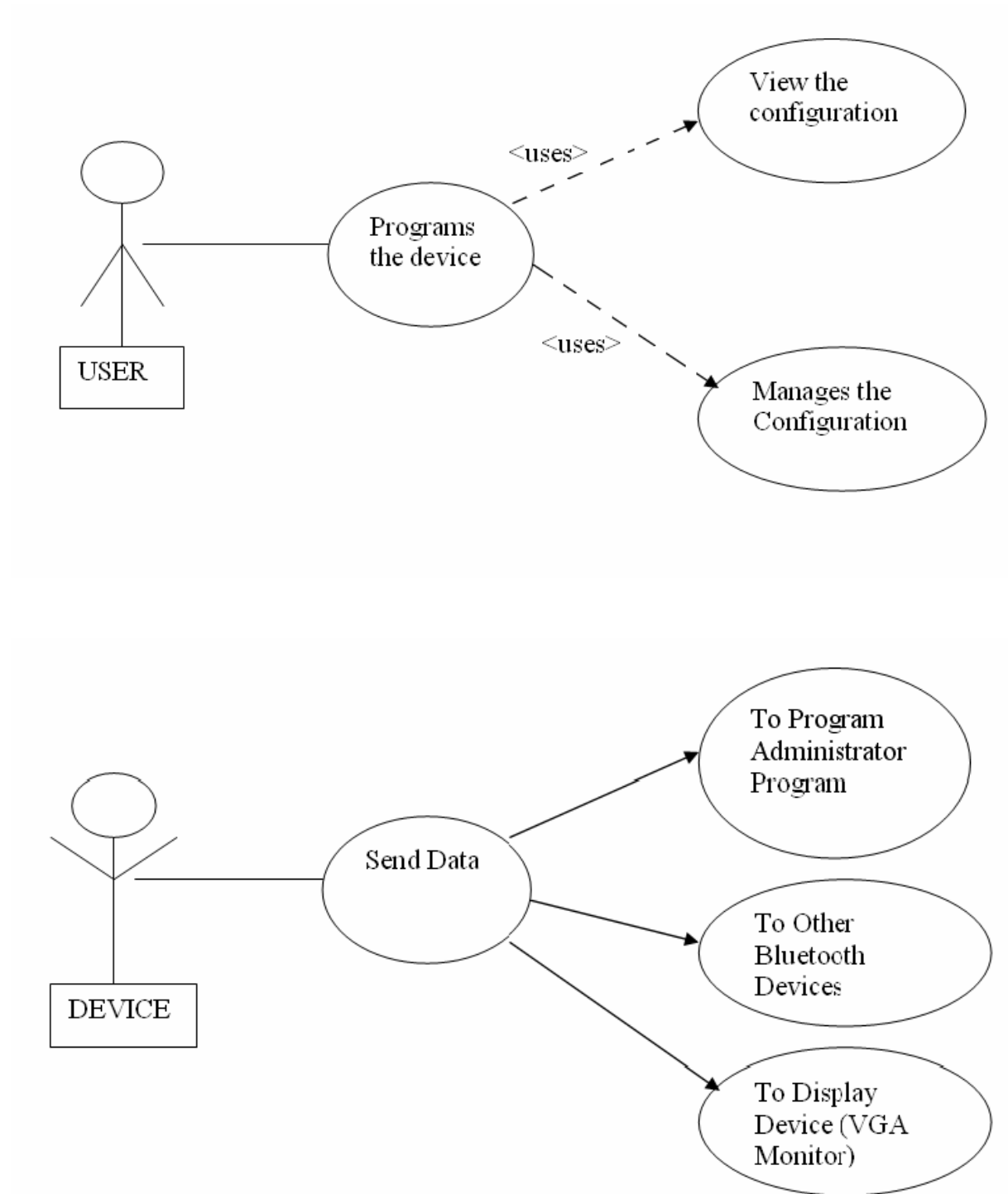
Usability:

The usability is important part of our project. User side of the project is just administrative part. It is include that simple Graphic User Interface with maximum capability. This interface of our product on computer will be very clear and understandable.

Connectivity:

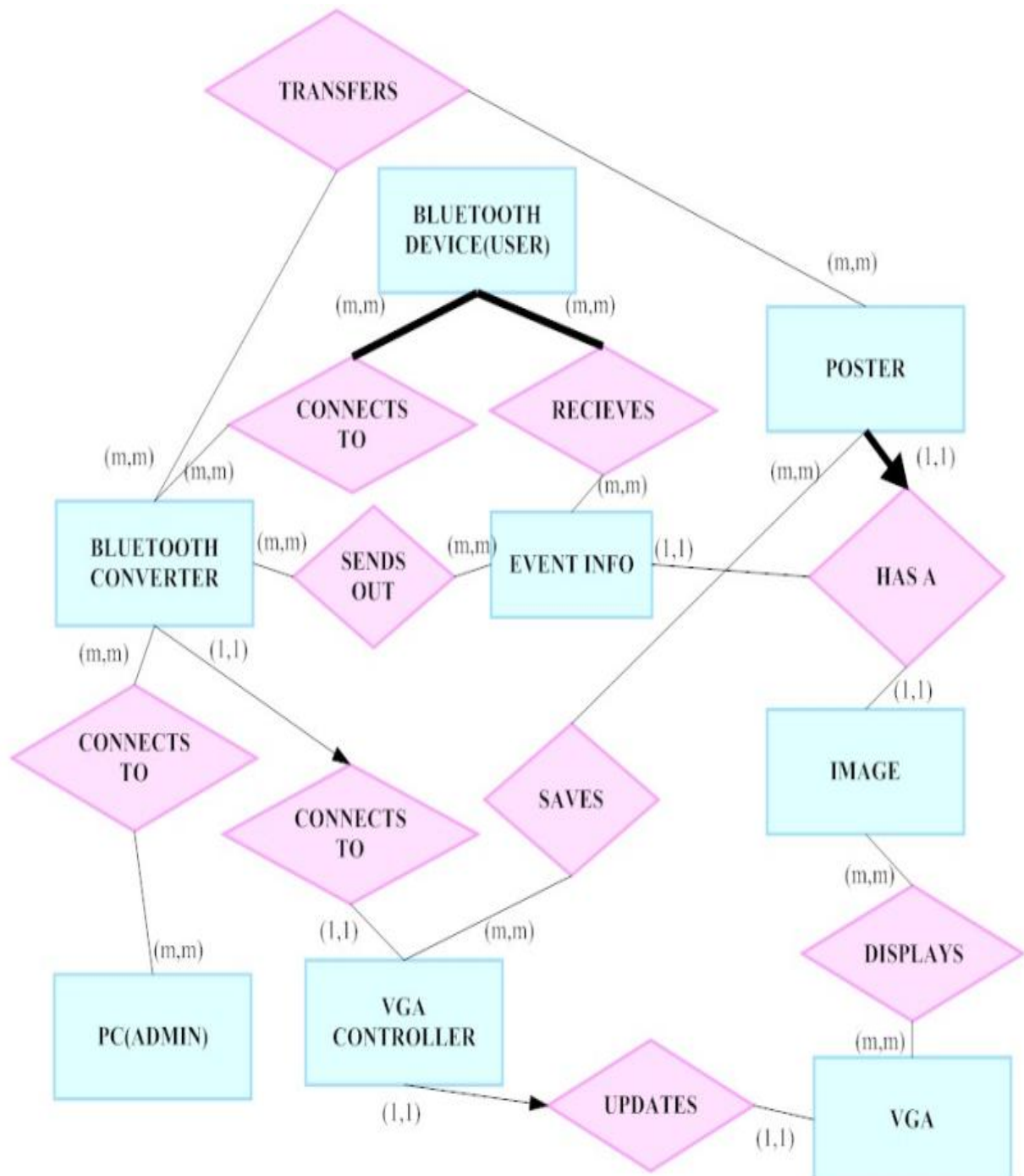
In order to send poster event data as a calendar event to cellular phones or PDAs, connectivity is vital for data flows from control device to these machines. Moreover, in our project we must have proper connection using serial/parallel ports. We must be ensured data flow between FPDA board and Bluetooth device.

4.2.3. Use Case Diagrams

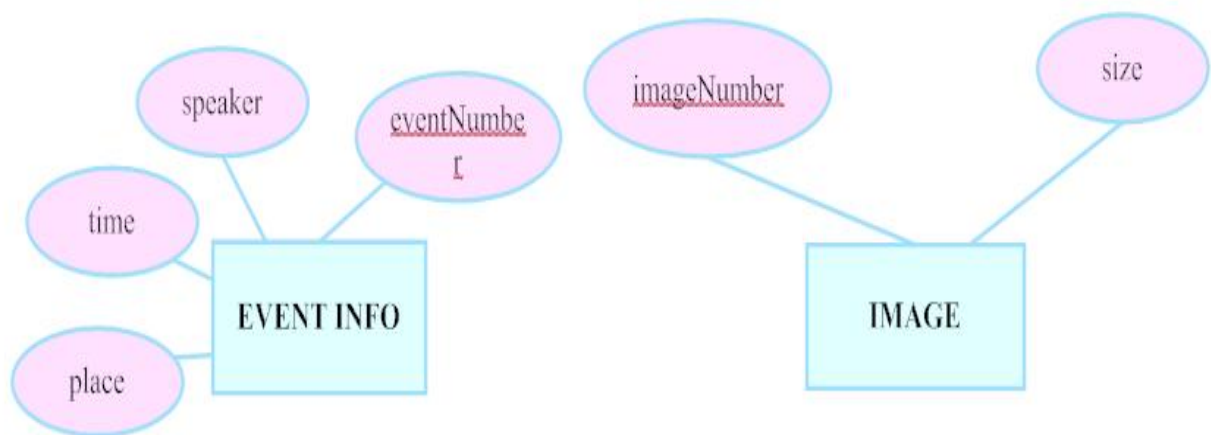


5. MODELLING

5.1. Data Model



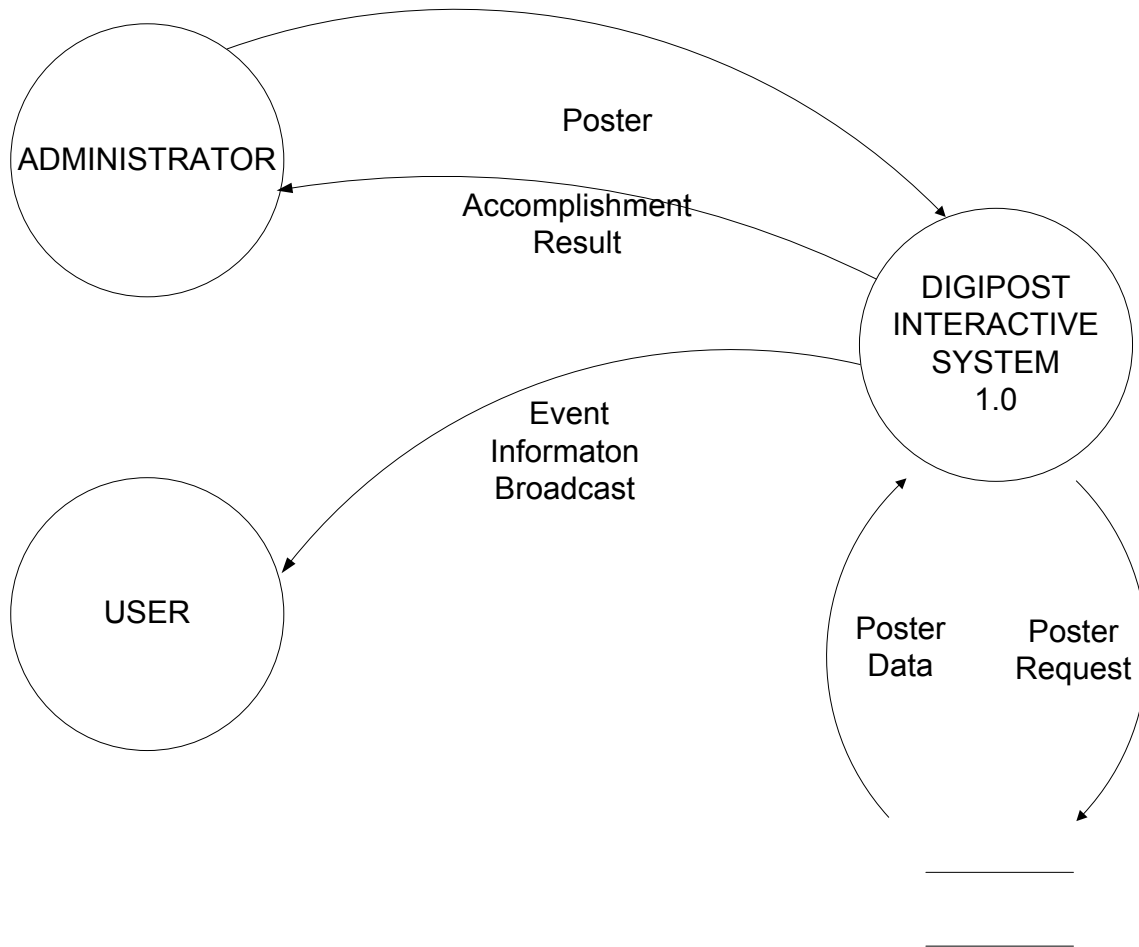
In our Entity Relation Diagram we intentionally thought of the system as a multiple one, which means, there is supposed to exist many billboards on a road for example. Another important consideration in our ER diagram is having many billboards displaying the same poster. An administrator is responsible for many billboards. Thus there is a relation of (m, m) in between PC and Bluetooth Converter. Additionally many VGAs display many images, stated as (m, m) again in our ER diagram. Also, many posters may be saved in different VGA controllers due to the number of billboards being more than 1, just like the relation in between Bluetooth Converter and Poster. Many users may connect to many billboards, meaning bluetooth converters. Same inspection can be done on event information.



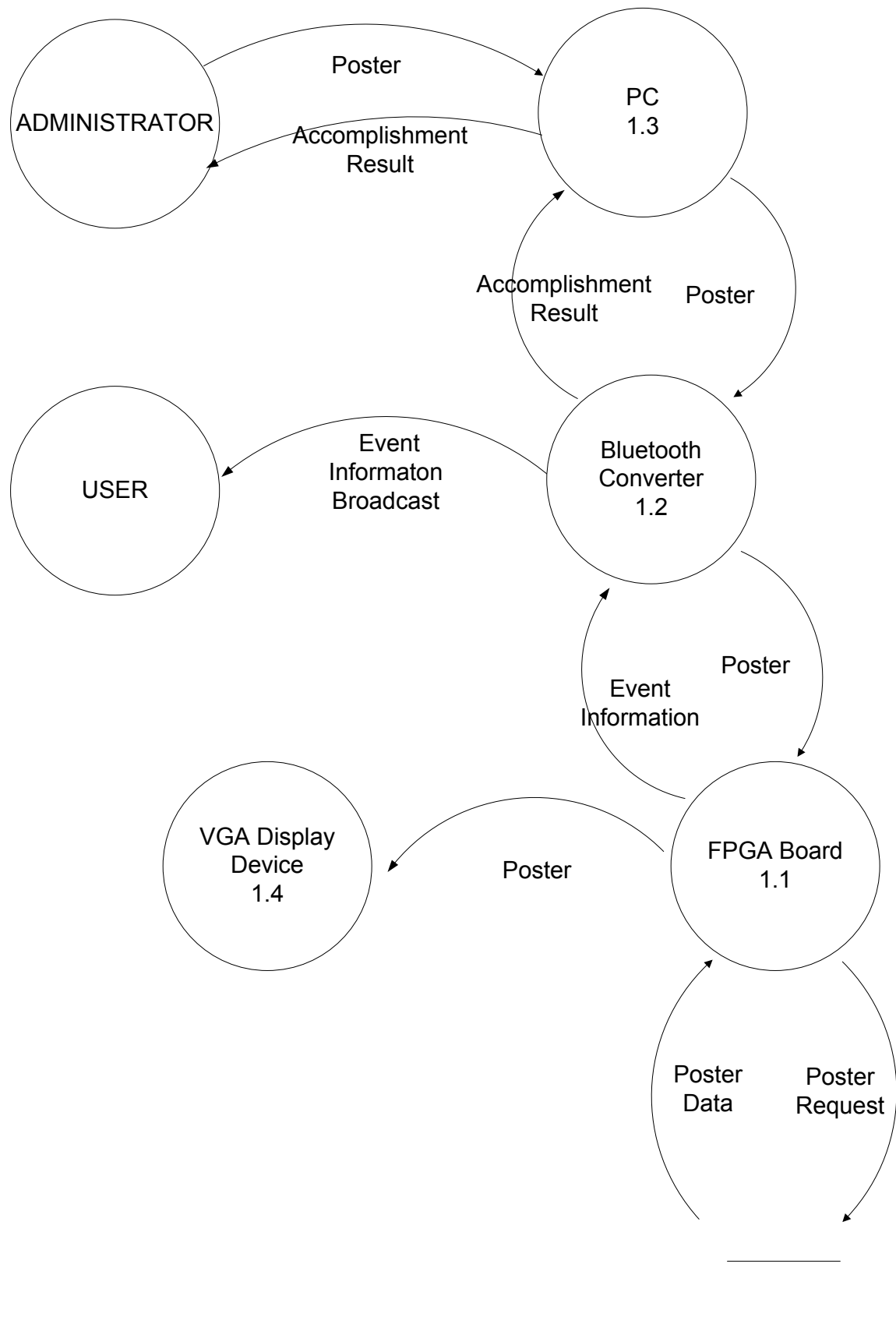
5.2. Functional Model

5.2.1. Data Flow Diagram

5.2.1.1. Level 0



5.2.1.2. Level 1



5.2.2. Data Dictionary

Name:	Poster, Poster Data
Aliases:	Image and event data
Where & how used	ADMINISTRATOR(output) PC(1.3)(input + output) Bluetooth Converter(1.2) (input + output) FPGA Board(1.1)(output) VGA Display Device(1.4)(input)
Description	Poster= image + event information 1. Admin loads poster to PC (input) 2. PC loads poster to FPGA Board through Bluetooth Converter (input) 3. FPGA Board keeps poster in memory (input) 4. FPGA Board loads poster image to VGA Display Device (input) 5. VGA Display Device displays image (output)

Name:	Accomplishment Result
Aliases:	Done/ not accomplished
Where & how used	ADMINISTRATOR(input) PC(1.3)(input + output) Bluetooth Converter(1.2)(output)
Description	States whether uploading poster event has been accomplished or not

Name:	Event Information Broadcast
Aliases:	Event data of the poster
Where & how used	USER(input) Bluetooth Converter(1.2)(output)
Description	Event info=detailed information of an upcoming event in the format that is acceptable by the bluetooth communication

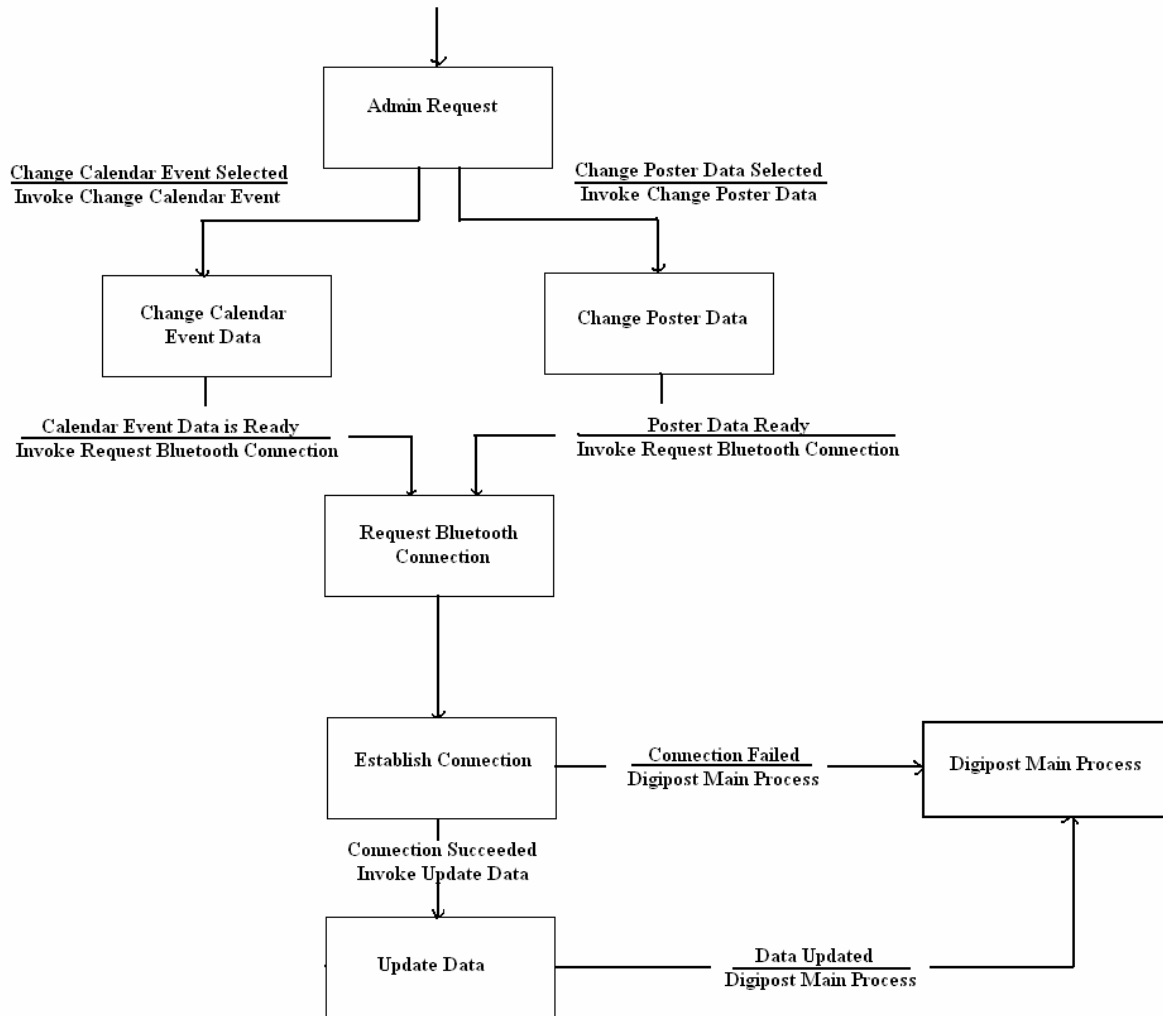
Name:	Event Information
Aliases:	Event data of the poster
Where & how used	FPGA Board(1.1)(output) Bluetooth Converter(1.2)(input)
Description	Event info=detailed information of an upcoming event

Name:	Poster Request
Aliases:	Selection query for a specific poster
Where & how used	Database(input) FPGA Board(1.1)(output)
Description	Poster is asked to be broadcasted to the bluetooth devices and poster is mainly saved in database, where database corresponds to FPGA Board's memory

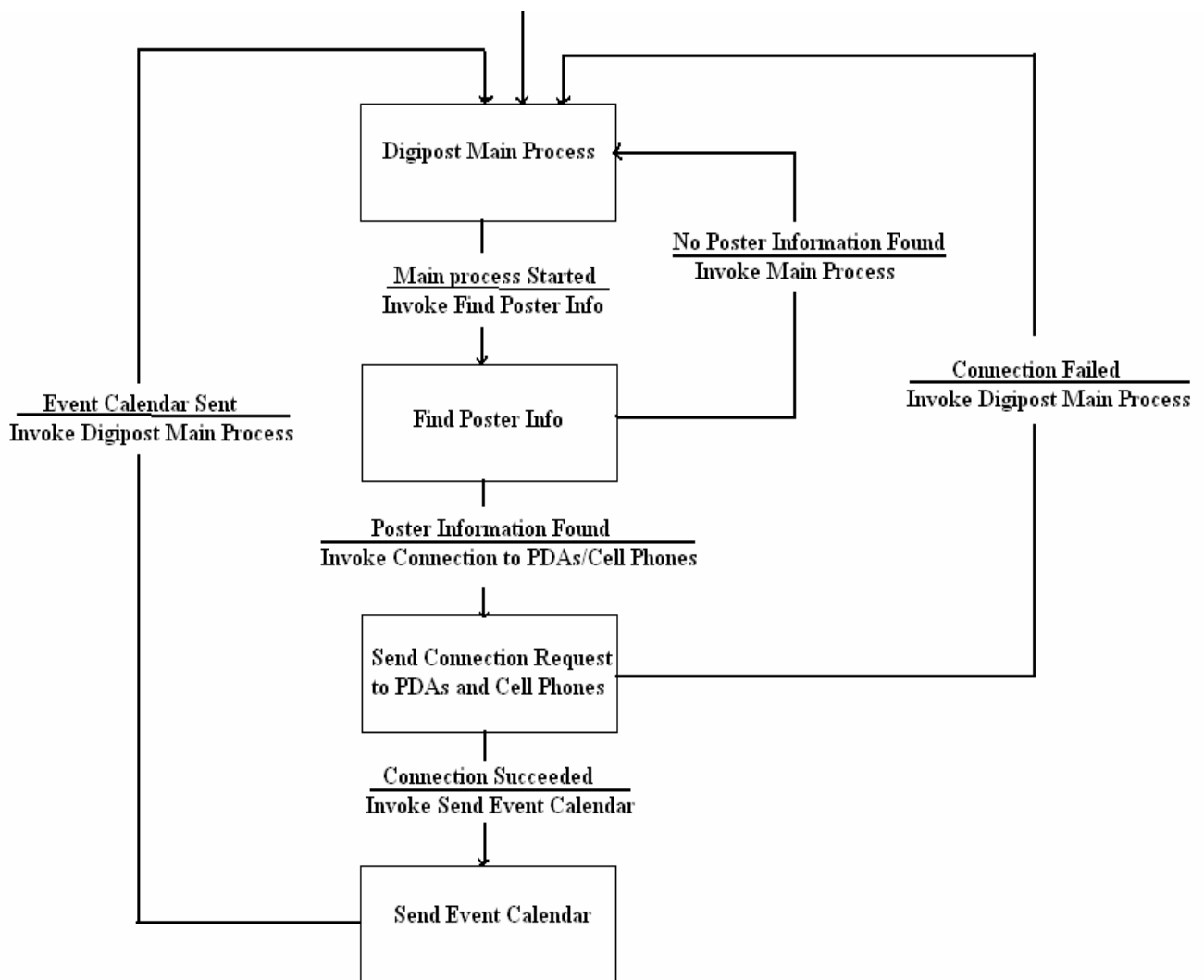
5.3. Behavioral Model

5.3.1. State Transition Diagram of User

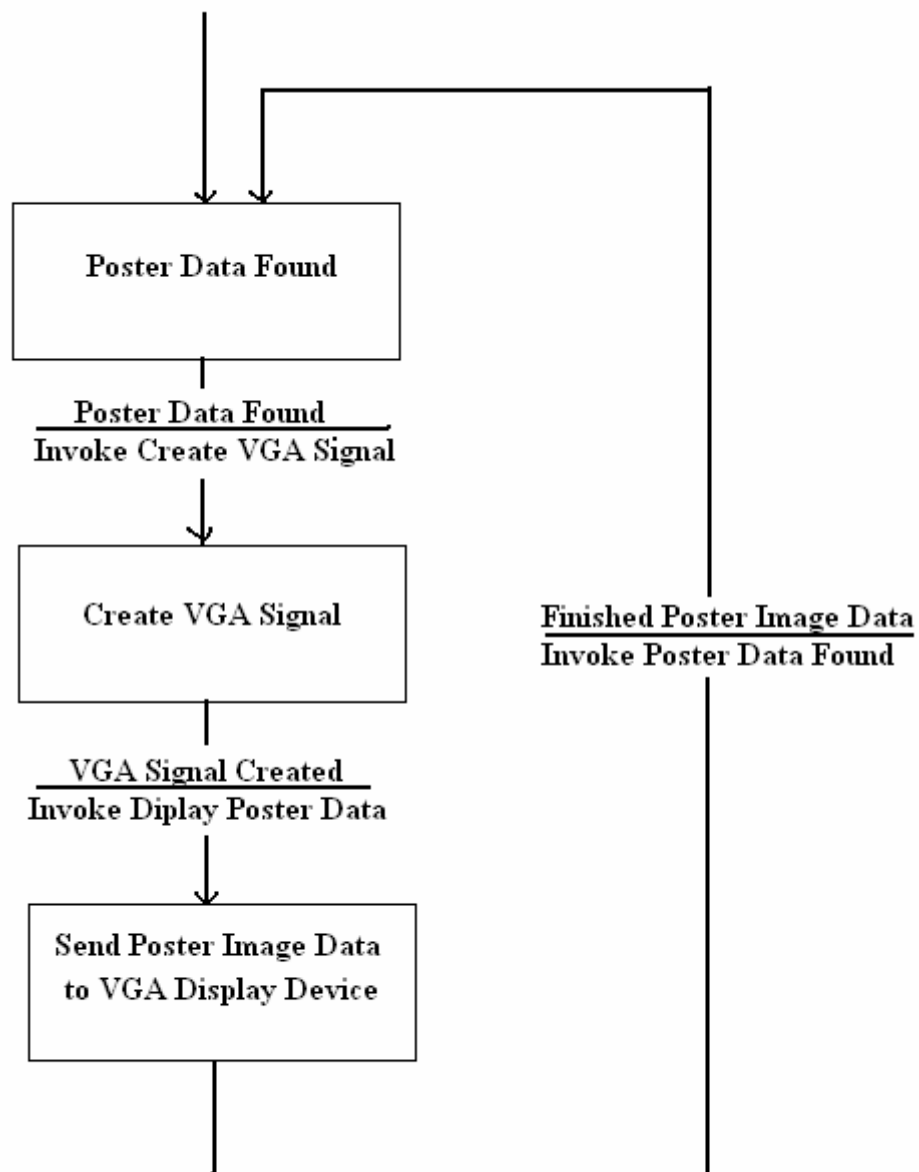
5.3.1.1. State Transition Diagram of Change/Load Configuration



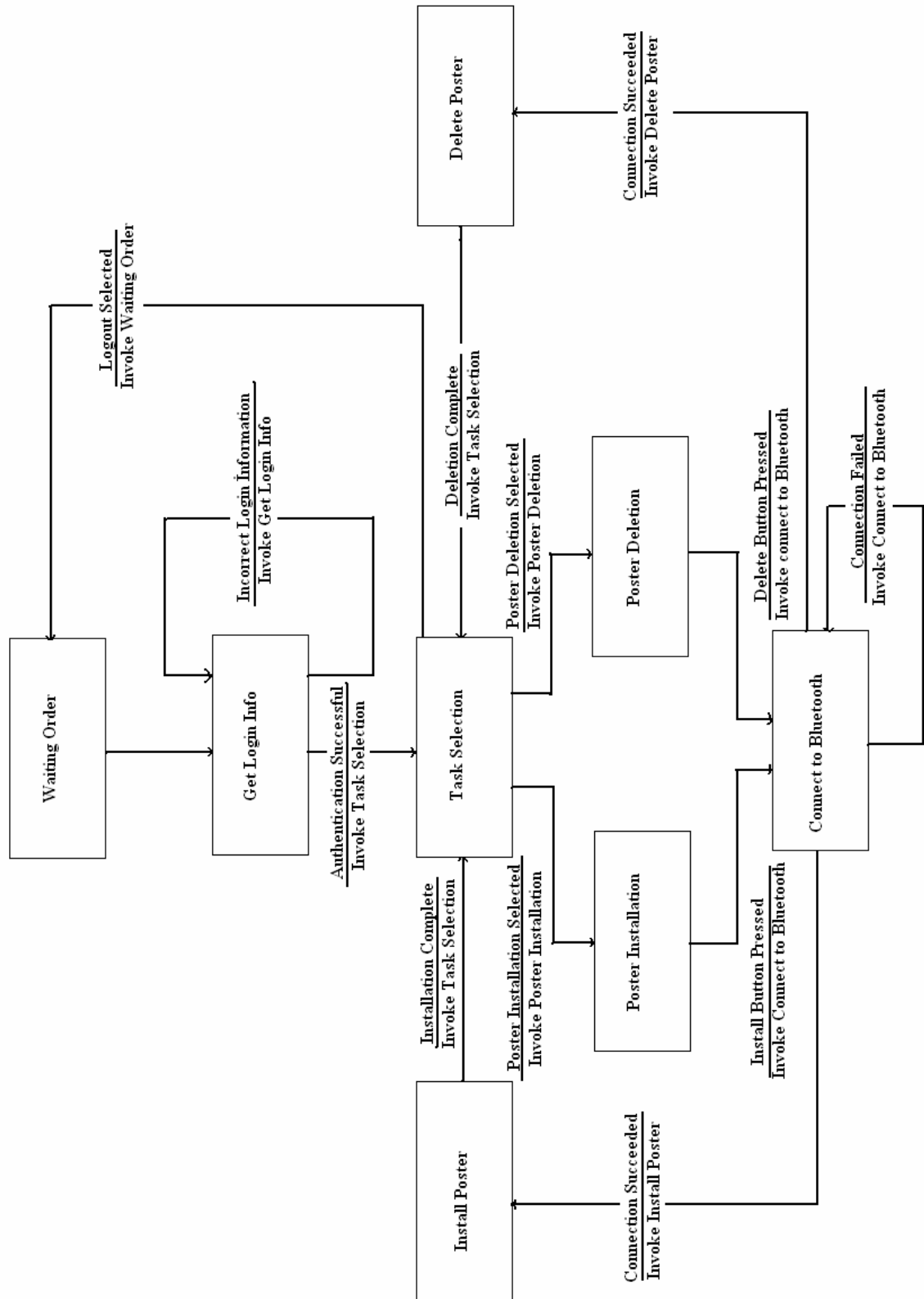
5.3.1.2. State Transition Diagram of Calendar Event Data Send Process



5.3.1.3. State Transition Diagram of Display Process to VGA Monitor



5.3.2. State Transition Diagram of Admin



6. MARKET RESEARCH

6.1. Literature Survey

6.1.1. Introduction

We have made a complete survey on the software that has been produced so far. In order to gain background knowledge, to ensure that the project is realizable, to infer useful ideas from both successful and unsuccessful projects and to broaden our imaginations, the market research was inevitable.

Actually we have not found something very close to our project. However, we found some projects, which have some basic functionality, we are going to use in our project.

- TransSend is a unique product that enables Internet content such as addresses, phone numbers, event calendar, maps, and other text and images to be wirelessly transferred from a Bluetooth enabled PC to another mobile Bluetooth device such as a phone or PDA.
- Remote Media has developed a range of Digital Posters that enable traditional printed posters to be replaced forever. The Digital Poster combines the very latest High Brightness LCD Displays, an embedded Remote Media Player and updating using Wireless, GPRS and 3G communications.
- Using a Digital Poster created by Instructional Technology and Academic Computing (ITAC) you can revolutionize traditional research presentation methods by combining text, audio, video and animation.
- LCD Digital Poster created by SHENZHEN Trykey Science and Technology

We constructed a table showing the existence of some properties and properties themselves of the projects that I mentioned above. Moreover, we added lone more columns for RedCat project's features.

The names in the table refer to:

- TransSend: The Bluetooth SIG product.
- RemMedia: Remote Media product.
- ITAC: Instructional Technology and Academic Computing product.

- Shanzhen: SHENZHEN Trykey Science and Technology product.
- RedCat: Our project

6.1.2. Comparison Table

Properties	TransSend	RemMedia	ITAC	Shanzhen	RedCat
Project Scope	Optional	Advertisement	Presentati on	Advertisem ent	Optional
Device type	PC+PDA	LCD	LCD	LCD	LCD+PDA
Communi cation method	Wireless (Bluetooth)	Wireless, GPRS and 3G	Wireless	Internet	Wireless (Bluetooth)
Multilang uage support	Yes	Yes	Yes	Yes	Yes
Supported files	vNote(text) vCal, vCard .png, .jpg, .gif, .bmp	Images, Video, WebPages, Animations	Images, Text, Audio, Video, Animation	Images, Audio, Video, Animations	Images (.jpg), Text (.xml)
Using of Bluetooth	Yes	No	No	No	Yes

The items mentioned in the above table are usually general properties of the software. Most admirable properties of all of the above projects are that all of them support images files, and almost all of them use LCD monitor to show supported files on it. In addition to this, Bluetooth technology is used in TransSend and RedCat projects. All projects have Multilanguage support and except the TransSend project, all the projects use LCD monitor.

6.1.3. Results

We have gained valuable knowledge about our project area during the research period. We have seen what kind of applications is present in the market, we realize how valuable is our project and what it will gain for market.

As a result of our literature survey, we could not find an exact matching to our project. However, each project mentioned above helped us to realize the structure of our project closer. In addition to this, it can be said that our project will be used almost all of the features of previous projects. Moreover, combining any project with TransSend almost gave us the definition of our project. So that it is crucial important for our team, to understand and be able to integrate the features of TransSend to our project.

To conclude, our research will not stop here and we will always avoid bad properties of the applications in the market. While we are benefiting from nice and worthy properties, we will cover the lacks of our reference projects.

6.2. Interview with Potential Users

For the very beginning phases of the Project, we decided to conduct a small questionnaire among department of computer engineering students and instructors and assistants. We delivered totally 11 copies. The questionnaire was composed of a very brief information about the DIGIPOST and aim of the Project, 6 six questions to answer and a comment part for people to fill. Here are the questions and our evaluation about the answers given under the name of comment:

Q1) Have you ever heard about digital poster?

Comment: Generally, most of the people answered this question as “yes” or “little”. This shows us that, it is new application and is not widespread yet.

Q2) Do you think it is useful?

Comment: Most of the participants answered this question as “yes”.

This shows us that, although it is new application and is not widespread yet, it is a promising.

Q3) In which areas can it be used?

Comment: In this question, people are wanted to comment on the possible application areas that DIGIPOST may be used. These answers should be considered in 4 topics:

1 .Social & Cultural Activities: Users can view information out social and cultural activities such as cinema, theatre or concerts.

2. Advertisement: DIGIPOST may be promising in the area of displaying advertisements and sending advertisement info to cell phones or PDAs. Instead, we know that some similar applications of DIGIPOST is started to be used in this area in Turkey and other countries.

3. Announcement: Some important announcements or latest news can be sent to PDAs or cell phones and its image info shall be displayed on screens.

4. Education: Some people this application area because of the reason that it can be used in displaying slides and sending slides information to the PDAs or cell phones during classes. Moreover, it may be a good assistant in seminars.

Q4) Have you ever seen a sample of digital poster?

Comment: This question was aiming to get the ideas of the participants' ideas of possible functionality and features of digipost or any other similar sample application if they have encountered one. .However, none of the participants answered this question as “yes”.

The participants are wanted to skip the forthcoming question if they have not seen a sample

Q5) Can you describe how it worked? Did you like it?

Comment: This question was aiming participants describing the sample they have encountered or seen. Moreover, we aimed to get a kind of real feeling how it works. However, since no participants have seen a sample, we could not achieve that we desired.

Q6) Do you have any other ideas in its working model?

Comment: This question was aiming to get the help of the participants' creativity for the working model of DIGIPOST. Most the participants have no ideas of about its working model. Some participants tried to describe connection process form one device that has bluetooth functionality with the other one. The other ideas were behind the scope of the project.

Q7) Do you have any other comments?

Comment: As I said before this part was aiming to learn the participants comment on the Project on any issue. Most participants preferred not comment on any issue. But the comments made were interesting and important to consider. Let us talk about them.

One issue was about security and accountability of the data issue. If this technology becomes widespread, there would be many digipost applications trying to access the users' cell phones or PDAs. The user may be under attack of a virus or trojan. So the control mechanism of data accountability is important in the future. We think that, this issue can be resolved by the PDAs and cell phones trusting only some certain certificates.

Another issue is about the data type of image to be displayed. For this project, we decide to support some certain image file extensions such as ".JPG". One participant's comment was about supporting not only image files but also media such as video. This feature is a necessity in the application area of social & cultural activities such as cinema for the future applications. Moreover, supporting html files would break a new ground in the area of advertisements of web page.

Other comment was about not only the users displaying poster information on PDAs or cell phones but also sending messages back to the digital poster and making some actions interactively. As an application of this issue, we can consider a movie advertisement. The user not only can display movie info but also reserve a ticket for this movie in a selected cinema by choosing an option among the served ones according to his interest. Another example is GSM operators advertisements. The user may transfer selected amount of units to the prepaid phones (kontör transfer) interactively with the digipost with the options delivered by the digipost via bluetooth functionality.

7. CONCLUSION

Preparation of this report was a very beneficial process for our team. We did valuable brainstorming and made some points clearer. What to do in the following days, and how the system is supposed to work has been well understood. Another thing is we realized the fact that people are not familiar to this topic, and this has both pros and cons for us. The pro is this is like a monopoly in Turkey, and the con is we have to do a good amount of advertisement to inform people so that we may sell our product. We believe this analysis report will be helpful both for us and for the ones who are following the project.

8. REFERENCES

<http://www.remotemedia.co.uk/digitalposter.htm>
<http://www.case.edu/its/itac/product/poster.htm>
<http://ejcts.ctsnetjournals.org/cgi/content/full/19/6/953>
http://chinalightbox.en.alibaba.com/product/50074895/50343281/LCD__digital_advertising_player_series/LCD_Digital_Advertising_Player.html
<http://www.remotemedia.co.uk/>
<http://www.scala.com/signage/billboards.html>
<http://www.w3.org/>
<http://www.w3schools.com>
<http://www.comptechdoc.org>
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<http://www.xess.com/>
<http://www.blueradios.com/>