ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

MT MA1 - Projet de semestre

China Hardware Innovation Camp - Vesta

Engineering Report

Jonathan Bregnard,
Igor Ayrton

juin 2015

Responsables:
Prof. M. Bouri

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1 Introduction

This semester project takes part of the CHIC2015 which is a new project initiated at EPFL by Marc Laperrouza. The goal of this new project is for students develop a project from idea to production in a semester. Indeed a trip to Shenzhen in China is programmed following the end of the semester(july). We are heading to a prototyping facility ther called Seeedstudio. They mainly do pcb prototyping but they also mill and 3d print parts.

Three groups of 5 people are created after a brainstorming week-end at the beggining of the semester with for each group one HEC (economy) student, one ECAL (industrial design) student and three engineers from EPFL. For the project presented in this report, two engineers are from microengineering and one is from material science.

After the brainstorming week-end, the rough idea was to connect elderly people to their families with an easy to use electronic device.

2 Problem and Solution

In this section we will lay out the problematic we wanted to adress during this project. Our chosen solution will be introduced and described.

2.1 Problem

The first part of the project was to define what are the old people and young people needs. The goal is to connect the elderly to their families. To determine what are the young people needs, a quiz(survey) was put on internet to ask how young people would like to discuss with their grand parents. The quiz contained the following questions :

- How often do you discuss with your grand parents ?
- What is the best way to do it ? Social network, phone call, sms, visit them...
- ...

Most of them wanted to have more contacts with their grand parents but not with the actuals social networks available (facebook, twitter, instagram, google+).

To define what old people needs, a visit in an EMS was organised and some questions about what they want and what they are able to do were asked to them and also some technical questions were asked to the nurses.

The questions to the nurses were more about the facilities old people have with new technologies. The results that came out of the discussion was that the old people don't ear well sounds and are not able to define where the song is coming so putting an alarm on the device wouldn't be a good idea. The interface has to be as simple as possible because they are lost if there are too many options. The device has to be big enough and shouldn't break after a shock. The text on the device has to be big enough to be read by old people.

2.2 Solution

Different solutions were imagined. A device that connects to the TV with HDMI and display pictures, messages and videos on it.

A device that connects to the web with a 3G chip (don't need the wifi and is more portable) or a device that contains only a wifi chip.

A device with a touch screen or only a screen. With physical buttons or not.

2.3 Vesta tab

The Vesta tab is a tablet oriented towards the elderly. It has a capacitive touch screen, a wifi and bluetooth connection and a unique casing. The main usage at the moment is receiving and displaying pictures and text sent by the younger family via the dedicated website. As soon as a new image or text is received an LED blinks to inform the user of new content. The interface is designed to be very user friendly and easy to use.

3 Value Proposition and Buisness Model

3.1 Value Proposition

3.2 Buisness model

3.3 User tests

4 Hardware

This section is dedicated to show all the electronic components we chose and how they work together. As described earlier the hardware will be manufactured by Seeedstudio. They manufacture PCBs with other hardware components and they sell quite a number of different breakout boards and other developpement parts. A request made by the managing people of the project was to source as many components as possible at Seeedstudio. Of course not all components we needed were available by them so some of the components are from different sources.

Hardware :

- Beaglebone black
- SD card (containing the Operating System)
- PCB
- Wl1835mod WIFI and bluetooth module
- Capacitive touch screen
- ADXL-345 accelerometer
- Some other tension regulators and a battery drive

4.1 Beaglebone Black

The Beaglebone black is an open-hardware microcomputer very famous for development. The beaglebone black use an ARM processor from Texas Instruments, the AM335X. It is clocked at 1GHz.

4.2 Screen and Touchscreen

We first ordered a resistive touchscreen BBB cape available from seeedstudio to see how its was made and to see if the resistive technology was applicable to our project. We quickly realised that the resistive tuchscreen was not very adapted to manipulate photos. Especially the very well known “swipe” geasture to move from one photo to another was impossible to do with the resistive touchscreen. So we looked for a similar screen but one using a capacitive touchscreen. We started by looking on chinese sites which had the cheapest screens of course. But the cheap chinese screens were lacking documention. At the time we were unfamiliar with the interface the screens used and we needed at least a datasheet to get going. Finally we chose a screen we found on Mouser which had good documentation and especially there was an existing driver for the touchscreen IC in the linux kernel we were going to use.

4.2.1 Screen

At the current state of our prototype the main function is to view images Table with screen specs.

4.2.2 Touchscreen

4.2.3 Backlight

4.3 Wireless Communication

4.3.1 Wlan

4.3.2 Bluetooth

4.3.3 Power management

4.4 Front LED

The LED is there to inform the user of a new message. Therefor it could be quite low power. Seeedstudio only had an RGB LED which we ordered although for the final led we will use is a warm white single color LED.

We want it to flash in a heartbeat patern. This is achieved by using a PWM pin of the BBB

4.5 Power management

4.6 Batteries and charger

4.7 PCB

4.8 Cost estimates

5 Software

The software of this project contains 3 parts :

- The operating system configuration and modification to be fully compatible with the hardware used.
- The website that is used by the young users to send pictures and messages to the old users.
- The Vesta tab software that is used on the tablet to display the differents messages and pictures received by the old users.

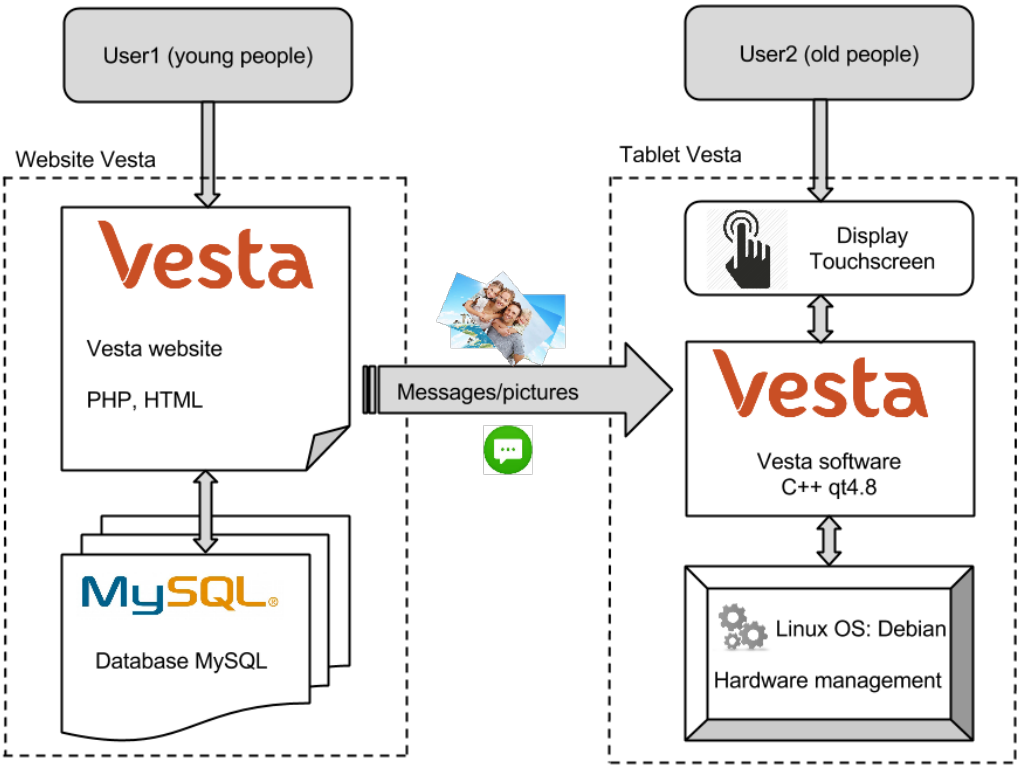

FIGURE 5.1 – Basic user flow.

5.1 Operating system

The OS used for this project is a debian. Debian is a linux distribution and was given by the conceptors of the beaglebone black.

5.1.1 Drivers

A lot of work on this linux distribution was made to be fully compatible with the chosen hardware. The touch screen driver edt-ft5x06 had problems with the original 3.8 kernel of the distribution we used. The driver was not loading correctly from the device tree overlay. An upgrade to the 3.14 kernel resolved the problem. Then the scale of the touchscreen was not correct. When a touch event was done on the right-down corner, the mouse pointer moved to the center of the screen. Some configuration scripts had to be modified for the ? graphical display server.

5.1.2 Display

The touch screen works with 24 bits parallel interface so the X11 configuration file had to be modified to works correctly. The LCD output was initialy configured in 16 bits parallel interface. The hardware management in linux is called a device tree blob. It's a script that is compiled and is loaded at the OS startup. In this file, the driver for the touch panel was declared and the interrupt pins was defined. The resolution and frequency of the display is also configured in this script. The wifi chip also needs to load drivers at startup and tell the OS to connect to internet via this chip and with the SDIO protocol. The file is located in /boot/dtbs/3.14xx/ and is called vesta.dtb (compiled) and the source is called vesta.dts. The file uEnv.txt located in /boot/ also need to define which device tree blob(dtb) the OS has to load at startup.

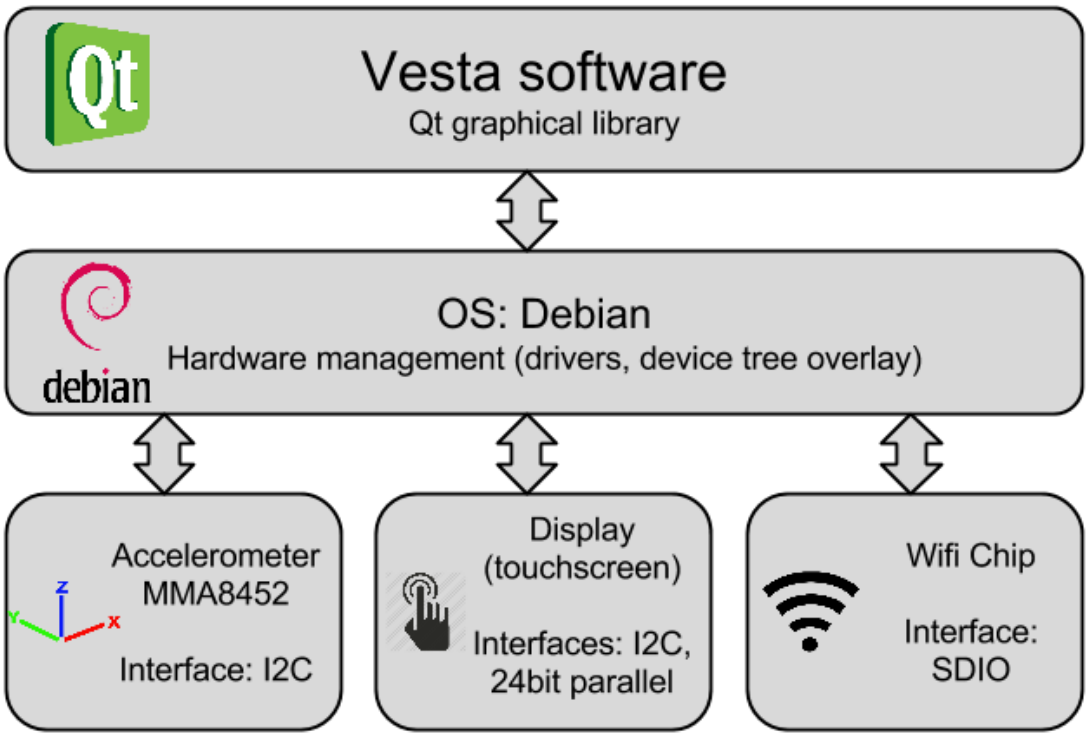

FIGURE 5.2 – Firmware dependencies.

5.2 Website

The website is used by the young users to send messages and pictures to the old user's tablet. The website contains a MySQL database, a php/html page that let the young user send a message and a php script used to parse the database to XML to be readable by the tablet.

5.3 Vesta software

The Vesta software is used by the old users to receive and display the messages and pictures sent by the young users. The software is made in C++ with Qt4.8/Qt quick 1.0. Qt is a free library used mainly to design softwares with graphical user interfaces (GUI). It is cross platform so with the same code it is possible to compile for linux,windows and mac. The library contains also a lot of utils to facilitate the development of emmbedded interfaces and manages the touchscreen events like the swipes, clicks and more. A lot of documentation is available and a lot of users develop with it.

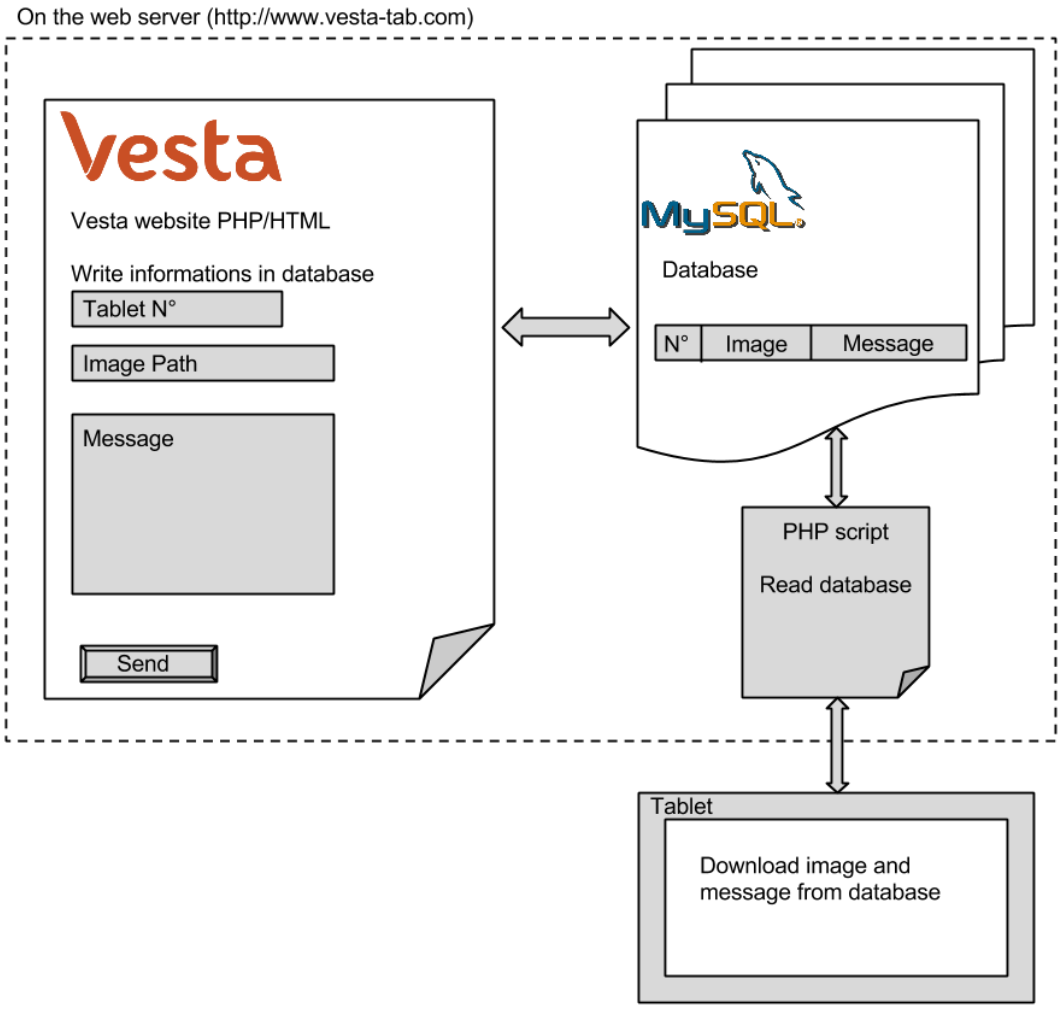

FIGURE 5.3 – Vest website architecture.

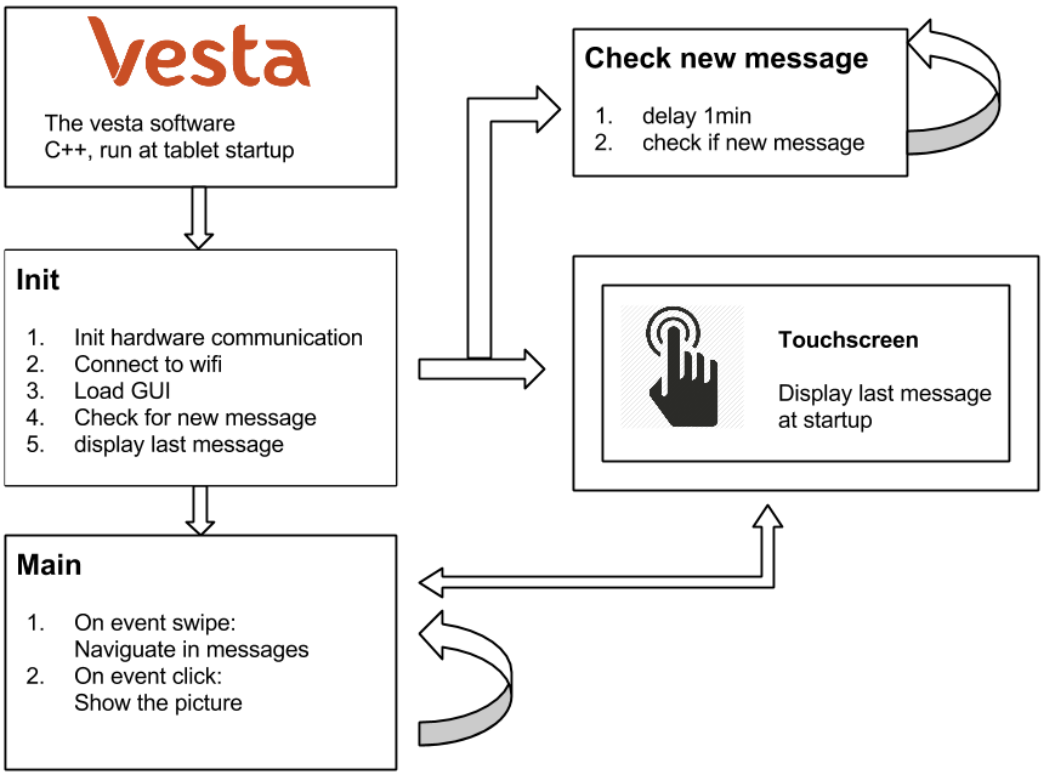

FIGURE 5.4 – Vesta software architecture.

6 Next steps

Activity monitoring

In the beginning of july, a first prototype will be made in Shenzen (China) with an industrial partner (Seedstudio). A final presentation of the project is going to take place in october with the prototype.