Software Requirements Specification

Bedrock Clock Radio

PROG 1350
Assignment 1
Submitted Feb 15, 2019

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1. Introduction

1.1. Purpose

The purpose of this document is to provide a complete description of all the functions and specifications of the software for the “Bedrock Clock Radio”.

The intended audience of this document includes the prospective developers of the software and the technical assessment personnel of the client organization.

1.2. Scope

The product to be developed is the software for “Bedrock Clock Radio”, further in this document referred to as “BCR”.

This software has to provide an interface for operating with BCR. This includes setting highly customizable alarms, displaying time and date, setting radio presets, changing and listening to radio stations. Customization of the alarms is done by changing time, repeat mode, volume, associated radio station or tune, etc. The software can also read input from the webcam in the device to decide whether or not the person to wake up is still in bed and continue or stop playing the alarm based on that input.

The goal of this software is to utilize the hardware provided by BCR and compliment it to the finished system with functionalities of a feature-rich clock radio. This software is to be installed on BCRs only.

1.3. Definitions, Acronyms and Abbreviations

Term	Definition
SRS	Software Requirements Specification
BCR	Bedrock Clock Radio – the product for which the software is being developed
Wi-Fi	Wireless local area network
Bluetooth Low Energy (LE)	Wireless close-range communication technology
TCP/IP	Transmission Control Protocol / Internet Protocol
UDP	User Datagram Protocol
NTP	Network Time Protocol

FTP	File Transfer Protocol
RDS	Radio Data System
User	A person who interacts with the BCR
Admin Administrator	A person who has higher privileges and permissions within the system than a regular user
UI	User Interface
Flash memory	Solid-state non-volatile storage
RAM	Random Access Memory – volatile storage
CPU	Central Processing Unit
RTOS	Real-Time Operating System
UTC	Coordinated Universal Time
MB	Megabyte
AM/FM	Amplitude/Frequency Modulation
AM/PM	Ante/Post Meridiem (before/after midday)

1.4. References

IEEE. (1998). *IEEE Std. 830-1998: IEEE Recommended Practice for Software Requirements Specifications.* Retrieved February 5, 2019 from eConestoga.

Rubble, F. (2019). *Proposal for New Clock Radio.* Retrieved February 5, 2019 from eConestoga.

McConnel, S. (2004). *Code Complete* (2nd ed.). Retrieved January 6, 2019 from http://aroma.vn/web/wp-content/uploads/2016/11/code-complete-2nd-edition-v413hav.pdf

BS Software Inc. (2014). *API Documentation: BS API* (v. 1.0.3). Retrieved Febraury 11 from eConestoga

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1.5. Overview

The remainder of this document contains 2 sections and an appendix. The second section provides an overview of the system functionality and interaction with other systems. This section also introduces different types of users and their

interaction with the system. Besides that, it mentions constrains and assumptions about the product.

The third section provides requirements specification in detailed form and description of different system functionalities and interfaces. In this section requirements are specified more precisely in order to be understood completely by the developers of the system.

Appendix contains various questions asked by developers and answered by the client as an additional reference for this document.

2. Overall Description

This section gives an overview of the whole system and provides basic description of its functionality and interaction with other systems.

2.1. Product Perspective

The discussed software is a part of the BCR, which contains multiple hardware components. This is the only software to be installed on the BCR.

2.1.1. System Interfaces

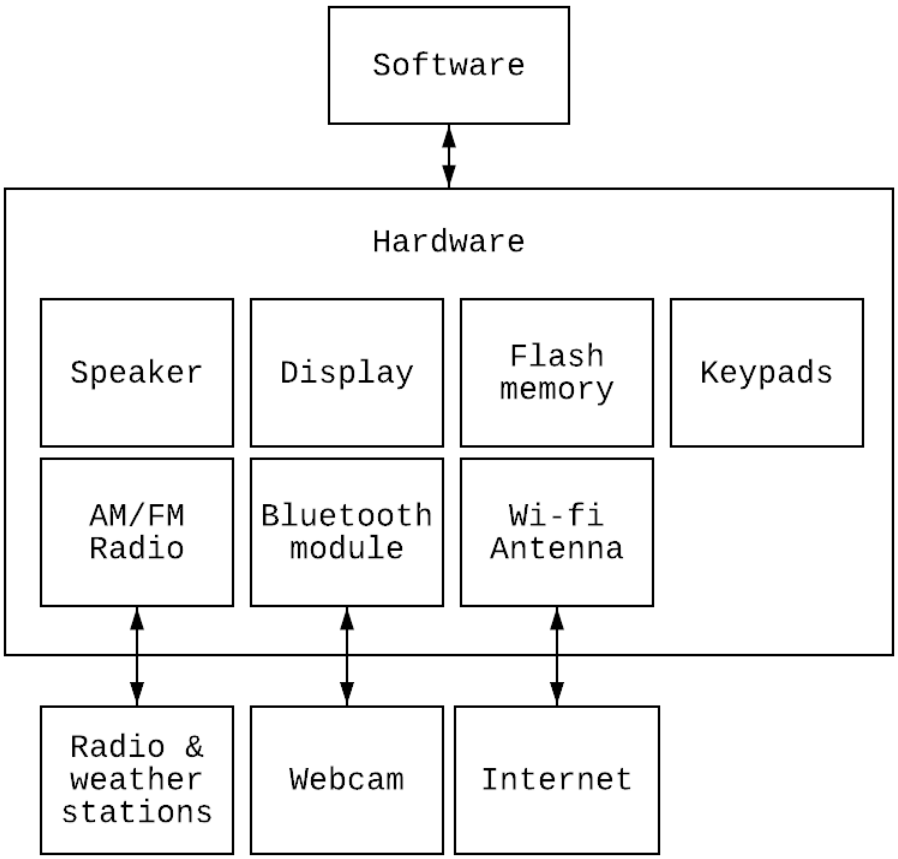

Figure 1: Block diagram of the BCR

2.1.2. User Interfaces

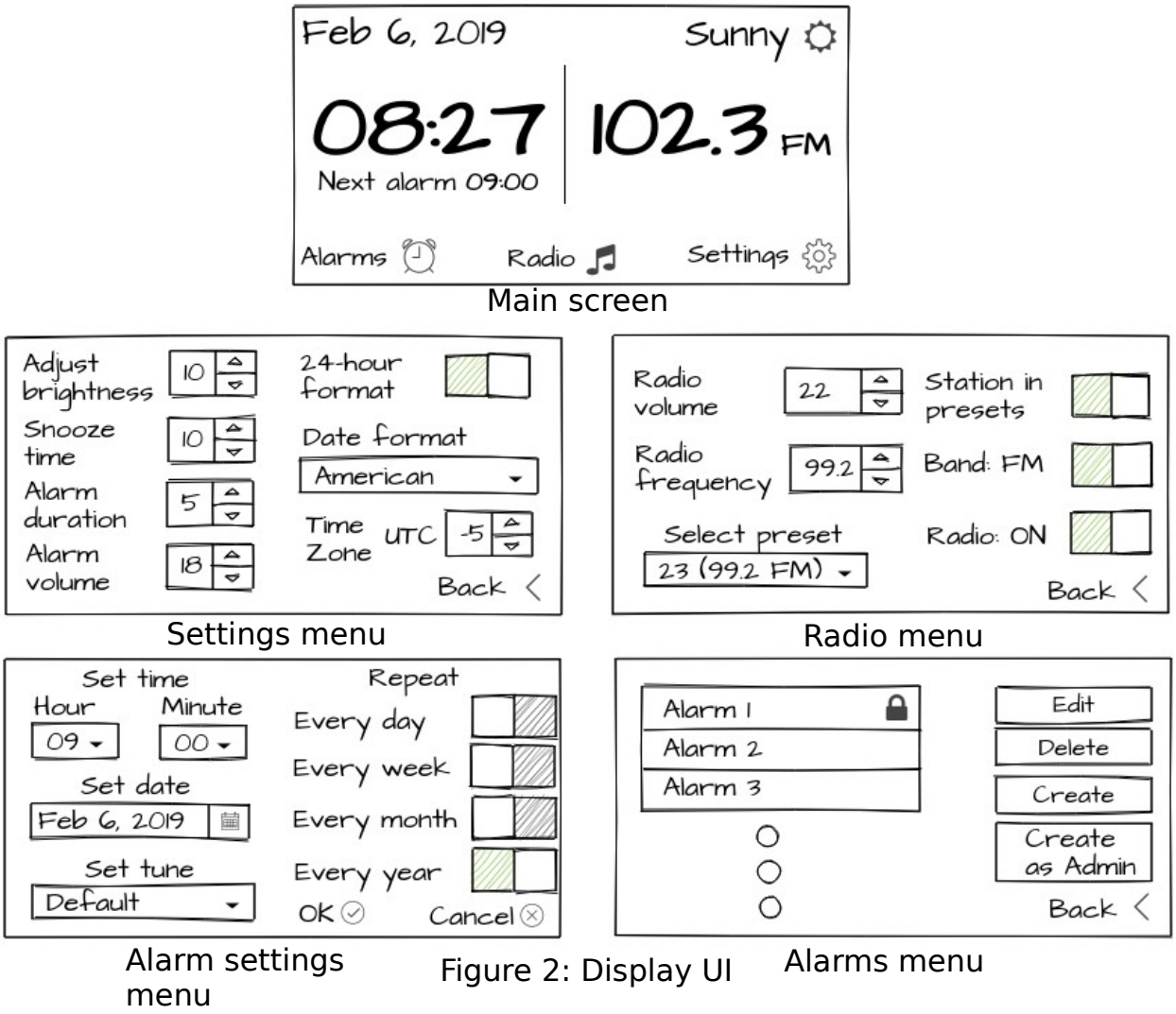

Figure 2: Display UI

2.1.2.1. LCD Display

The LCD Display is placed on the front panel of the BCR to provide visual output for the user. It has a resolution of 128x256. Color scheme is grayscale. Figure 2 provides sample mockups for what will be displayed on the screen. User can navigate through the menus with keys (see Sec. 2.1.2.2.). The display does not provide a touch input option.

2.1.2.2. Keypads & keys

A keypad with arrows, OK and SNOOZE buttons are placed on the front panel of the device. For the precise layout see Figure 3.

OK and arrow buttons are used for navigating through the menus and are primary input method of the user. SNOOZE button is used only for snoozing the alarm.

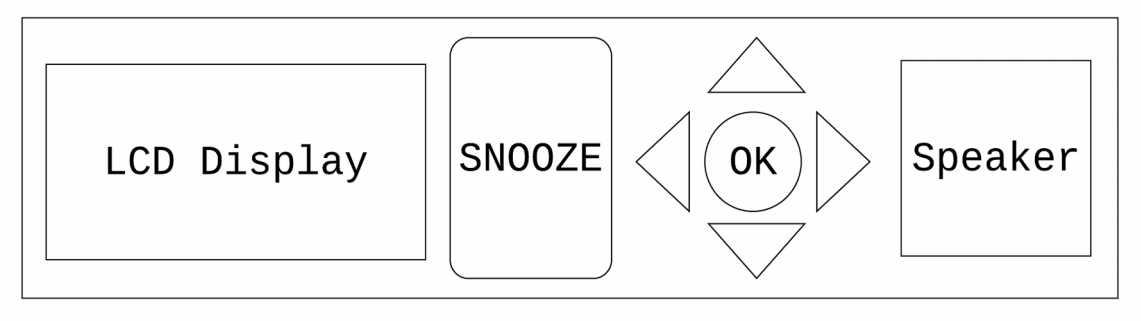

Figure 3: Front panel layout

2.1.3. Hardware Interfaces

The system is equipped with an ARM SAMA5D2 CPU (model ATSAMA5D24C).

There is an Bluetooth LE module for communicating with detachable webcam. There is also Wi-Fi 802.11a/b/n module present for interfacing the system via local network.

Primary input source is keys on the front panel and a webcam sensor. Output is provided by integrated LCD display and speaker.

2.1.4. Software Interfaces

The software runs on a RTOS version of Linux.

The system has to interface with a detachable webcam that detects whether the person is gotten out of bed or not. For those purposes third-party API is provided.

Also, APIs are provided for all I/O methods, such as Screen, Keypad, Speaker and Radio. For complete documentation, see References 4-5.

2.1.5. Communication Interfaces

Bluetooth LE is used for communicating with detachable webcam.

Wi-Fi module might use TCP/IP, UDP, NTP or FTP when communicating be the means of Internet. NTP (and therefore UDP) are used to fetch the current UTC time. FTP might be used while downloading a new audio file. Finally, TCP/IP is used to connect to external web apps or servers.

Radio module uses RDS protocol to receive data from radio and weather stations.

2.1.6. Memory Constrains

The system is equipped with 32 MB of flash memory and 2 MB of RAM. Memory is internal and non-upgradable. No extension slots or ports provided.

2.1.7. Operation Modes

2.1.7.1. Initial setup

This mode is entered once only – on the very first power-up of the device. It’s purpose is to connect to the user’s Wi-Fi, set screen language – English or Japanese and set an Admin password. These values are set once and cannot be reset after.

After the setup a small message is displayed on the screen, presenting a user with a short overview of user interface. Then, user enters user mode (see Sec. 2.1.7.2).

2.1.7.2. User mode

While in user mode, access is granted to the main screen and an alarms menu.

On the main screen display presents current date, time, weather, radio station, time to the next alarm and navigation to alarms menu and settings menu (see Figure 2). This is also the default screen display if the device is unattended.

Alarms menu lets user create, delete or edit alarms, as well as view the list of all set alarms.

2.1.7.3. Admin mode

Admin mode provides access to the settings menu. Before entering the menu, user is prompted for the password that was set during the initial setup. Input is done by virtual keyboard displayed on the screen and navigation by arrows.

Settings menu provides a user with a way to change various system settings, such as volume, display brightness, time format, etc. (see Figure 2).

The admin will also have the ability to set alarms that cannot be edited or deleted by normal user. (Displayed with a lock beside in alarms menu.)

2.1.8. Site Adaption Requirements

Software is to be installed during manufacturing process. It is to be installed only on specially designed hardware (BCR itself) and does not require any additional configuration.

2.2. Product Functions

2.2.1. Clock

The device will have basic clock functionality, including displaying time, date, and support of various settings, such as time format, date format, time zone change and daylight savings switch. The UTC time will be retrieved by the means of NTP as soon as the device gets connected to user’s Wi-Fi.

2.2.2. Alarm

The BCR will have an alarm feature, which includes setting alarms with various configurations, such as time, date, associated tune or radio station, repeat mode. There is a number of preloaded tunes for user to choose from. The duration of the alarm and snooze time are also customizable in admin mode. If the alarm is set by admin, regular user cannot edit or delete it.

The BCR also provides a sensor that detects whether or not the person has gotten out of bed after alarm went off. If yes, the alarm stops automatically, otherwise it continues unless snoozed by user.

The user will be able to set up to 512 alarms to be active simultaneously.

2.2.3. Radio

The device provides a basic AM/FM radio functionality, including frequency scanning, changing volume, modulation, and setting up to 128 radio presets.

Weather stations are also supported. Retrieved weather is displayed on the main screen.

2.3. User Characteristics

User does not require any special training, experience or education, assuming he reads one of the two provided languages (English or Japanese).

2.4. Constrains

The choice of programming language is restricted to C or C++.

The software is not safety critical.

For hardware limitations see Sec. 2.1.2, 2.1.3. and 2.1.6.

2.5. Assumptions and Dependencies

Since the software is to be installed only on the BCR, and its hardware compounds are well-defined, there are no assumptions or dependencies, except the reliability of hardware manufacturer and third-party API providers.

2.6. Apportioning of Requirements

The only requirement to be apportioned is the “Download new tune” function. Since for its existence an additional mobile app or a web interface has to be developed, tested and deployed, this functionality will be implemented in a future release. Also, security threats have to be taken into account while designing this feature.

This feature, as the name suggests, provides an ability to download new .mp3 files and set them as a tune for the alarm. Number of tunes that can be downloaded is limited my the amount of free flash memory.

Similarly, accompanying “Delete tune” function has to be added for obvious reasons.

3. Specific Requirements

This section contains all of the functional and quality requirements of the system. It gives a detailed description of the system and all its features.

3.1. External Interfaces

N/A

3.2. Functional Requirements

ID	Title	Description	Notes
1.1	Power up (first-time)	When user powers up the BCR for the first time, the system shall prompt the user for Language, Wi-Fi network and password, admin password. The system shall reprompt for Wi-Fi password until the connection is successful. After that it shall display a “Setup Complete!” message on the screen for 3 seconds. After that it shall display the main screen (see Figure 2, top).	All text input is accepted through digital keyboard on the screen and keys used for navigation and typing.
1.2	Power up (regular)	When user powers up the BCR, the system shall display the main screen (see Figure 2, top).	
2.1	Main screen navigation (arrows)	When user presses Right or Left arrow while on the main screen, the system shall move the focus from current icon to the icon respectively right or left to it.	Alarms ↔ Radio ↔ Settings
2.2	Main screen navigation (OK button)	When user presses OK button while on the main screen, the system shall enter the menu screen mapped to the button it was focused on (see Figure 2).	
3.1	Access Settings menu	When user want’s to access Settings menu, the system shall prompt him with admin password. If it is accepted, user is presented with settings menu, otherwise he is reprompted. User can choose to go back to the main menu by navigating to the “Back” icon.	

3.2	Settings screen navigation	When user presses Right or Left arrow while on the main screen, the system shall move the focus from current setting to the next setting in top-down left-right order.	This also applies to navigation on every other menu
3.3	Change brightness, alarm duration, snooze time or volume	When user is in the Settings menu and focused on the “Adjust brightness”, “Snooze time”, “Alarm duration” or “Alarm volume”, if he presses Up or Down arrows, the system shall increase or decrease the value of the setting focused on respectively. If the maximum/minimum value reached, system shall do nothing.	Constrains: from 1 to 20
3.4	Toggle time format	When user is in the Settings menu and focused on the “24-hour format”, if he presses OK button, the system shall toggle the time format. This shall be seen on the main screen.	24-hour ↔ AM/PM
3.5	Change Date format	When user is in the Settings menu and focused on the “Date format”, if he presses OK button and then Up or Down buttons, and then OK button again, the system shall switch the time format. First OK press – choose to adjust this setting, Up/Down presses – choose the format from drop-down, second OK press – confirm. This shall be seen on the main screen.	Available: MM/DD/YY DD/MM/YY YY/MM/DD Month D, Yr
3.6	Change Time Zone	When user is in the Settings menu and focused on the “Time Zone”, if he presses Up or Down arrows, the system shall add or subtract 1 hour from the current time respectively. If the maximum/minimum value reached, system shall do nothing.	Constrains: from -12 to +12
4	Exit menu	When user is in any menu and focused on the “Back <” icon, if he presses OK button, the system shall navigate to the main screen.	Applies to Settings, Alarms and Radio menus
5.1	Change radio volume	When user is in the Radio menu and focused on the “Radio volume”, if he presses Up or Down arrows, the system shall increase or decrease the radio volume respectively. If the maximum/minimum value reached, system shall do nothing.	Constrains: from 0 to 20

5.2	Change radio frequency	When user is in the Radio menu and focused on the “Radio frequency”, if he presses Up or Down arrows, the system shall scan up or down the frequency space respectively. If the maximum/minimum value reached, system shall do nothing.	Constrains: FM: from 87.5 to 108 AM: from 530 to 1700
5.3	Toggle radio band	When user is in the Radio menu and focused on the “Modulation”, if he presses OK button, the system shall change the modulation mode.	FM ↔ AM
5.4	Turn radio on/off	When user is in the Radio menu and focused on the “Radio”, if he presses OK button, the system shall turn the radio on or off, depending on current state.	ON ↔ OFF
5.5	Remember or forget radio station	When user is in the Radio menu and focused on the “Station in presets”, if he presses OK button, the system shall add or delete he station from the list of presets, depending on current state. If it’s the 129^{th} station to add, the system shall display a warning and do nothing.	
5.6	Choose station from presets	When user is in the Radio menu and focused on the “Select from presets”, if he presses OK button and then Up or Down buttons, and then OK button again, the system shall switch frequency and band to those in the chosen preset. First OK press – choose to select a preset, Up/Down presses – choose the preset from drop-down, second OK press – confirm.	
6.1	View alarms	When the user is in the Alarms menu, the system shall display the list of all alarms and 4 buttons: “Edit”, “Delete”, “Create” and “Create as Admin”. Alarms created by Admin shall be displayed with a lock icon beside.	
6.2	Choose alarm	When the user is in the Alarms menu and focused on alarms list, if he presses OK button, the system shall navigate to this alarm’s settings menu. If he instead presses Up or Down buttons, the system shall shift the focus from current to the alarm before or the alarm after, respectively.	

6.3	Edit alarm	When the user is in the Alarms menu and focused on “Edit”, if he presses OK button, the system shall focus on the alarms list. After alarm is chosen, the system shall navigate to the alarm settings for chosen alarm. If the chosen alarm was created by admin, the system shall do nothing.	
6.4	Delete alarm	When the user is in the Alarms menu and focused on “Delete”, if he presses OK button, the system shall focus on the alarms list. After alarm is chosen, the system shall delete it from the list. If the chosen alarm was created by admin, the system shall do nothing.	
6.5	Create alarm	When the user is in the Alarms menu and focused on “Create”, if he presses OK button, the system shall navigate to the alarm settings menu. After alarm was set up, the system shall add it to the list.	
6.6	Create alarm as Admin	When the user is in the Alarms menu and focused on “Create as Admin”, if he presses OK button, the system shall prompt the user for Admin password. If it is accepted, see 6.6. Otherwise, return to Alarms menu.	
7.1	Set up / edit an alarm: time	When the user is in the Alarm settings menu and focused on “Hours” or “Minutes”, if he presses Up or Down buttons, the system shall increment of decrement the unit focused on, respectively.	Constrains: Hours: 0 to 23 Minutes: 0 to 59
7.2	Set up / edit an alarm: date	When the user is in the Alarm settings menu and focused on “Date”, if he presses OK button, the system shall display the calendar and focus on it. Then, if user presses arrow buttons, the system should navigate though calendar. Then, if user presses OK button, the system shall set the date user was focused on.	
7.3	Set up / edit an alarm: tune	When user is in the Alarm settings menu and focused on the “Select tune”, if he presses OK button and then Up or Down buttons, and then OK button again, the system shall change tune for current alarm. First OK press – choose to adjust this setting, Up/Down presses – choose the tune from drop-down, second OK press – confirm.	

7.4	Set up / edit an alarm: repeat	When user is in the Alarm settings menu and focused on the “Every ...”, if he presses OK button, the system shall toggle the repeat setting for that alarm.	... is for day, week, month, year
7.5	Set up / edit an alarm: confirm or cancel	When user is in the Alarm settings menu and focused on the “OK”, if he presses OK button, the system shall save the settings for the current alarm. If instead the user was focused on “Cancel”, the system shall discard all changes.	
8	Issue an alarm	When time comes, the system shall issue an alarm. See Figure 4 for details.	

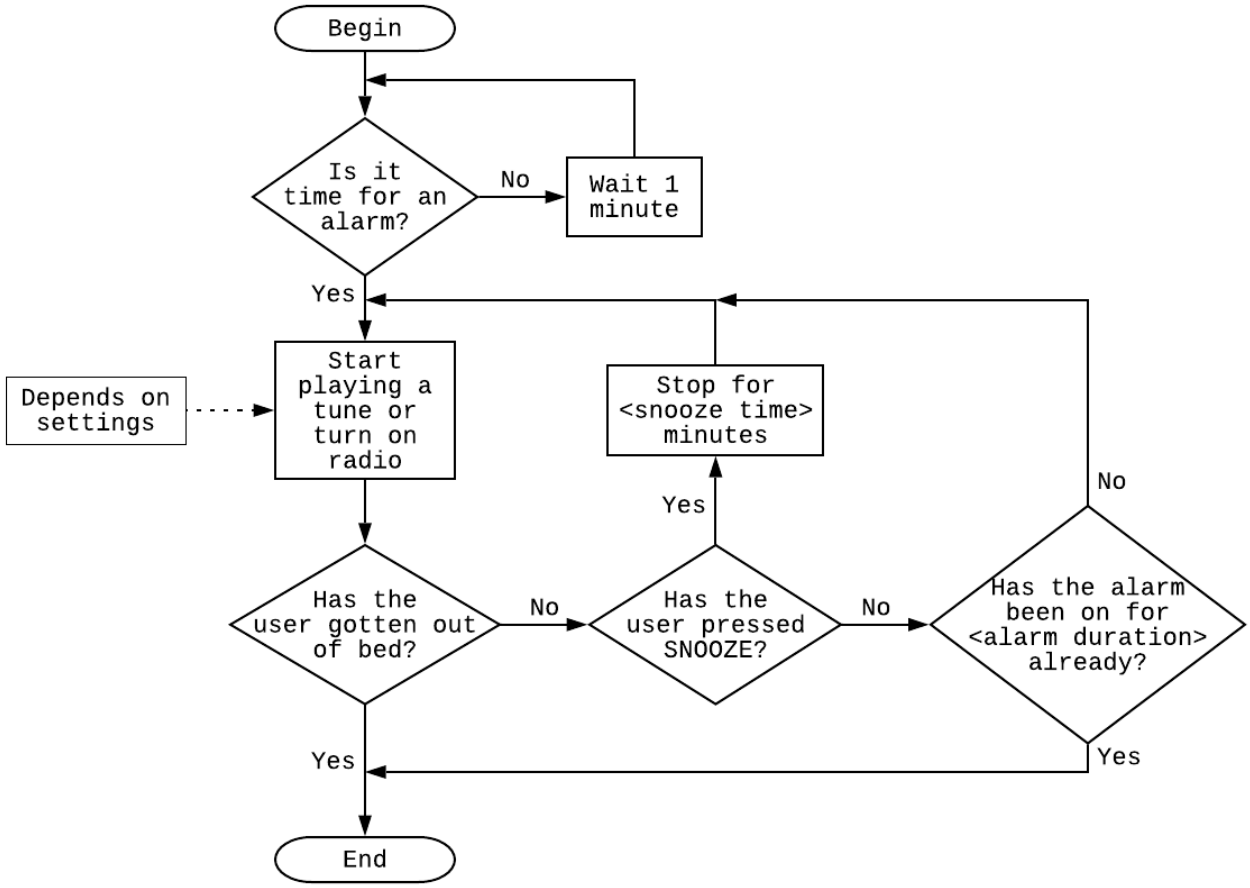

Figure 4: "Issue alarm" – Flowchart

3.3. Performance Requirements

N/A

3.4. Logical Database Requirements

Entity	Attributes	System usage	Retention	Notes
Alarm	• Time & date • Repeat mode • Associated tune or radio station • Mode • ID	Every minute, while checking if it is time for a particular alarm to go off	Stored in flash memory until deleted by user	Mode – User (editable) or Admin (frozen). Repeat mode – subset of {daily, weekly, monthly, yearly}. ID – unique number of each alarm.
Radio preset	• Frequency • Modulation • ID	Every time user wants to switch to a particular preset or set it as an alarm tune	Stored in flash memory until deleted by user	Modulation – AM or FM. ID – unique number of each preset.
Tune	• Path to .mp3 file • ID	Every time when alarm with a particular tune goes off	Stored in flash memory until deleted by user	ID – unique number of each tune.
Global settings	• Alarm volume • Alarm duration • Snooze time • Time zone • Language • Admin password • Wi-Fi password • Radio volume • Time format • Date format • Screen brightness	On power-up, when alarm goes off, when entering admin mode, updating settings, and generally (in unattended mode)	Stored in flash memory and cannot be deleted	Every attribute can be modified except Wi-Fi password, Language and Admin password.

Lists	• Alarms list • Presets list • Tunes list	When configuring alarms and toggling presets	Stored in flash memory and cannot be deleted	Each list stores IDs of entities it contains.

3.5. Design Constrains

N/A

3.6. Software System Attributes

N/A

Appendix A

This appendix contains questions & answers from the interview with a client as an additional reference.

Questions

1. What do you mean by “all normal functionality of conventional AM/FM clock radios”? Anything else besides altering volume and changing channels?

2. What else should be on the display apart from time (in the letter referred to as “other status information”)? Like current playing channel (if any), volume level, date, wake-up time, battery status, settings icon? Anything else?

3. Please state the exact number or range, how many radio presets and alarms will user have the ability to set?

4. What would you like to see in the settings interface on the display? Examples: Set/Edit/View/Delete an alarm menus, change volume/channel buttons.

5. What parameters does the user has to specify when setting up an alarm? Example: time, day, whether to repeat or not, when to repeat, alarm tune, associated radio channel. Should the input be accepted through display or pad/remote?

6. What should the buttons on a pad/remote be used for? The advice is that we should leave only arrows and OK/Cancel and with their help navigate and accept input though displayed interface. This will save manufacturing costs and simplify interface.

7. What do you mean by Basic and Advanced levels of operation? What features would you like to see in each of them? How would you like for the user to switch between them? Do you think these levels are necessary?

8. How would you like for the user to download a new alarm tone? From a fixed local database / remote website / through a USB port? Where and for how long would you like to store it? Where should the menu for this feature be located?

9. Could you please define what you mean by the words “flexible”, “easy to use”, “exceptionally well”, “extremely easily possible”, “simple” in your letter? We would like to document everything unambiguously.

10. What do you mean by “radio station associated with an alarm”? Do you mean that when alarm goes off, clock switches to this radio station / sets a tune of this

alarm as one of the songs played there or plays this radio station after alarm finishes?

11. What interval of time should the alarm clock wait to go off again if the user has not gotten up (according to the hardware sensor)? How long should it play the first time? Can this be customized be the user?

Answers

1. The device has to have clock functionality – showing time and date, and radio functionality – playing music from chosen radio station, changing frequency, volume and modulation.

2. Time, date, current radio station, weather, time to next alarm and any necessary menu buttons.

3. 128 presets, 512 alarms.

4. For alarms: Create/Edit/Delete buttons, for radio: Volume/Frequency/Modulation, other: screen brightness, time & date formats, and any necessary customizations.

5. Example suffices. Input only accepted from the keypad.

6. Buttons are used for user input. We can get rid of the number pad and place one large button instead.

7. Advanced level differs from the Basic in the sense that in Advanced level user will have access to additional system settings and will also be able to set alarms uneditable by Basic-level users. Yes, this feature is necessary.

8. Wi-Fi antenna is provided for this purpose. No USB ports. However, this feature is optional, if you provide a good reason for it to be optional.

9. I’m sure you understand what I mean.

10. When alarm goes off, the music from chosen radio station should play.

11. Can be customized.