Software Requirements Specification

for

Smart Medicine Drawer

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1. **Introduction**

In this document a **SMART MEDICINE DRAWER** is made. Smart Medicine Drawer is an advanced drawer designed for patients to maintain medication. Its elements are a digital clock, a display, weight sensors, alarm sensor, navigation buttons, enter button, drawer buttons and a power adapter. Whenever the clock strikes the medicine time, alarm beeps and the particular drawer containing medicines for that time opens up automatically. Also the display on the top shows up the weight of each drawer helping us to know how much of medicine is left. The alarms are set with the help of buttons.

* 1. **Purpose**

The purpose of this document is to build **SMART MEDICINE DRAWER** which will ease the work of the care takers and the nurses. In this drawer there will be four containers and every container have a button on it which is used to select the container in which nurse or care taker want to put medicine and then set alarm. To set an alarm there is a real time clock which is mounted on the top of the drawer and it is connected to the buzzer. When buzzer will buzz container will come out automatically. To make this smart medicine drawer, ARDUINO and its many modules are required which are as follow:

* ***ARDUINO UNO***
* ***DS3231 Real Time Clock***
* ***Passive Alarm***
* ***The 16×2 LCD display***
* ***I2C module***
* ***Resistors***
* ***Push Buttons***
* ***Jump wires***
* ***Weighting sensor***
* ***l298n motor driver***
* ***DC Motor***

There are many features in the drawer which will be a great asset to the patients. As it is fully automatic and no one has to take care of the medicine because smart medicine drawer will alert the patients that it is time to take medicine and patient can take medicine without the help of care taker or nurse. The whole procedure to use this drawer is nurses just have to put the medicine in the drawer and then click on the container button in which she want to set an alarm and when clock will hit the time drawer will buzzer and the container containing the medicine will come out automatically. ARDUINO will be programmed in ARDUINO IDE and then the whole program will be uploaded in ARDUINO board.

# The four project parameters in this project are time, cost, scope and quality. To accomplish all the parameters it is important to be clear, right from the start, that in order to achieve the final deadline, several other ‘mini-deadlines’ will have to be met. To make this project cost friendly ARDUINO is used as it available in the market at very affordable price and due to this whole project is becomes an affordable project. The scope of the project in the medical field is very high as this can be used by the every hospital as well as people can also use it in their homes. As this project has great scope so it is important that its quality must be good and yes, this medical drawer is a great quality project. Everything in this project matches all the parameters which are required to make a project successful. As it is very easy to operate, consumer can easily use it. Also it is very portable so patient can take it with itself and it will take care of patient’s medicine and as also give reminder to patient.

# This project can be sold in every hospital all over the world as every hospital want to make their hospital more advance and to make hospitals more advance everyone need advance products and our project is that much advance that it can make place in the market and have that capability that it will be very successful in today’s market because in today’s world every family have that one member that who take medicines and that member take the full benefit of this project.

* 1. **Intended audience and Reading suggestions**

The document is intended for normal, domain experts, developer and project manager. ou can go through with the ARDUINO and its modules for better understanding. You can learn the basic programming of the ARDUINO so that you will know how the program is working. This document needs to be read sequentially; users are not encouraged to jump to any section they find relevant. Below is overview of each part of the document.

* Part 1 (Introduction):

This section offers a summary of the project, including goals and objectives, project scope, general system details, and some major constraints.

* Part 2 (Overall Description)

This section gives an insight about the functionalities of our product, the various user classes under the product and their characteristics. It also tells us the about the operating environment of our product, then it includes design and implementation constraints for developers, then the assumptions and dependencies of the product.

* Part 3 (System Features)
* Part 4 (External Interface Requirements)

This section specifies the hardware, software or elements with which a system or components must interface.

* Part 5 (Non Functional Requirements)
  1. **Project Scope**

**SMART MEDICINE DRAWER** will be a great asset to the doctors, nurses, care takers and patients. It will make work easier for them. Nurses and care takers don’t have to go again and again to the patients to give medicines and patients don’t have to wait for nurses or care takers as they can take their medicine by their own because smart medicine drawer give a reminder by giving an alarm to patient that it is time to take medicine. Patients also don’t have to worry about that what medicine they have to take because smart medicine drawer will only open that container which medicine patient have to take at that particular time. Also, there is a weighting sensor which will show the weight of medicine in the drawer and if weight goes down nurses can refill the container with medication. In this way this project will solve the problem of skipping medicine and also lighten the work load of the nurses and care takers.

To use this smart medicine drawer all just need to do is put medicine in the drawer and then click on the button on the container in which medicine is kept and then you can set an alarm with the help of navigation button. When it is time to take medicine smart drawer will start buzzing and container will come out automatically and patient can take his or her medicine. This project really has great scope as it will help more than half of the world.

* 1. **References**

1. Tinkercad is used to design the circuits and helps in simulation.

[**https://www.tinkercad.com/things/5ytOTuzdbrQ-fantabulous-esboo/editel?tenant=circuits**](https://www.tinkercad.com/things/5ytOTuzdbrQ-fantabulous-esboo/editel?tenant=circuits)

1. From this website we have learned the mechanism of the dc motor and arduino module l298n.

[**https://lastminuteengineers.com/l298n-dc-stepper-driver-arduino-tutorial/#:~:text=We%20will%20make%20use%20of,5%2C%204%20and%203**](https://lastminuteengineers.com/l298n-dc-stepper-driver-arduino-tutorial/#:~:text=We%20will%20make%20use%20of,5%2C%204%20and%203)

1. From this website we learn about the mechanism of clock using arduino.

[**https://roboticadiy.com/how-to-make-arduino-alarm-clock/**](https://roboticadiy.com/how-to-make-arduino-alarm-clock/)

1. YouTube played an important role to understand the different mechanism of arduino. And at last we merge all the mechanism, making the mechanism of SMART MEDICINE DRAWER.

[**https://www.youtube.com/**](https://www.youtube.com/)

**2. Overall Description**

**2.1 Product Perspective:**

SMART MEDICINE DRAWER is built keeping in mind the need of proper medication. Our document specifies a standalone product i.e. Smart Medicine Drawer. Our Product is not at all integrating part of a larger system, it’s an advanced drawer designed for patients to maintain medication and does not depend on any other system. None of the part of our project is associated with any external system. The working of each part of our SMART MEDICINE DRAWER is independent of external devices, all its parts only depends upon the internal components of our product. Its internal components are a digital clock, a display, weight sensors, alarm sensor, navigation buttons, enter button, drawer buttons and a power adapter. Like here for setting up the alarm we depend upon the navigation button, the opening of the drawer depends upon the alarm sensor, similarly the other parts also depends upon each other in a way. The main user for our product is going to be patients. Patients are going to be the one who will directly interact with our Smart Medicine Drawer either at hospitals or at home.

**2.2 Product Functions:**

Following is the list of functionalities our product is going to offer to the end user. The end users for our product are mainly patients or they can be doctors/care takers also.

1. As our Product is fully automatic so the user would not need any manual support for operating the smart medicine drawer.
2. Patients or the care takers do not need to remember the timing for the medication as the automatic drawer will open up at the correct timing.
3. Also it provides the functionality of changing the alarm time with the help of navigation buttons according to the user at any time, as the prescriptions by the doctors may keep changing.
4. Also it isn’t necessary to change the timings for all the sections of the drawers together, it can be done separately for each section as we are providing the choosing buttons for each section.
5. Also the weight sensors provided in the drawer displays the weight for each section which helps us to estimate whether we are running short of medicines or not. It also acts like an alarm like now if the weight is less then we need to fill in the medicines.
6. Our product - Smart medicines drawer will also make the beep sound at the time of medication when the drawer will be opening so that if any user misses on visual he/she can hear the sound and have medicines.

**2.3 User classes and characteristics:**

In this section of the document we are going to specify the various user classes that can use our product and usability requirements for using the product.

The following are the user classes that come under our project:

* **Patients**: This is the user class that is going to be most benefitted by our Smart medicine drawer. As our drawer is an automated drawer, so patients do not require any manual support for using it. All the patients can use it independently. As the alarm timings needs to be only set up once which is very easy using the various buttons present there, only the patient should be able to read the timings.

Also patient needs to be able to understand weights displayed on the screen if he/she is using it independently.

* **Doctor:** Doctors can also use smart medicine drawer if they want to set up medication care for a particular patient on their own .They do not need to perform any extra operations for it as our drawer is Automatic. Doctors can use it for the patients admitted to their hospital to make the management easy. Our product only requires power, which is easily available at each and every hospital. Otherwise we can also set it up with batteries for time.
* **Nurses/Care Takers:** This class is also hugely benefitted with our smart medicine drawer as it reduces their workload and stress in a way , they do not need to remember the medicine types and medication timings for each and every patient at hospital or at home also. Our product is very easy to use, so they only need to once set it up in the patient’s ward and set up the alarm and put in medicines, then their work is done. They will have to stress out less on timings and their patients will get proper medication.

**2.4 Operating Environment:**

Firstly our product can be set up anywhere at home or hospitals. The most basic element that is being used in our product for functioning is ARDUINO Uno and the ARDUINO needs code to work. Microsoft Windows, also called Windows and Windows OS, computer operating system (OS) developed by Microsoft Corporation is used to run personal computers (PCs).  And here we specifically are using windows operating system through our PC to store the code in ARDUINO ,so that it can done smoothly , once the coding part is done, then our Smart medicine drawer only needs power source to be operated.

**2.5 Design and Implementation constraints:**

Issues that will limit the options available to the developers are as follows:

* The main component of the product is ARDUINO Uno, and anyhow if it fails to work, developers won’t be able to make the product work anyhow because ARDUINO is the core for the Drawer.
* An issue may arrive if power source isn’t available and the developers are not prepared with any backup batteries.
* Anyhow if the display of the digital clock breaks or the screen for displaying the weights broke, then these hardware components need to be replaced.
* One of the issue can be the proper working of the motor and the direction in which it is working , so the developer needs to careful while specifying the direction for the motor.
* One of the main tasks to be done by the developers is coding part. So the developer needs to be very precise and careful while writing this part.

**2.6 Assumptions and Dependencies:**

In our Smart Medicine Drawer, we are not using any third party or commercial component. Its working is Automatic and it doesn’t depend upon any external component except for Power.

Following are some Assumptions and Dependencies that are required for the successful completion for our project:

* Firstly all the components that we are going to use to build our project-

1. ***ARDUINO UNO***
2. ***DS3231 Real Time Clock***
3. ***Passive Alarm***
4. ***The 16×2 LCD display***
5. ***I2C module***
6. ***Resistors***
7. ***Push Buttons***
8. ***Jump wires***
9. ***Weighing sensor***
10. ***l298n motor driver***
11. ***DC Motor***

* The complete code need to work fine, all loops and values of the ARDUINO Pins must be accurate for smooth working.
* The time needs to be set precisely otherwise there will be no benefit of the drawer if it opens up at the wrong time.
* Also care must be taken of the power source, because power is mandatory for the working of our Smart Medicine Drawer.

**3) System features**

**3.1) Functional Requirements:**

* **Description and Priority**

Smart medicine drawer maintains different types of information such as timing, weight, when the alarm rings etc. This project has a high priority because it is very difficult to take medicines on time and many times a person forgets to take medicine on given time prescribed by the doctor or physician. Many patients will be benefited by using this device as it will help them a lot in taking medicine at given time without worrying very much and their health will also improve.

* **System features include:**
* **Distributed drawers:**

Different drawers are available to the person on which he/she can put medicines according to his/her convenience.

* **Alarm System:**

Alarm will beep according to the time which is set by the person so that he/she can take his/her medicine at time.

* **LED Display:**

A separate LED display is provided to set the alarm for different drawers.

* **Device Requirements:**

1. Device must allow inputs to be entered and saved by the user.
2. Person can change device inputs anytime.
3. There must be least number of errors in the device.
4. The device must execute different tasks at that given time accordingly.
5. The drawers also have the function of manually open.

**4. External Interface Requirements**

* 1. **User Interfaces**
* There will be a clock mounted on the top of the drawer which shows real time to the user.
* One can also set an alarm in that clock.
* There are navigation button which will help to set an alarm.
* Every container has a button mounted on it.
* A display is also mounted on the top.
* Weighting sensors show its result on the display.
* Display is divided into 4 columns hence, showing weight of medicine in each and every container.

**4.2 Hardware Interface**

* To match the time ***DS3231 Real Time Clock*** is used and it is connected with ARDUINO UNO.
* **Alarm** will buzz when it is time to take medicine as passive alarm is installed in it.
* ***The 16×2 LCD display*** is connected with ARDUINO and this display shows the real time and help in watching time also. It has supporting device ***I2C module*** which has total of 20 male pins. 16 pins are faced to rear side and 4 pins faced towards front side. The 16 pins for connect to 16x2 LCD and the 2 pins out of 4 pins are SDA and SCL.
* ***Push Buttons*** are installed to get the input from the user and ***Resistors*** are connected with them to control the flow of current.
* ***l298n motor driver*** is used the control the rotating direction of the ***DC Motor*** which will help open and close the container easily.
* ***Weighting sensor*** is connected with another display used to display the weight of the medicine in each container.

**4.3 Software Interface**

* In this project ***ARDUINO UNO*** is the main component which holds the command of the whole product.
* ARDUINO IDE platform is used to program the product.
* The program then uploaded in the ARDUINO UNO with the help of USB cable.
* Every component of the product gets command from the ARDUINO UNO.
* There are many components on the ARDUINO itself which are given below:

1. **Power USB**

ARDUINO board can be powered by using the USB cable from your computer. All you need to do is connect the USB cable to the USB connection

1. **Power (Barrel Jack)**

ARDUINO boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack

1. **Voltage Regulator**

The function of the voltage regulator is to control the voltage given to the ARDUINO board and stabilize the DC voltages used by the processor and other elements.

1. **ARDUINO Reset**

You can reset your ARDUINO board, i.e., starts your program from the beginning. You can reset the UNO board in two ways

1. **Pins (3.3, 5, GND, Vin)**

* 3.3V − Supply 3.3 output volt
* 5V − Supply 5 output volt
* Most of the components used with ARDUINO board works fine with 3.3 volt and 5 volt.
* GND (Ground) − There are several GND pins on the ARDUINO, any of which can be used to ground your circuit.
* Vin − This pin also can be used to power the ARDUINO board from an external power source, like AC mains power supply.

1. **Analog pins**

The ARDUINO UNO board has six analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.

1. **Main microcontroller**

Each ARDUINO board has its own microcontroller. You can assume it as the brain of your board. The main IC (integrated circuit) on the ARDUINO is slightly different from board to board. The microcontrollers are usually of the ATMEL Company. You must know what IC your board has before loading up a new program from the ARDUINO IDE. This information is available on the top of the IC. For more details about the IC construction and functions, you can refer to the data sheet.

1. **ICSP pin**

Mostly, ICSP is an AVR, a tiny programming header for the ARDUINO consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often referred to as an SPI (Serial Peripheral Interface), which could be considered as an "expansion" of the output.

1. **Power LED indicator**

This LED should light up when you plug your ARDUINO into a power source to indicate that your board is powered up correctly. If this light does not turn on, then there is something wrong with the connection.

1. **TX and RX LEDs**

On your board, you will find two labels: TX (transmit) and RX (receive). They appear in two places on the ARDUINO UNO board.

1. **Digital I/O**

The ARDUINO UNO board has 14 digital I/O pins of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labeled “~” can be used to generate PWM.

1. **AREF**

AREF stands for Analog Reference. It is sometimes, used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

**5) Non-Functional Requirements:**

**Performance Requirements:**

1. **Response Time:**

Responding time should be fast and accurate. At a given time the drawer of the particular medicine should be open without delay.

1. **Alarm Sound:**

Sound of the alarm should be loud enough so that the person is able to listen it and take his/her medicine at proper time. If the sound is quite low it will cause difficulties in hearing which will produce problems.

1. **Drawers quality:**

The material used in making device should be of good quality so that it will cost less maintenance and provide more output. Different parts used in device should be of high quality especially that of the drawers as they will open and close a lot.

1. **Execution time:**

The execution time should be fast and accurate so that the whole process should went smoothly and there will be no delay in opening and closing of the drawers. This will make device more reliable in terms of using.

1. **Storage Capacity:**

There should be a decent storage space in the drawers so that one can put different types of medicines easily without affecting the performance of the device due to the excess weight provided by the medicines.

1. **Service and Maintenance:**

The cost for maintenance should be low and also one can service or clean device by own its own by providing a proper maintenance guide while giving this device to the customer.

**Safety Requirements:**

Ensuring safe and effective use of medical devices for patients and users is a crucial responsibility for manufacturers and developers, not only in terms of addressing regulatory requirements but also of mitigating risks to public health. In order to pass scrutiny from market regulators and demonstrate that their products do not compromise public health and trust, medical device and technology companies must tie safety and risk management processes closely to their design, development and pre- and post- commercialization efforts.

If there is any damage to the device than there should be an option to open the drawers open manually so that the patient will be able to take his/her medicine at time.

If there is any medicine which is sharp in shape, made of glass or any medicine which is reactive to moisture or any other chemical present in nature. There should be a system that will provide safety to these types of medicines. Providing a separate drawer to the device that will make these medicine safe will be beneficial.

**Security Requirements:**

The FDA suggests security measures that device manufacturers should consider for protection of medical devices. Those include:

1. Limiting access to devices to trusted users through the use of [authentication](https://www.healthcareinfosecurity.com/authentication-c-206), such as ID and password, smart card and biometrics, including multi-layered authentication "where appropriate”.
2. Once designed and built, medical devices are mass produced, resulting in thousands to millions of identical devices. Once discovered, a successful attack against one of these devices can be replicated across all the devices. So Required steps should be taken to prevent these types of attacks.

**Software Quality Attribute:**

**Correctness:**

Medical devices are nowadays more and more software dependent, and software malfunctioning can lead to injuries or death for patients. So, the device should behave properly and provide proper output without malfunctioning.

**Availability:**

Medical devices and equipment form a significantly essential part of healthcare delivery. While technological advancements in the devices sector are expected to play a critical role in improving healthcare outcomes, it is important that appropriate measures are initiated to ensure greater affordability and accessibility. This can be improved by providing:

1. online delivery
2. Available at local stores
3. making these devices at local so that shipping cost and tax on device should be least

**Maintainability:**

1. **Maintain a Clean Workspace and Keep Equipment Clean.**

Keep away food, fluids and flammable substances from your workspace and avoid them getting in contact with your device.

1. **Turn Off Unused Equipment**

Turning off a medical device when it is not in use not only helps your facility conserve power, but also helps to increase the life span of the device.

1. **Carry Out Routine Checks**

One of the first and basic things to always do to ensure that your brand-new device is functioning optimally is to frequently carry out routine checks.’

**Functionality and Reliability:**

Functionality and reliability are important qualities for all medical devices. Improving accuracy of a component device such as a sensor can result in higher functionality and accuracy for these systems. For a low-cost, high-volume application, innovation in small, affordable sensing technology has helped bolster measurement accuracy that can rival some premium solutions.