"ThePillBox" - A Smart Pillbox (Team 05)

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Figure 1: "ThePillBox"

ABSTRACT

Managing multiple prescriptions can be challenging, particularly for elderly individuals. To address this issue and improve medication adherence, the development of "ThePillBox," a comprehensive smart pillbox system is proposed. The system aims to assist individuals in adhering to the correct dosage schedule, benefiting not only the elderly and sick but also nurses and caretakers. "ThePillBox" offers a versatile medication management solution suitable for various settings, from private households to retirement homes. The system features a compact and portable design, allowing users to carry it conveniently. It incorporates a secure pill dispenser, ensuring precise medication dosage administration at designated times. It also incorporates smart functions and high mobility to support forgetful and elderly patients in adhering to their medication regimens. By addressing the challenge of medication management, the system minimizes instances of missed or unplanned doses, thereby enhancing medication adherence and quality of life.
Overall, "ThePillBox" offers a comprehensive solution for medication management, combining a secure pill dispenser, versatile features, and smart functions. By improving medication adherence, the system aims to enhance the overall quality of life for individuals requiring multiple prescriptions, benefiting both patients and caregivers.

1 INTRODUCTION

In our present society, it is not only a moral obligation but also a societal duty to provide comprehensive assistance and support to the elderly population. As individuals age, they often face numerous challenges, including managing multiple prescriptions on a daily basis. Even for the most organized and responsible individuals, this task can be overwhelming and burdensome. Recognizing the difficulties faced by older adults, particularly those experiencing age-related cognitive decline and other health-related adversities, we have developed an innovative solution called "ThePillBox" to address these challenges and improve their quality of life.

The proposed system named "ThePillBox" is a cutting-edge medication management system that offers versatility and adaptability to meet the unique needs of senior citizens. Whether they reside in private homes or retirement communities, our solution seamlessly integrates into their living environments. At the heart of

ThePillBox lies a secure and reliable pill dispenser, meticulously designed to ensure the precise administration of medications at designated intervals. By using an intuitive and user-friendly web interface, individuals or their caregivers can easily configure the medication schedule, specifying medication types, dosages, and timing of administration. Once the initial setup is complete, the system takes over the task of dispensing medications, providing audible cues to remind users to take their doses. This user-centered design promotes adherence and reduces the likelihood of dosage errors, such as over or under-dosing. To address the issue of missed doses, ThePillBox incorporates a specialized collection platform equipped with a weight-based scale. In the event that a dose is overlooked, the system intelligently detects and withholds further medication dispensation until the missed dose is either consumed by the user or attended to by a designated caregiver. This feature ensures that individuals receive the appropriate medication as prescribed, minimizing the risks associated with missed doses. Furthermore, we understand the importance of accommodating different medication types and multiple dispensers within a household setting. To address this, we offer supplementary pill towers that act as client modules, seamlessly connecting to the central server of ThePillBox. These additional pill towers can be easily interconnected, allowing for the creation of a unified and expansive pill dispenser system. Alternatively, users or caregivers can distribute the pill towers strategically throughout the residence, based on individual preferences and convenience. By establishing a shared network infrastructure, ThePillBox operates seamlessly, ensuring the efficient and convenient management of medications. Our overarching objective is to provide a comprehensive solution that caters to diverse medication requirements while respecting individual preferences. By doing so, ThePillBox not only provides invaluable assistance to elderly and ailing individuals but also alleviates the burden on nurses and caretakers working in retirement homes and medical institutions. The global shortage of healthcare professionals has placed significant strain on caregivers, and ThePillBox aims to support and enhance their efforts, ultimately improving the well-being and quality of life for all stakeholders involved. The implementation of ThePillBox requires minimal prerequisites, including an internet connection, limited setup assistance, the availability of prescribed medications, and a reliable power supply. With these requirements met, the system is poised to deliver the anticipated outcomes efficiently and effectively. Moreover, the scientific and pioneering nature of this solution holds the potential for widespread adoption and recognition, contributing to the establishment of an environment that prioritizes the optimal well-being of our aging population.

In conclusion, ThePillBox represents a breakthrough in medication management, addressing the specific needs and challenges faced by the elderly population. By providing a user-friendly interface, precise dosing, adherence reminders, and the ability to accommodate various medications and settings, we strive to enhance the lives of older adults while supporting caregivers and healthcare professionals. Together, we can create an inclusive and caring society that promotes the optimal health and well-being of our aging population.

2 RELATED WORK

The scientific paper [1] explains a solution to overcome some common limitations in taking pills for medical reasons. Some of these drawbacks are, e.g., the difficulty of opening pill cases for some patients [1]. Also, one might forget to take the pills on time. Furthermore, the pill case does not accommodate the use of pill boxes for sorting medications into daily doses, as are commonly used by the elderly and when multiple drugs are taken. Therefore, the authors developed an instrumented pillbox, namely „MedTracker“ which allows the monitoring of medication adherence on a continuous basis. This pill case provides mobility frequent and automatic data collection, more detailed information about nonadherence and medication errors [1]. The device has a regular interface of a 7-day drug store pillbox. The authors defined four key requirements before developing the pillbox. First, the device should use a basic multi-compartment pillbox for holding the medication. Second, the device should be portable. Users should be able to take the pillbox anywhere they want to. According to the authors this maximizes the likelihood of taking their medication on time. This also concludes that the system needs to be run on batteries and had to be compact as presented in Figure 2. The third requirement is that the system doesn't require user interaction, beyond taking the medication itself. Last, the medication adherence data should be available for review on demand, so that a failure to take medication could be detected immediately and intervention could be taken if needed [1].

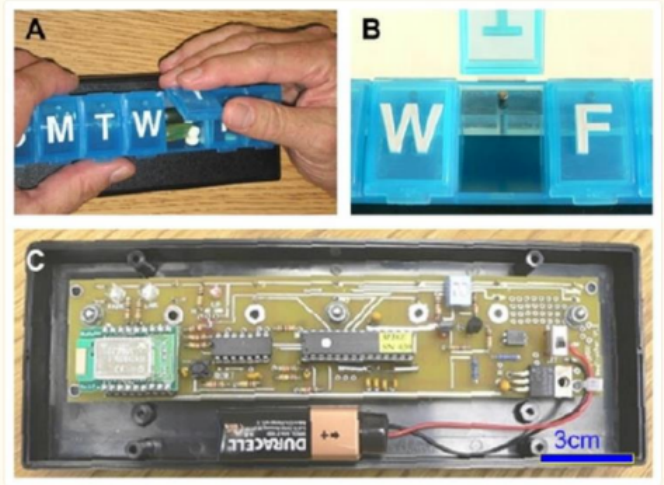

Figure 2: Med-Tracker Prototype [1]

The approach outlined in the scientific paper not only acknowledges the limitations of existing solutions but also presents a novel pillbox design aimed at addressing these challenges. Despite previous attempts at developing electronic pillboxes, widespread adoption and integration into daily routines have remained elusive. Recognizing this, the authors of the paper place significant emphasis on creating a highly user-friendly and accessible pillbox.

The focus on usability is of paramount importance, especially when considering older individuals who may encounter difficulties

with technology or intricate systems. Ensuring effective medication management for this demographic is a key objective for the authors. To achieve this, they propose simplifying the user interface and minimizing the level of interaction required beyond the act of taking the medication itself. By streamlining the user experience, the authors aim to develop a pillbox that older individuals can easily navigate and seamlessly incorporate into their daily routines. This particular approach is intriguing, as it aligns closely with our own pillbox specifications. We, too, recognize the need to overcome the mentioned limitations and prioritize ease of use in our design. It is evident that existing electronic pillboxes have struggled to gain widespread acceptance in practical settings, prompting us to refine our pillbox to maximize user-friendliness. By employing intuitive design principles, we strive to create a pillbox that is straightforward and effortless to operate. Our goal is to ensure that individuals, including older adults, can easily comprehend and interact with our pillbox without any undue complications. By minimizing complexity and employing clear instructions and visual cues, we aim to make our pillbox accessible and user-friendly for all age groups.

In summary, the approach described in the scientific paper offers a noteworthy contribution by not only acknowledging the limitations of existing pillbox solutions but also proposing a design aimed at overcoming these obstacles. The emphasis on usability, particularly for older individuals, is a crucial aspect of the proposed pillbox. This aligns closely with our own vision, as we also prioritize ease of use in our pillbox design. By creating a user-friendly interface and streamlining interactions, we aim to ensure that our pillbox can be effortlessly incorporated into the daily lives of all users, regardless of age or technological familiarity.

In another related article [2], the innovative multifunctional pillbox SIMoP is introduced as a solution poised to revolutionize the healthcare system. With its five essential components, this smart device aims to provide comprehensive support to patients [2]. By seamlessly integrating cutting-edge technology with convenience and ease of use, SIMoP sets itself apart in the realm of medication management. One of the standout features of SIMoP is its ability to monitor patients in real-time through wireless connectivity [2]. This capability empowers healthcare providers to stay well-informed about their patients' medication adherence and overall well-being. The benefits derived from SIMoP's real-time monitoring align closely with our own vision for a state-of-the-art pillbox. The pill dispenser integrated within SIMoP is another critical aspect that deserves attention [2]. This component ensures the precise administration of dosages at the designated times, effectively reducing the risk of medication errors [2]. These functionalities resonate with the fundamental objectives we aimed to achieve with our own pillbox. Our pillbox, known as ThePillBox, similarly focuses on high mobility and smart functions, facilitating the accurate intake of medication for patients [2]. Specifically, we designed ThePillBox with the intention of supporting forgetful and elderly patients, enabling them to manage their pill regimen effectively. Therefore, the inclusion of a reminder or alarm function within ThePillBox system is absolutely essential.

Drawing inspiration from SIMoP and its innovative solutions, we have incorporated similar features into ThePillBox. By leveraging high mobility and intelligent functionalities, ThePillBox aims to empower patients to maintain optimal medication adherence. The reminder or alarm function within our system acts as a crucial tool, ensuring that patients never miss a dose and enhancing their overall treatment experience. In conclusion, the multifunctional pillbox SIMoP, as discussed in the article [2], serves as a notable reference for our own pillbox innovation. By adopting and adapting solutions from SIMoP, we have crafted ThePillBox to provide comprehensive support for patients, particularly forgetful and elderly individuals. The integration of a reminder or alarm function serves as a vital component in both SIMoP and ThePillBox, guaranteeing that patients receive their medication on time and facilitating their healthcare journey.

3 USE CASES

1. The first use case illustrates the significant advantages of utilizing the pillbox, particularly for elderly individuals. In this scenario, we consider a persona that embodies an elderly man who resides alone in a private household. Given his reliance on the accurate dosage and timely intake of medication, ThePillox emerges as a valuable source of support. The pillbox offers a user-friendly web interface through which the elderly man can effortlessly operate the system. By accessing this interface, he can specify the desired quantity, timing, and type of pills to be taken. This personalized input ensures that he receives tailored reminders at the appropriate moments, precisely when he needs to take his medication.One of the primary benefits is that ThePillox effectively addresses the issue of forgetfulness frequently experienced by the elderly man. The system's alarm functionality plays a crucial role in reminding him to take his pills promptly. This eliminates the concern of missing doses or taking them incorrectly due to memory lapses. Additionally, the correct dosage is ensured through the user settings generated beforehand. The system takes into account the user's specific requirements and provides the precise amount of medication needed. This feature instills a sense of confidence and reliability in the elderly person, knowing that ThePillox consistently reminds him to take the correct dosage. To visually represent this use case, Figure 3 showcases a graphical representation of the system and its functionality. This visual aid further reinforces the understanding of how ThePillox effectively supports the elderly man in adhering to his medication schedule.

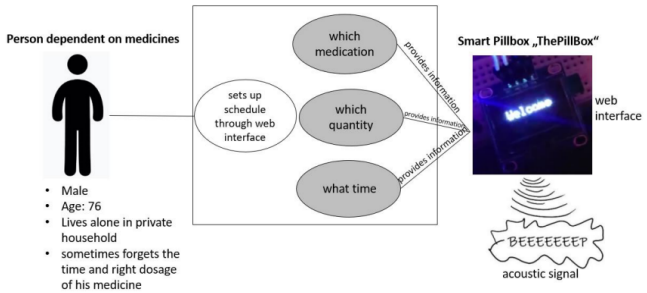

Figure 3: 1.Use-Case

2. The second use case revolves around a nurse persona responsible for managing the medication intake of multiple patients. Given the complexity of keeping track of each patient's medication schedule, the pillbox proves to be an invaluable tool in assisting the nurse. To provide an effective solution, the use case employs a structured approach, as depicted in Figure 4:

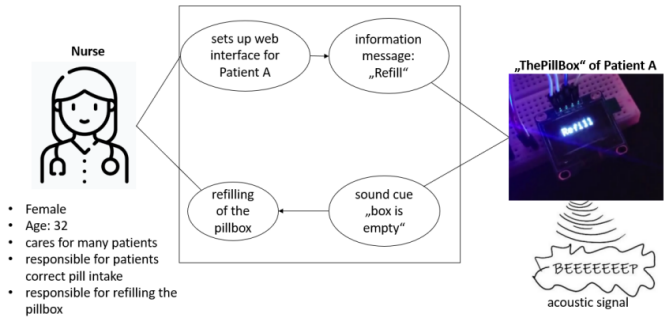

Figure 4: 2.Use-Case

Each patient is assigned their own pill box, streamlining the medication management process. Using the web interface, the nurse configures the specific time, dosage, and medication details for Patient A. This customization ensures that the patient receives the right medication at the right time. One of the key features of the pill box is its ability to notify the nurse when the medication supply is depleted. Once all the pills have been consumed from Patient A's pill box, the interface display triggers a "refill" message, accompanied by an audible alert. This alerts the nurse that Patient A's pill box needs to be refilled promptly. This proactive notification system prevents medication shortages and ensures a continuous supply of pills for the patient. By incorporating the pill box into her workflow, the nurse gains a comprehensive overview of the patients' medication intake. This centralized system alleviates the burden of having to memorize the medication schedules for each patient. Instead, the nurse can rely on the pill box's interface to monitor pill consumption and receive refill notifications. This feature enables the nurse to efficiently manage the medication intake of multiple patients, reducing the risk of errors and improving overall patient care. The use case presented in Figure 4 visually demonstrates the pill box's role in enhancing the nurse's workflow and facilitating effective medication management. It highlights how the pill box serves as a reliable tool to optimize the nurse's ability to track and administer medication for each patient under her care.

3. The third use case involves a geriatric nurse who plays a pivotal role in caring for elderly individuals who often struggle with medication management due to forgetfulness and dependence. This dedicated nurse takes on the responsibility of ensuring that each person receives their required medication on time. To facilitate this task, an intuitive interface is employed, allowing the nurse to configure the appropriate number of pills for each individual and schedule their intake times. With the aid of the interface, the geriatric nurse diligently manages a personalized pill box for each elderly person under their care. When the pill box runs out of pills, a clear message reading "Refill" promptly appears on the display, accompanied by a distinctive signal tone. This alert serves as a reminder for the nurse to replenish the pill box promptly, ensuring a seamless continuity of medication administration. By leveraging this system, the geriatric nurse gains the ability to attend to the needs of each individual with utmost attention and efficiency. Consequently, the elderly recipients can feel assured that they will receive their precise dosages at the prescribed times, enhancing their overall well-being and health. Moreover, the system alleviates the burden on the nurse, as they no longer need to manually keep track of every person's medication schedule. The pill box display further provides comprehensive information, such as the quantity of pills taken and the remaining amount in the box, promoting transparency and enabling accurate monitoring of medication consumption.

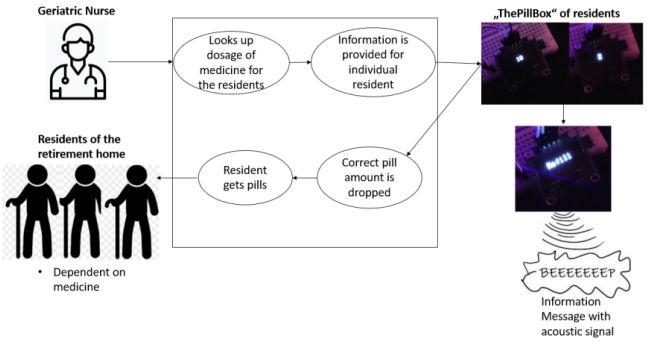

Figure 5: 3.Use-Case

Figure 5 depicts a geriatric nurse carefully examining the pill box display, assessing the appropriate medication dosage for the respective individual. The display exhibits numerical values, such as 10 or 8, signifying the correct dosage of medication that is dispensed at the designated time, ensuring the elderly person receives the accurate amount. Once all the pills have been consumed, the display promptly transitions to "Refill."

4 IMPLEMENTATION

We are confident that we have been able to address certain aspects of our problems in interesting ways and have fought quite every problem with a fitting solution. Ofcourse a lot of bug fixing and error handling had to be done and be discovered since none of us ever worked on something like this, what made the expirience often more trial and error than a planned out path that was easy to follow. But this was one of the reasons, why motivation stayed high and it was fun to continue, we always had something new to learn and seeing everything come together to a final version was just a good thing to feel. That said we would love to adress our most mesmerizing challenges / solutions regarding the implementation.

4.1 Design

How could we better start than to talk about the design. This will give all of us the same foundation and a good introduction into the code used to bring the project to life. To be more specific for us its important to talk about code structure itself, since good structure

makes strong foundations for code that is easy to read, easy to debug, easy to expand and way more.
Since the Arduino framework is based on C++ and therefore all needed functions too, we made use of header files as good as we could. Header files can be used to define functions and include them into other files making functions available across the project. And as one of our goals was to keep the main class as clean as possible, we moved functions that execute logic into seperate files corresponding to their functionality. This lead to a well structered code and important modular one too. Another thing to mention is a desired side effect that was created doing this. The functions inside the main file are often easy to read as pseudo code, therefore i want to add this example of code:

```
void handleSetTimer() {
    turnLEDOn(yellowLED);

    String hours = server.arg("hours");
    String minutes = server.arg("minutes");
    String seconds = server.arg("seconds");
    String amountString = server.arg("boxAmount");
    int amount = buildNumber(amountString);

    String newTimer = createString(hours, minutes,
        seconds);

    String currentTime = timeClient.getFormattedTime();

    addNewTime(newTimer, timerCol, checkTimers,
        currentTime, amountToDrop, amount);

    Serial.println("New Timer: " + newTimer + " | Pills:
        " + amountString);
    server.send(200, "text/plain", "new timer was set!");

    delay(1000);
    turnLEDOff(yellowLED);
}
```

What is to be observed, is that all of the lines in the code snipped are easy to understand without having to know how the underlying logic of functions like buildNumber(), createString() or addNewTime(). And all of these functions also no where to be found in the main file, making them not take up any unecessary space.

4.2 Technical Considerations

Talking about technical considerations, we do like to talk shortly about error handling. Since the project is an interactive system activly used by humans, it is important to decide where the error handling happens and the respond is to be seen. And because the control of the pill box and its towers happens on a user web interface level we decided to handle errors on the level of the web interface. We found it kinda unneccesary to wait with the error handling for something like, wrong inputs, until it reaches the firmware level, because users often need fast and direct responses and dont have access to all firmware functions (what is also absolutly right). To continue with our example, we limited the possible inputs when using the web interface and use alerts as the easiest and most obvious way to inform users about it, but not only for wrong inputs but also for correct ones, since users need some sort of validation and not a static screen that doesnt tell anything.[Figure 6]

We mentioned that users dont have access to all firmware functions and stated this also as important. Why? A lot of control over firmware gives a lot of power over a system and as we all know, with great power comes great responsibility, and because our target group also contains sick and elderly people this is right what we want to avoid, we want actively take responsibility away and make things easier accessible. This meant we implemented a way to authenticate as a healthcare worker or similar, which gain access to control the box and towers, but also another login to check the schedule and read important statistics.[Figure 7] Even if the patient / user has the ability to control the box the same as a healthcare worker the functions will be limited and stay simple, improving usability and understanding, preventing unwanted confusion.[Figure 8]

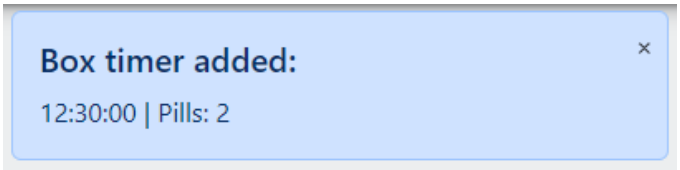

Figure 6: Alert

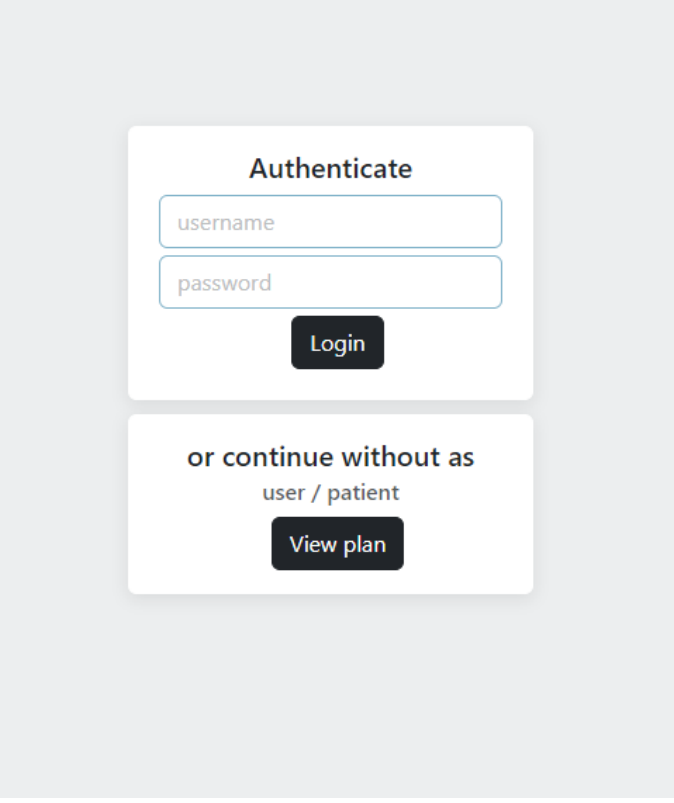

Figure 7: Login

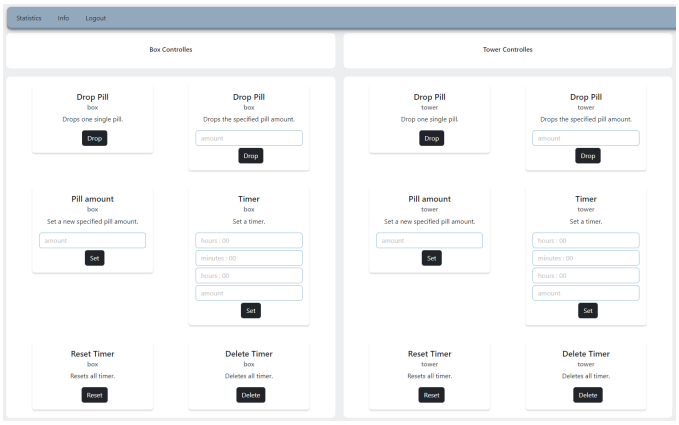

Figure 8: Controlles

4.3 Hardware

Our hardware choice have been precise to fullfill the needs of multi modality, provide the user with enough information about the state of the device and perform the process to deliver the correct dosage to one. This includes multiple LED´s that represent the device state, a buzzer alarming, warning or just notifying the user and a servo motor used to drop the pills. But we think the most intresting combination is the one of the button and a I2C screen. We use the customizability of the screen to show the most crucial information right at the device making it unnecessary for the user to look always on the web interface statistics page.

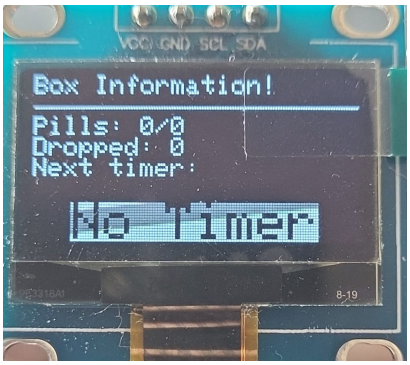

Figure 9: Box Information

But as to be seen one screen is not enough to show every information. Our solution was to group the information to topics, create single screens for each topic and use a button to rotate through the selection of screens, simple as that. The users can always look for the information they want and we utilize the space of 128 x 64 pixels perfectly. And if needed the code forces the screen to change to the currently relevant screen.

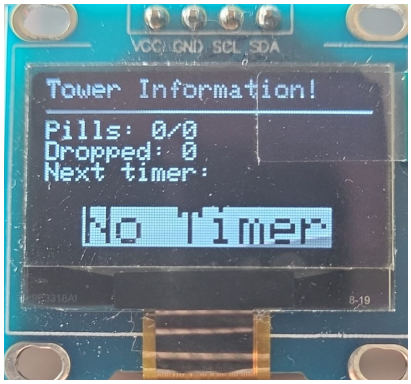

Figure 10: Tower Information

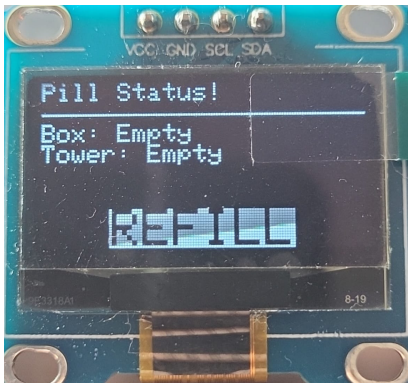

Figure 11: Pill status

4.4 Firmware

4.4.1 Webserver, Websocket server. We want to start with probably the biggest decision we had to made. What board is used as what. Our project was not only to implement one single box and we are good to go, we wanted more. A system of a main box and towers which listen to the main box and perform their tasks accordingly. For this we needed a way for bi-directional communication between server and clients. Here the server representing the main box and the clients the single towers. And pretty fast we hit a hardware / software problem, an ESP8266 board is not powerfull enough to be used as a websocket server and a webserver at the same time. Which meant we had to decide, dont make use of bi-directional communication or no webinterface, but this was never the solution. The way we handled this problem was at the end fairly simple, but still an intressting approach. Since the client was a client and therefore not hosting a server, why not try to use the client as the host for the webserver?. It worked perfectly, sure each server neeeded to listen on different ports and so on but yes it did work. In addition to this since the websocket server provided bi-directional communication, we where able to restructere the code in a way that the client was in the end the initial server sending out requests, controlling the websocket server. We wanted to show how a system of multiple towers and a box could look like and we are sure we

did it correctly with this approach, we can show every feature we wanted using the hardware we got provided and overcoming the limits of it.

4.4.2 handleClient(). Keeping the topic fairly the same lets take a look at how we handle requests. We use a special function call inside our loop function:

```
void loop() {
    //. . .
    // code
    //. . .

    server.handleClient();

    //. . .
    // code
    //. . .
}
```

This function allows us to listen to events of the web interface. To be more precise we listen to different endpoints of the http link. Inside the main file we can than decide how we handle each event separately (An example for this is the code snippet under the section 4.1). This not only makes the code more readable but also keeps the loop function simple as possible which is really important since it is the heart of the code and should not break.

```
void setup() {
    //. . .
    // code
    //. . .

    server.on("/exampleEvent", handleExampleEvent);

    //. . .
    // code
    //. . .
}
```

4.4.3 Timer. Another rather intressting topic is how we handle the timer that can be set. Lets break down how this process works: We get a timer in the following format "HH:MM:SS", this timer is then compared to the current time, if it is smaller or equal the current time we drop a pill else we dont drop a pill. But this causes a problem, the timer will stay for a long time smaller or equal than the current time, meaning we would get a lot of unwanted pills. The solution vector arrays! One could argumnet just use maps, but no we needed a straight forward solution which could handle three elements that belong to each other. Maps would need help from structs or a std::pair for example. Also lists didnt work because they caused problems in combination with the libraries we used. As we mentioned we needed three elements that would be belonging to each other. We did this modifying three vector arrays at the same time. As example for your understanding we gonna take the time 12:30:00, we want to drop 3 pills at this time and its currently 13:00:00, meaning the timer should not drop anything today anymore:

```
    vectorTime -> []
    vectorCheck -> []
    vectorPills -> []
```

The arrays are empty before inserting.

```
    vectorTime -> ["12:30:00"]
    vectorCheck -> [1]
    vectorPills -> [3]
```

This is how they look after inserting one timer. We can see the vectorCheck now contains a "1", this is a array used as a flag when inserting. We check if the timer is in the past, if so we set a 1 at the current index if not we set a 0, indicating its not in the past and is still to be used. The sideeffect of this method solves another problem. The index of what ever element will always correspond to the correct element in another array meaning we have allways three elements which belong together that provide us all information about a timer we need to execute the code correctly. The timer always reset at 00:00:00 or if a healthcare worker instructs it over the web interface.

4.5 Usage

Lastly we want to make a brief summary what is needed for usage. For the box and towers it is neccessary to provide a stable power supply as a stable internet connection, which should be the same for the devices. This is needed to create the network and allow the bi-directional communication amongst them. To control the system as a whole is something like a smartphone or laptop needed, with internet connection, to access the web interface. Thats it, the system is ready to go, a great feature of this is, that its possible to place the box and towers where ever wished seperatly from each other inside the houshold or a hospital as long the requirements written above are met.

5 PSEUDO-EVALUATION AND RESULTS

For the pseudo evaluation we chose 2 questions. These two questions are:

- What are the technical strengths and limitations of your system?
- What is the feedback of your participant?

In order to get more useful information from the above questions, we have come up with sub-questions for the above questions. The sub-questions are:

- 1.What was missing that you would have liked to have had?
- 2.Was something particularly good about the use or was something particularly bad?
- 3.What did you like about the interface?
- 4.What bothered you about the pilen box?

For the data we have interviewed 3 friends as participants. we showed them the pill box and gave them a couple of tasks and then asked them the sub-questions from above. These were their answers.

- 1.Participant 1: Very easy to use and nothing was missing. He found especially good that you can also specify an exact number of pills that should come out of the box so you do not have to constantly press "drop a pill“. However, the user found the finger reader bad because he feels that this can confuse older users. In general, he liked how quickly the pills fall out of the box. There was nothing on the pill box that would have bothered the user.
- 2.Participant 2: The user missed that when using the interface you can not set the pill box to drop a certain number of pills every day. But you have to reset the timer every

time. Has especially liked but it has particularly disturbed him that there was no dark mode for the site. He found it good that you can set a timer. However, nothing bothered him about the pill box.

- 3.Participant 3: Participant 3 did not miss anything during use. He especially liked that you can see all the information on the small screen. However, nothing particularly bothered him either. The user found the idea good and sensible and also likes the fact that the box tells you when you need to refill the pills. The small buttons on the pill box bothered him because he has larger hands.

From the tasks that we have given to the participants, we have created a graph that shows how long it took the people on average to solve them. This is the graph for the average time for task processing:

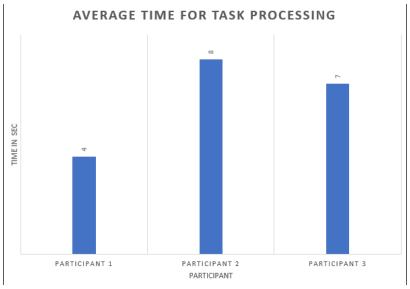

Figure 12: Task duration

5.1 Study Design

As already mentioned in the evaluation, we gave the participants tasks and asked them questions. The tasks they had were:

- 1.drop a pill
- 2.drop a specified pill amount
- 3.set a new specified pill amount
- 4.set a timer 5.delete a timer.

5.2 Results

Through the interviews and tasks we have found out the following Answers for he our own main questions: A technical strengths is the small motor that throws the pills very quickly and cleanly out of the box. Also a strength is the small display on which you can see immediately without problems as the pill level and the timer is. However, the pill box has one weakness. This is that every time the user's timer is over, he has to set a new one. This is not very complicated but it can lead to forgetting to take pills from time to time. Therefore, based on feedback, we have added a new feature that lets you reset a timer automatically when it reaches zero o'clock. In addition, we have taken out the finger reader because the participants are of the opinion that it could confuse older users. We have also found out that the participants like it very much that the use of the pill box is very simple and you find out very quickly how to use it. They also like the idea as it can be a great help in hospitals etc. and takes a little stress off the nursing staff. In order to confirm this once again, we asked all participants which of the strengths and weaknesses they mentioned play the most important role for them. For the following statistics we gave every participant two votes. This are the results of the evaluations:

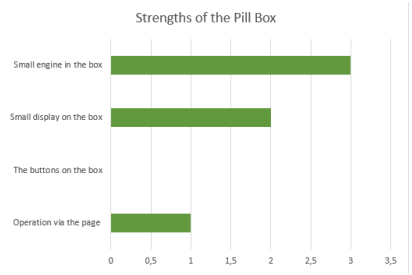

Figure 13: Strengths

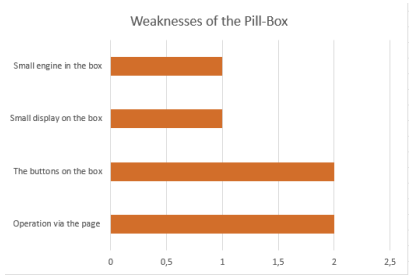

Figure 14: Weaknesses

6 CONCLUSION

In summary, "ThePillBox" represents a revolutionary solution for medication management that aims to significantly improve the quality of life for older individuals. It recognizes and addresses the challenges faced by older adults in managing multiple medications. The versatile and adaptable nature of "ThePillBox" allows it to meet the unique needs of seniors, whether they reside in private homes or nursing homes. At its core, the system features a secure and reliable pill dispenser designed to ensure precise administration of medications at specific times. Nevertheless, in the future, potential areas for expanding "ThePillBox" system can be included. The development of a dedicated mobile application would be a valuable addition to "ThePillBox" system, providing users with the convenience of accessing their medication schedule, reminders, and other features right from their smartphones or tablets. This mobile app would enable individuals to manage their medications on-the-go, ensuring that they can stay on track with their medication regimen no matter where they are. By expanding the connectivity and interoperability of "ThePillBox" system with other healthcare platforms and medication management apps utilized by pharmacies, a seamless exchange of information can be achieved. This integration would allow for efficient communication and data sharing between different healthcare stakeholders, promoting better coordination and continuity of care for the users. Last, user feedback and engagement features are vital for ensuring continuous improvement and meeting the evolving needs of the users. By incorporating feedback mechanisms within the system, individuals would have the

opportunity to provide valuable input, report any side effects or concerns, and ask questions. This interactive approach would foster a user-centered environment, where their voices are heard, and the system can be refined based on their experiences and suggestions, ultimately enhancing the overall user experience and effectiveness of "ThePillBox" system. In conclusion, "ThePillBox" represents a breakthrough in medication management that addresses the specific needs and challenges faced by the individuals in health care system.

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