SA-PG3 Project:

MedBot

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CPRE288

November 11, 2024

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Problem Statement:

Medical Professionals are often overworked and overburdened, leading to medication errors. These mistakes carry significant risks, potentially endangering patients' lives and impacting healthcare workers' careers. To mitigate these risks, specific tasks can be automated, reducing the burden on medical professionals and improving patient safety. Automating medication delivery with the cyBOT could benefit all involved, including doctors and pharmacists who also face similar challenges in their roles.

We want the bot to start at ‘home’ position which would be at its dock. Then the bot should move onto the set positions of the Pharmacist, and then take the medication to the patients to deliver to them.

Application/Narrative Statement:

Medication errors are the most common and preventable cause of patient injury. These errors typically involve administering the wrong drug or dose, or giving medication to the wrong patient. In today’s world, healthcare professionals are often faced with overwhelming workloads, especially in environments where staff shortages and high patient counts are common. These factors, along with others combined can cause fatigue and/or exhaustion for hospital personnel, and have detrimental consequences for all parties involved. For example, a healthcare personnel might be feeling both physically and mentally exhausted while working a long shift. Leading to the patient being at risk, as well as the medical personnel’s career and reputation. These errors are user errors, and can be prevented using our MedBot!

MedBot is an automated medication delivery system. The system works by heading to the pharmacy to receive instruction. Once at the pharmacy, the pharmacist fills the prescription giving it to the MedBot. Finally the medication is sent off to the patient via selection on the MedBot. If MedBot runs into trouble by hitting a human or another unexpected obstacle, it will play a sound to notify and back up and redirect around the obstacle to find another path to its target (patient). This solution will significantly lower the likelihood of a medication causing harm to a patient or hospital personnel by automating

medication delivery to reduce workload intensity on healthcare workers and improving accuracy by reducing user error rates.

Empathy Maps (Users 1-4):

User 1: Doctor

Review:

Since COVID-19, there has been a significant decrease in the number of healthcare providers available on shift, and this caused a lot of issues for the staff. The introduction of robots in the medical field has eased the strain on health care workers. By allowing robots to transport prescriptions, doctors and healthcare providers have more time for patient care. Although doctors do not directly interact with the robot frequently, it gives them ease knowing that it can help with medication availability, which is especially important during time-sensitive treatments, as well as help save time on having to manually deliver medication.

User Research:

1. **Article**

"Moxi's support in delivering meds has helped our staff recoup 20 to 30 minutes per delivery," [13]. Having a medication delivery robot has helped save a lot of time for healthcare providers. By allowing for a robot to deliver medication, it frees up healthcare providers to give more time to patient care.

"I could do it faster, but it's better for Moxi to do it so I can do something else more useful," [13]. Although having the human touch on such things such as medication delivery, it is better to use the robot to ensure the healthcare professionals use their time more wisely.

2. **Article:**

In addition to more time for healthcare providers, using a medication delivery robot has become more secure, ensuring that the robots drawers storing the medication are locked, and only able to be opened by designated staff. This security measure ensures that medication is going to the correct location. These robots are also self-sufficient, opening doors on their own and navigating the busy halls of a hospital [14].

3. **Case Study:**
    - 81% feel hopeful that technology can improve their experience as healthcare providers [15].
    - 58% of healthcare workers' time is already spent on repetitive tasks [15].
    - 57% are worried they will burn out due to the high volume of repetitive tasks they have to complete [15].
    - 48% believe their organizations are not doing enough to help with job burnout by hiring/retaining staff [15].
    - 32% of time is spent on non-patient care-related tasks like deliveries throughout the hospital [15].
    - 28% have already quit a job due directly to burnout [15].

With the help of a medication delivery robot, there is far less burnout, and less stress on the team. Having a happy team can alleviate stress on the doctors, and ensure patient care is prioritized.

Empathy Map:

DO:

- There is less stress on healthcare professionals
- Less burnout due to repetitive tasks

THINK:

- Doctors think medication delivery robots help the flow of work
- Doctors think that the staff moral is an important part of providing exceptional care to patients

SAY:

- Doctors say that the help of robots help alleviate stress on them and their team
- Doctors express concern about the efficiency and safety of these robots delivering medication
- Doctors say that although using a robot for medication delivery might be slower, they appreciate the ability to utilize them so they can focus on patient care.

FEEL:

- Doctors feel less overwhelmed with manual medication delivery
- Doctors feel good about being able to spend more time on providing patient care

Point-of-View Statements:

Needs:

- There needs to be more help on the team to alleviate stress and burnout
- There needs to be accuracy with the delivery to ensure that the patients are well taken care of

Statements:

- As a doctor, I need the team to work efficiently, and give the patients the best care while also staying attentive to their own needs
- As a doctor, having accuracy in the delivery robot will provide less stress on the team, and ensure that the patients are well taken care of, especially in times of time-sensitive treatments.

User 2: Patient

Sources Used for Gathering User Information:

- Research Articles
- Case Studies
- News Articles

Sources:

1. **Research Article:**
    - **Stanford engineers develop tiny robots to bring health care closer to precisely targeted drug delivery**.
    - This article discusses advancements in medical robots that improve drug delivery precision, potentially enhancing patient safety and reducing the risks of medication errors.
    - *Quote:* "These fingertip-sized robots are poised to become medicine's future lifesavers – to crawl, spin, and swim to enter narrow spaces on their mission to... dispense medicines."
2. **Case Study:**
    - **Automation of a tertiary hospital pharmacy drug dispensing system in a lower-middle-income country: A case study and preliminary results**
    - This study examines the impact of automated drug dispensing systems in hospital settings, showcasing reduced medication errors and improved pharmacy management efficiency.
    - *Quote:* "The use of robotic systems in the central pharmacy may improve hospital pharmacy management and generate fewer errors in dispensing pharmaceuticals to patients."
3. **News Article:**

- **Physical human-robot interaction for clinical care in infectious environments**
- This article explores the role of robots in minimizing direct contact in infectious disease settings, thus ensuring safer care delivery while easing healthcare provider workloads.
- *Quote:* "Robotics can enhance patient care and provider safety by 'minimizing contact of caregivers with infected patients to reduce infection transmission' and 'increasing capacity and efficiency of clinical providers'."

4. **Research Article:**
    - **Automated Drugs Dispensing Systems in Hospital Pharmacies and Wards: A Systematic Literature Review**
    - This literature review summarizes the safety and efficiency benefits of automated dispensing systems, supporting the goal of cyBOT's accurate medication delivery for patients.
    - *Quote:* "Automation substantially mitigates errors in drug administration, encompassing dosage mistakes and curtails errors in drug dispensing and distribution."

B) Empathy Map (Patients):

The empathy map summarizes patients' needs based on their interaction with the automated medication delivery system, cyBOT.

- **Says:**
    - "I worry about medication accuracy, especially when staff are overwhelmed."
    - "Receiving timely and correct medication is crucial for my safety."
- **Thinks:**
    - "I hope this robot can help minimize mistakes."
    - "It might be strange at first, but if it works well, it could be reassuring."
- **Does:**
    - Relies on healthcare staff for regular and timely medication delivery.
    - Becomes accustomed to traditional staff interactions for medical needs.

- **Feels:**
    - "I feel uncertain but curious about automated medication delivery."
    - "I want reassurance that the robot is delivering my medication correctly."

C) Point-of-View Statements (Patients):

Needs:

- Accuracy in medication delivery to ensure patient safety and health.
- Timely delivery of medication to maintain consistent treatment schedules.
- Clear notifications from the cyBOT to know when medication has arrived, creating reassurance in the automation process.

Statements:

1. As a patient, I need an automated system that accurately delivers my medication so that I can feel safe and trust in my treatment process.
2. As a patient, I need a reliable tool that minimizes errors to receive consistent and timely medication for effective treatment.
3. As a patient, I need clear signals or notifications from cyBOT to know my medication has arrived, helping me stay informed and reassured about my care.

User 3: Pharmacist

Review:

“This medBot has significantly reduced our workload. It takes the medication delivery process to a whole new level, it ensures that patients receive the correct medications on time. This has minimized errors and improved patient safety. It's particularly useful during busy shifts.” -Pharmacist[3]

This review highlights how the process of medication delivery helps reduce errors in wrong prescriptions, ensures that patients are able to receive medicine in a timely manner , and takes some of the workload off the pharmacist[2].

Case Study:

This case study suggests that while automated medication delivery can improve patient outcomes, it can also add to the initial workload of pharmacists due to the need for setup and monitoring.

“Although it can prove useful in reducing medication errors as well as assisting us in ensuring patient safety, we have noticed that setting up and maintaining the robot would cause troubles to us, pharmacist[2].

Online video:

Dr. Tajal Gandhi, a professional in the healthcare field talks about some of the reasons why we should be hopeful of technology and why we shouldn't when it comes to innovation in healthcare. She just suggests automation in terms of technology needs more attention from healthcare administrators, “There is a belief that incorporating automation into daily practice would be unduly burdensome initially but beneficial in the long run” Dr. Tajal[1].

She breaks down some of the disvalues that of the technology will bring to healthcare, and that there are alot of innovations that are made to improve the workload, but of course it takes a long time to optimized these technologies, which it case for pharmacist Implementing the Bot can be a challenge, pharmacist can quickly assess the Bot's efficiency and While this indicates a potential initial burden for pharmacists, the overall benefit to patient safety is significant[4].

Empathy Map:

DO:

- Use the medBot to automate medication delivery.
- Ensure the medBot correctly picks up and delivers medication as per the prescription.
- Track the medBot's efficiency and patient satisfaction.

THINK:

- Consider the initial burden on pharmacists in setting up the medBot's for medication delivery.
- Weigh the benefits of reducing medication errors and aid in time usage against the effort required for setup and monitoring.
- Review how automation impacts patient safety and pharmacist workload, considering initial concerns.

SAY:

- pharmacists express the most satisfaction with the ease of applying the medBot's in practice[4].
- Concerns exist about the additional initial workload associated with setting up and monitoring the medBot.
- Discuss the need for support in managing the automation process.

FEEL:

- Feel overwhelmed and stressed by the initial responsibilities of setting up the medBot.
    - Collected from a case study: “Adapting to evolving policies and practices which leave them feeling worn out and emotionally drained” [2].
- Experience a sense of accomplishment when the medBot successfully delivers medications without errors.
    - “High efficiency in automation consistently leads to more positive outcomes, such as improved patient safety... and higher job satisfaction” [3].
- Feel that improving medication delivery through automation is crucial for patient safety but challenging to implement initially[4].

Point-of-View Statements:

Needs:

- Reduce medication errors leading to improved patient safety and job satisfaction for pharmacists .
- Efficiency in managing medication delivery using automation features such as prescription verification.
- Feedback from the medBot’s performance increases confidence in the automation process and helps pharmacists understand its benefits.

Statements:

- As a pharmacist I use the medBot to automate medication delivery to receive the prescription slip from the doctor so that I can ensure patient safety, doing so I experience greater job satisfaction and fulfill my role effectively and efficiently.
- As a pharmacist ,I need efficient automation features, such as receiving the right prescription, to help streamline the medication delivery process and maintain patient safety.

- As a pharmacist , I need the ability to provide feedback on the medBot's performance quickly, so that I can better understand its benefits and enhance the automation process in the healthcare setting[1].

User 4: Nurse

Online Product Review (Pyxis):

The following review is another medical automation system called Pyxis, which focuses on medicine dispensing. Although nurses had to be trained and may find difficulty adjusting, the overall impact has been positive; and we can see that for the use of cyBot in a healthcare setting.

“Medication administration device and it didn’t work out for us and that led us to our researching the Pyxis. Now having it, I couldn’t imagine not having the Pyxis as it’s been wonderful and we love this Pyxis!”-: Donna Perchatsch RN, MSN [10].

Case Study:

In a world where everything is getting automated; there’s an urgent need in the medical field where tasks carry burdens.

“ “Automation” has become a buzzword these days. Every manager within a company seeks to shortcut, optimize existing business processes, reduce costs, and increase productivity and efficiency. In the medical industry, this situation is not a trendy case but a case of urgent need.” [11].

Article:

This article by the National Health Executive emphasizes how automation in nursing saves time by simplifying tasks, allowing nurses to focus more on patient care.

“One of the significant benefits of automation in nursing is the time saved. Tasks that were once manual and time-consuming can now be streamlined and expedited. Automation in scheduling and data entry further contributes to time efficiencies, enabling nurses to focus on critical aspects of patient well-being.” [9]

B) Empathy Map:

DO:

- Use to pass medication to patients
- Use automation to maintain accuracy
- Maintain efficiency in passing meds to the right patients, right amount and right time.

THINK:

- Consider the burden that is relieved from nurses, due to automation
- Consider reduction in human error that could cost lives
- We could think about how it can improve accessibility to care, especially for patients in isolation.

SAY:

- Nurses appreciate the ease of use and efficiency.
- There has been a lot said about automation of medication aiding nurses in focusing on other tasks.
- Discussion needed to look at the long-term impact of automation on nursing roles and optimization of patient care.

FEEL:

- Feel a sense of relief knowing that tasks are being taken care of reliably.
    - "Nurses appreciate the ease of use and efficiency that automation brings to their daily tasks, alleviating stress and improving workflow."[10]
- Nurses feel more confident in patient care when they are less burdened.
    - "Automating routine tasks such as medication delivery can help nurses focus more on patient-centered care, boosting their confidence and reducing burnout." [11]
- A sense of accomplishment is felt when a multitude of tasks can be accomplished without too much stress.
    - "Automation allows nurses to accomplish more tasks in less time, providing a sense of accomplishment and reducing the physical and mental strain." [9]

C) Point-of-View Statements:

Needs:

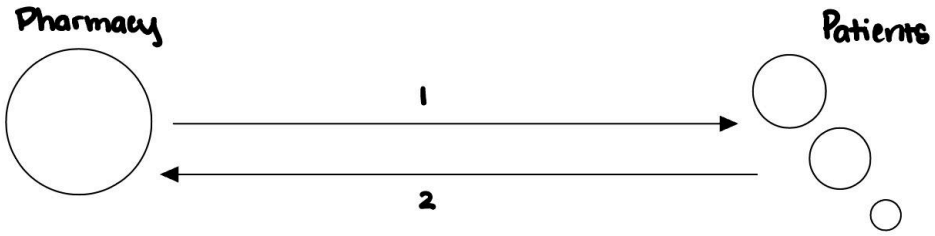
- Reduce burden on nurses, and increase efficiency.
- Optimize patient care.
- Improve accuracy in passing medication to patients, reducing risk on both nurse and patient.

Statements:

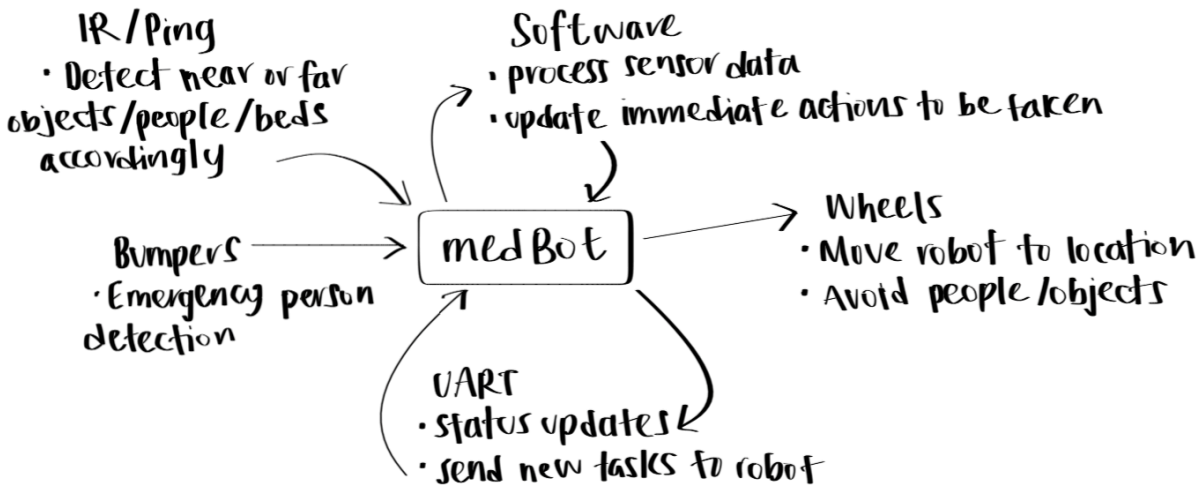
- As a nurse, I need a system(cyBOT) that reduces my workload so that I can focus more on patient care and improve my efficiency.
- As a nurse, I need accurate medication dispensing tools to ensure patient wellbeing and reduce the risk of medication errors.
- As a nurse, I need an automation system that will integrate smoothly into my workflow

Sketches:

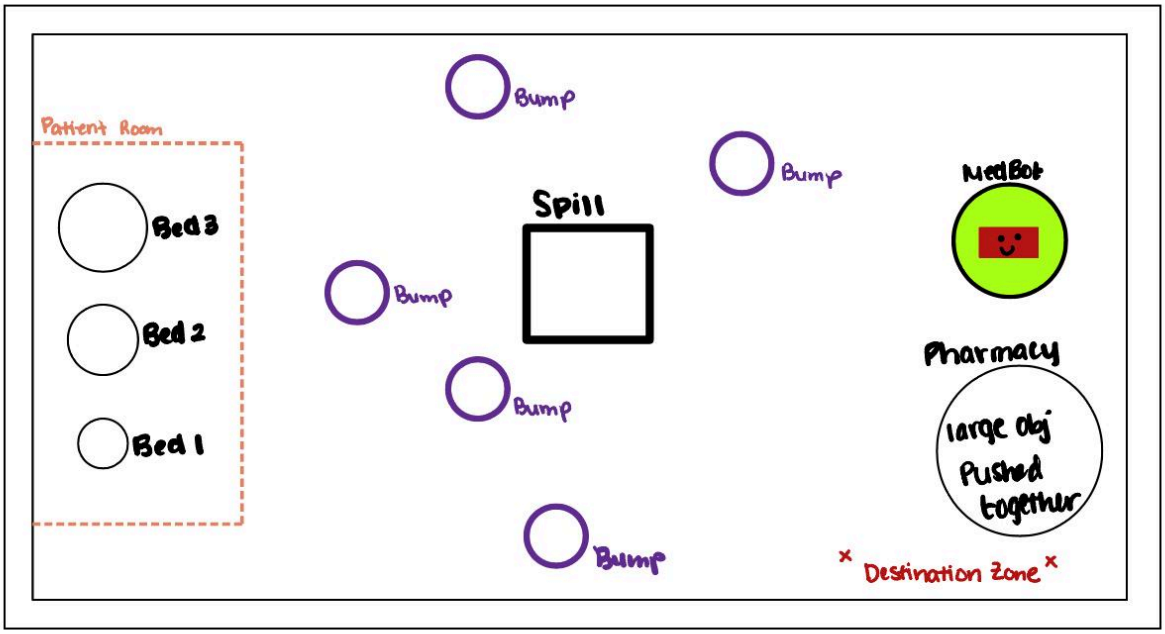
User-Centered Sketch:



Technical-centered sketch:



Test-field sketch:



Team Collaboration:

Team Member:	Contribution:
Aisha Mohamed	Created the new project proposal (updated the old and reformatted), but specifically wrote the problem statement, along with research for User 4-Nurse. Worked on creating songs, and the cliff sensing along with navigation around obstacles. Helped debug code with Mia.
Gurumanie Dhiman	Drew the sketches user and technical centered, along with the Test-field sketch. Worked on the distance for the IR and Ping sensor. Worked with Mia added all the code together and testing and debugging errors
Alisala Mwamba	Did research on User 3: Pharmacist, worked on the GUI with Oksana. Helped debug the main code alongside everyone
Jacob Mashol	Worked on User 2: Patient, Worked on the gui alongside Oksana and Alisala.
Mia Vogel	Created the Application/Narrative Statement, worked on the Pharmacy and patient menu with Oksana and coded into main to implement it when needed. Worked with Aisha. Helped with debugging main code alongside everyone
Oksana Grudanov	Worked on details for User 1: Doctor, Worked on the GUI code along with Alisala. Helped Mia with the pharmacy and patient menu. Helped debug code alongside everyone

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