



Intelligence cart

JINXIN LIU(KYLE)
Glasgow school of art
Design Journal
19179448





Design background

In late December 2019, cases of pneumonia of unknown cause occurred in Wuhan. The WHO then officially named the disease COVID-19 ("COVID-19" for short). Medical institutions are responsible for treating confirmed and suspected COVID-19 patients, as well as for treating non-COVID-19 patients. Studies have shown that nearly **30%** of health care workers develop nosocomial infections. Therefore, strengthening the prevention and control of COVID-19 nosocomial infection and avoiding nosocomial cross-infection is a top priority.

The original purpose of this project is to reduce the transmission of the virus caused by human contact in hospital Settings. The main purpose of this project is to combine hardware and software to avoid contact between doctors and affected limbs as much as possible, and to avoid the chance of suspected COVID-19 patients transmitting the virus to health care workers. In this paper, how to solve this problem is studied. Through the analysis of the user's and doctor's behavior journey, the solution of using the intelligence machine as the handover tool is obtained, and a tool car that conforms to the current hospital situation and use experience is designed.



Problem and opportunities

Almost before we knew it, patients with fever need to visit designated hospitals. As a result, hospitals are a high-risk site compared to other areas, during the COVID-19 outbreak.

For patients without fever symptoms but with other medical needs, whether it is safe to go to the hospital in emergency during the epidemic period and whether there is a risk of cross-infection in the hospital during the treatment process is a topic of concern to the broad masses of people.

Who we are design for

Related hospital staff and patients treated or quarantined in hospitals

WH
O

WHAT

What we can do?

Minimize contact between staff and patients while ensuring efficiency

Why do we need this kind of product

Studies show that nearly **30%** of hospital staff developed nosocomial infections during the first outbreak.

More than **3,000** staff across China were infected with the new coronavirus by February 14, 2020

WH
Y

WH
ERE

Where do we use it

Hospital and infection site

Initial research

Users

This product has two potential users, one is the patient, the other is the doctor staff, so the following two aspects of the perspective of demand analysis:



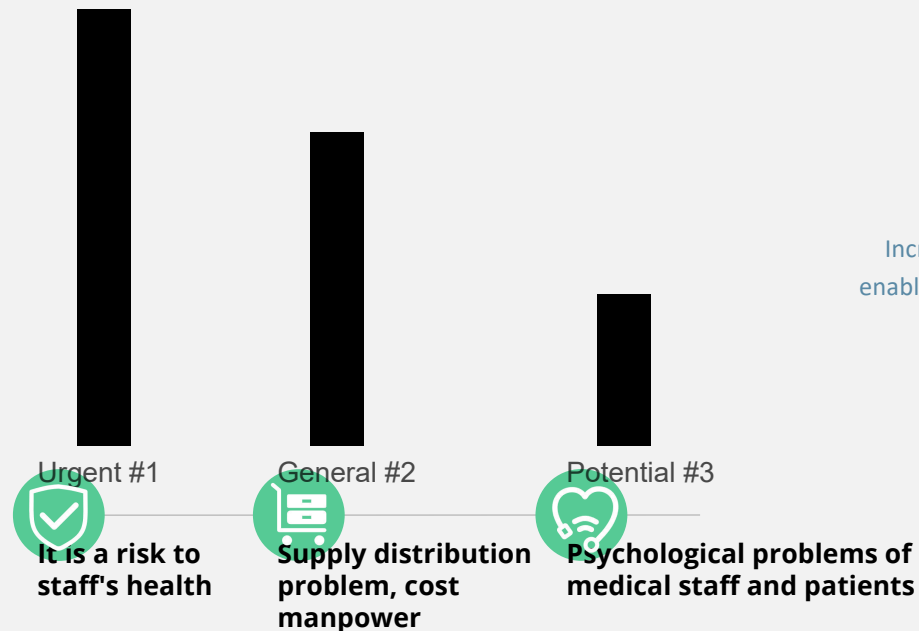
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Related questionnaire work

In the preliminary research, 18 health care professionals and students of related majors were questioned



In the whole process of investigation, the most frequent occurrence is safety, patients and medical staff still put safety in the first place, at the same time, for patients, 80% of the people are not familiar with the hospital operation process. As for health care workers, 60 % said they were too busy with too many different tasks.

4 Points to think of

solving the problem

Reduce the contact

Direct and indirect contact between health staff and patients must be reduced



Add indicative information

Increase knowledge and information on the job to enable health care workers and patients to act more efficiently and safely



Increase efficiency

Efficiency in work and distribution of materials must be improved



Psychological guidance

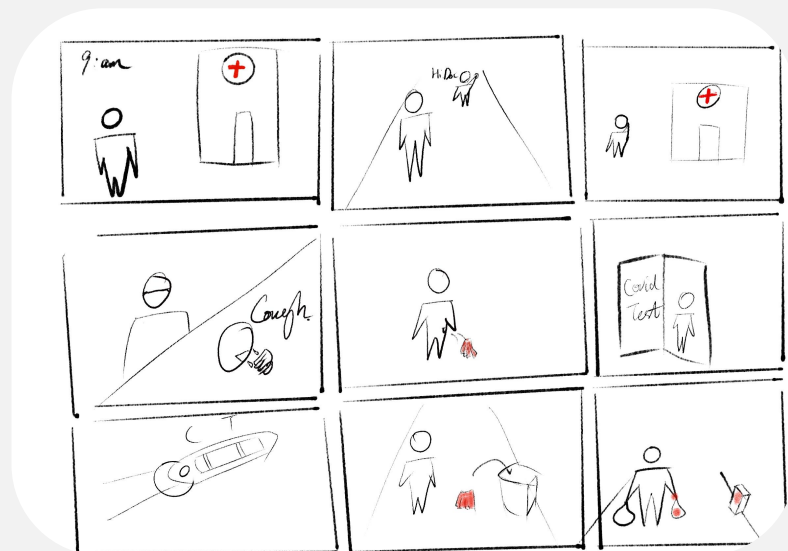
Increase the psychological counseling for medical staff and patients

Requirement scenario

and

Design point

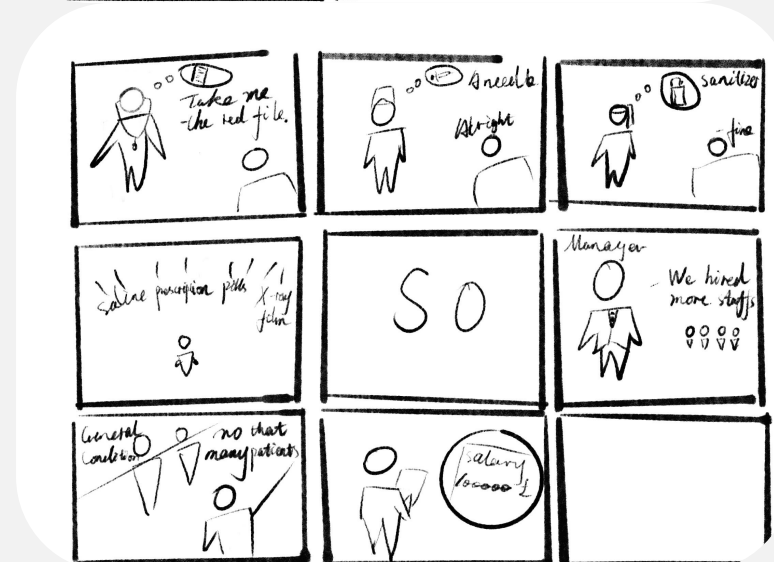
The potential scenarios were defined, based on the previous research.



Patients may drop garbage unintentionally, which can spread the virus.



Another possible point not to be overlooked is the heavy workload in the hospital.



Key points:

From the user's scenario we extracted the details and focus to the following design points, which could be attached on my product.

- A drawer or box is needed to provide a place to deliver things.
- A stable place to store the tubes needs to be provided
- Items need to be identified to identify where they belong and where they came from, as well as to facilitate future tracking control.
- Sanitary disposal and use of trash cans
- The user interface is needed for both the patient and the healthcare staff
- The product needs to have navigation or pathfinding to accurately deliver the object or sample to the target.
- The product needs to have a follow function that can follow the patient through the entire operation
- The product requires a printer to produce reports and labels
- The product needs to have a scanning element that can scan QR code or barcode
- Products need to have an indicator light
- The product needs to have a handle and other structure to facilitate the transportation of the product or to move when there is no power. According to these characteristics, the corresponding preliminary sketch is made

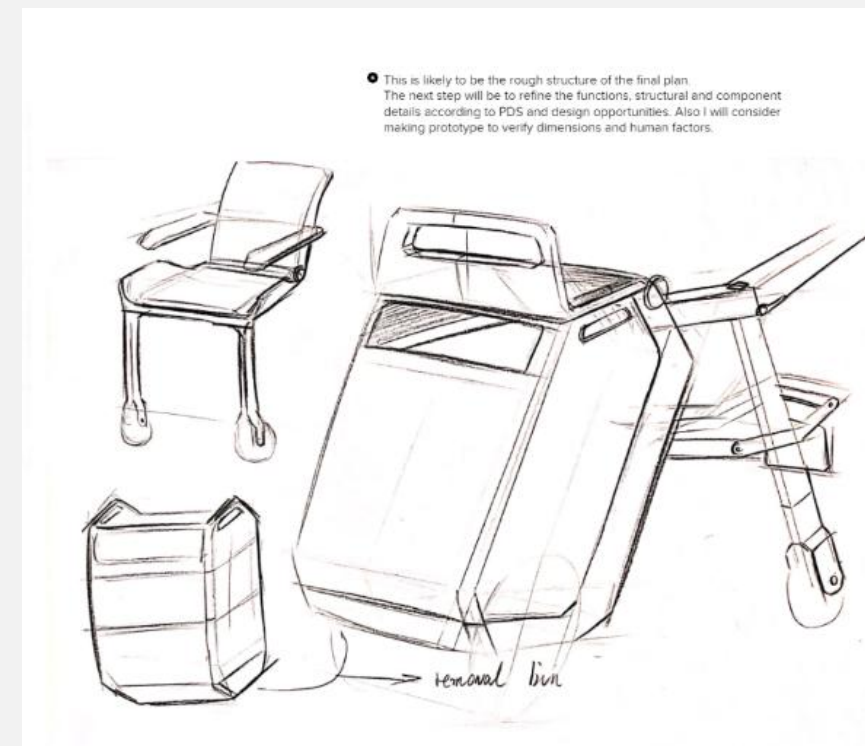
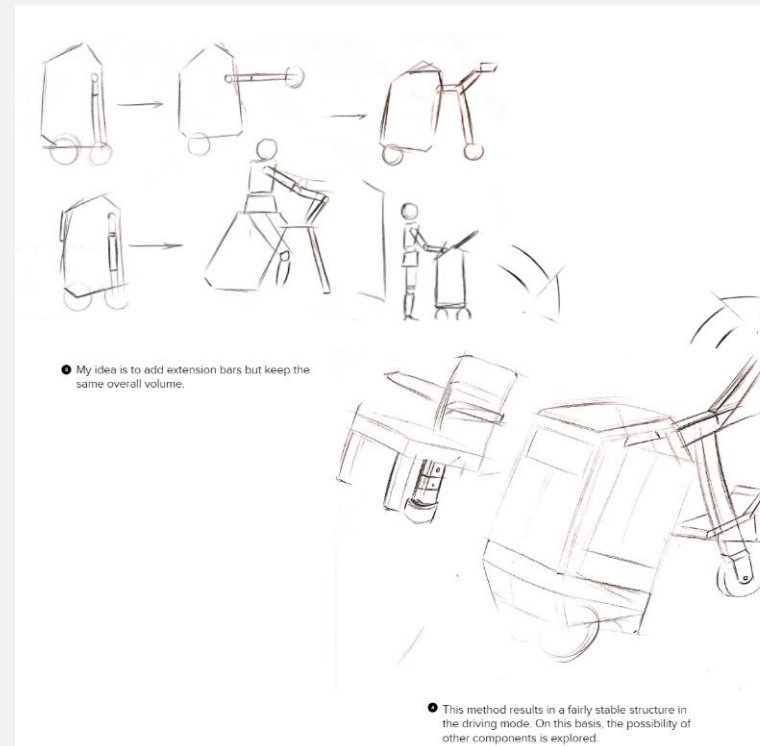
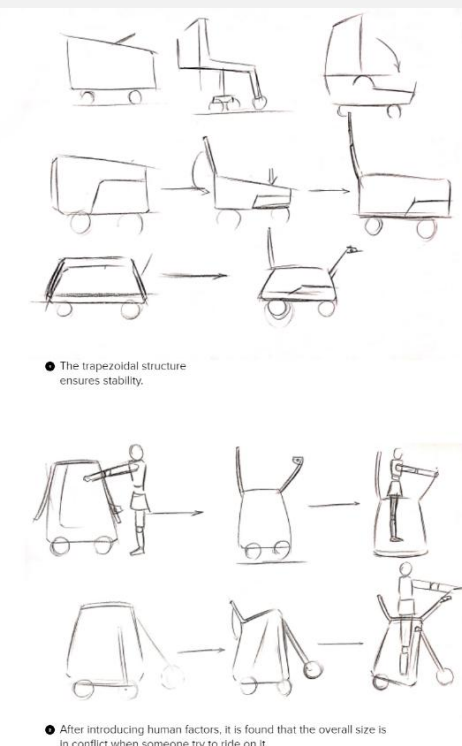
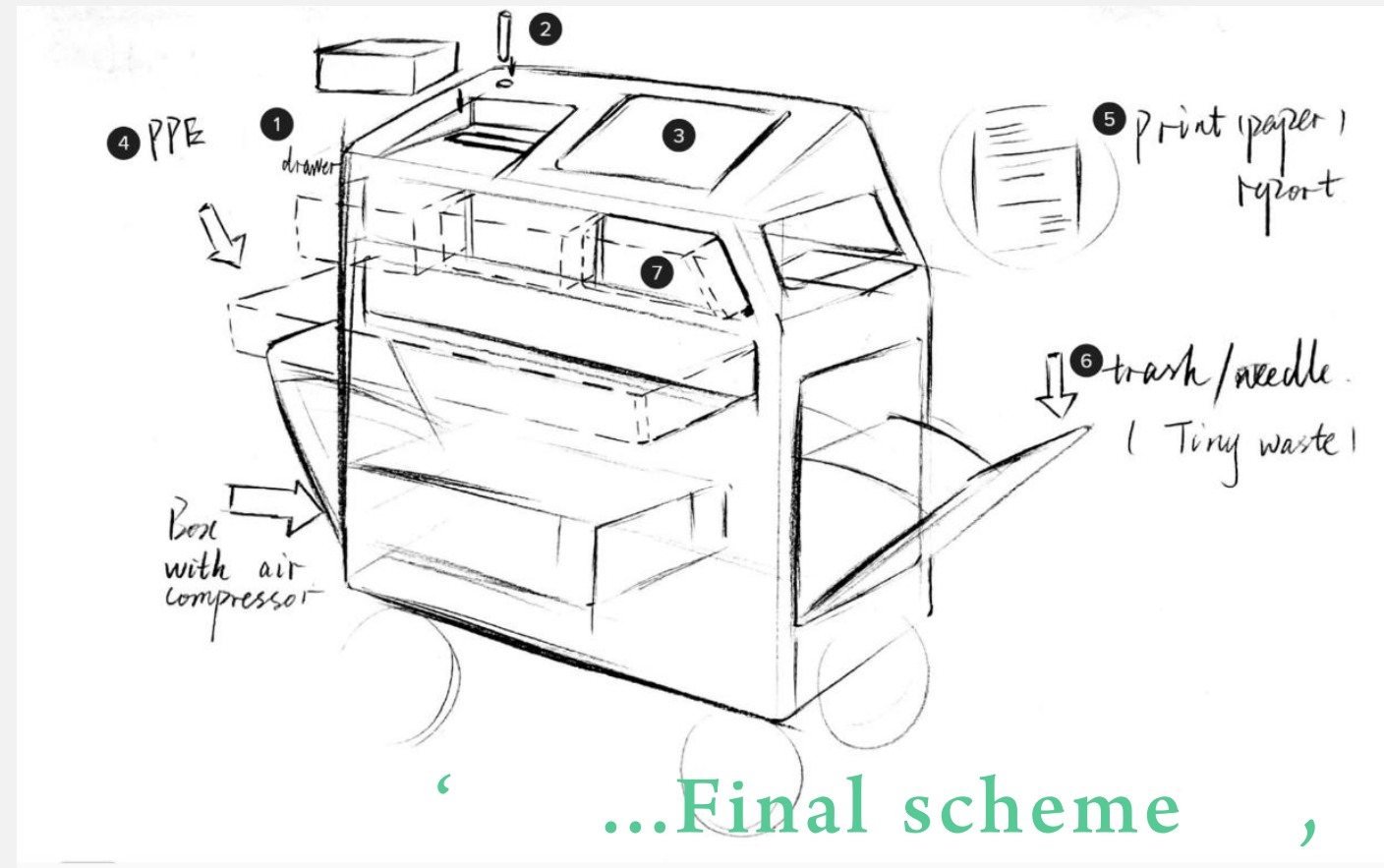


Concept development

and

sketches

I concretized the design points and sketched them and gradually develop my concept.



Prototype making and ergonomic test

Make the prototype according to the plan selected from the sketch



The first step is to verify the ergonomics of the product.

I made a large model with an estimated size of 1000mm*500mm*800mm.

The overall material is cardboard. Eight volunteers, five men and three women, were invited. Some were students, some were restaurant workers. Of these, two are between 155cm and 165cm, two are between 165cm and 175cm, three are between 175cm and 185cm, and one is 187cm. Afterward I ask them to fill a table and their comments

	A	B	C	D	E	F
1	AUTONOMOUS CART PERFORMANCE ANALYSIS					
	SPECIFICATION					
2	1 (awful)	3(dissatisfied)	5(passable)	7(satisfied)	9(excellent)	
3	Efficiency					
4	Convenience					
5	Reduce the risk of viruses					
6	Room saving					
7	Affordance					
8	Fit human factors					
9	Goal achievement					
10	Interaction					
11	Functional					
12	Use ratio					
13	Labor saving					
14	Integrity					
15	Visual effect					
16	Machanical complexity					
17	Manufacturing difficulty					
18	Maintainance					
19						
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26						
27						
28						

Insight

After sorting out the experimental data, the following problems were found during the whole experiment

- The overall height of Lower height is too high, which will cause great difficulty for people with low height.
- There is No need to place the PPE BOX. Where there is confusion in the frequency and time of use of the overall product, and this function can be solved by centralized and stacked fixtures, without the need to make them movable, which would add too much burden and constraints to the product.
- The Lower Screen Angle operates at a high Angle, which can be a strain on the wrist and elbow joints when used
- It is too big to move in busy period during use, the size of the tool car is too large, which will cause influence when passing through a narrow road section. In addition, the oversized volume is not conducive to the product moving in the busy period with large human flow
- Vertical scanner makes the user have to flip the phone, should make it level, and ensure a certain Angle, the user put the phone down normally can be scanned
- There is no handle or other parts to facilitate the user to move the product when It is powered off.
- The overall size of the screen is small, because people are far away from the screen, there will be a risk of not being able to see clearly, and operation will be difficult.

Improvement

According to these test results, I adjusted the details of each part.

- operation platform angle: 20-15°
- Height: 100-85cm
- Width: 50-40cm
- Length: 80-60cm
- Extra handle
- Lower scanning angle
- Screen size 10.8-13.3inch

Technical challenge and test

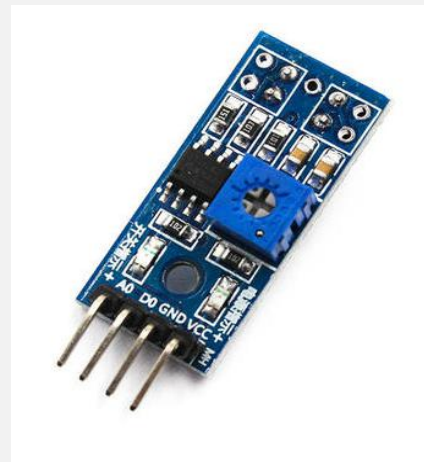
After determining the size of human-computer interaction, I studied the implementation of software and hardware functions and began to make a complete physical model. Due to the large overall volume, the time cost and consumption of materials to make a complete model of the same size would be too large, which would also increase the difficulty of experimental adjustment. Therefore, such a large model is unnecessary. Therefore, on the basis of man-machine data, I made an equal scale model and a mannequin to demonstrate the function of the whole product, so that the experiment of software and hardware functions can be reasonably completed.

The software and hardware system with Arduino Uno3 as the core was used in the experiment



COMPONENTS

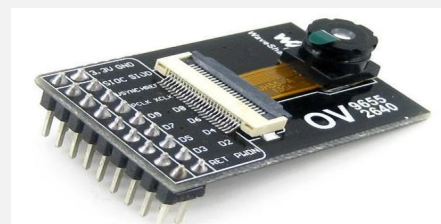
Firstly, the infrared sensor is used to realize the tracking function.



Ultrasonic ranging sensor is used to detect obstacles.

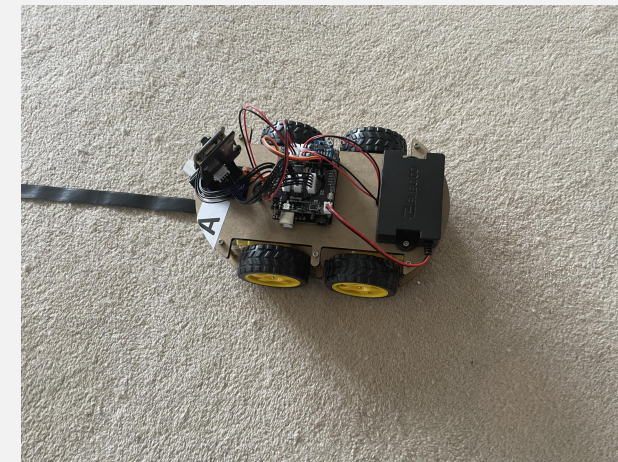


Add a camera to complete the acquisition of user images



Physical test

The cart can identify and follow the black line



When the distance between the front object is less than 10, it will automatically avoid



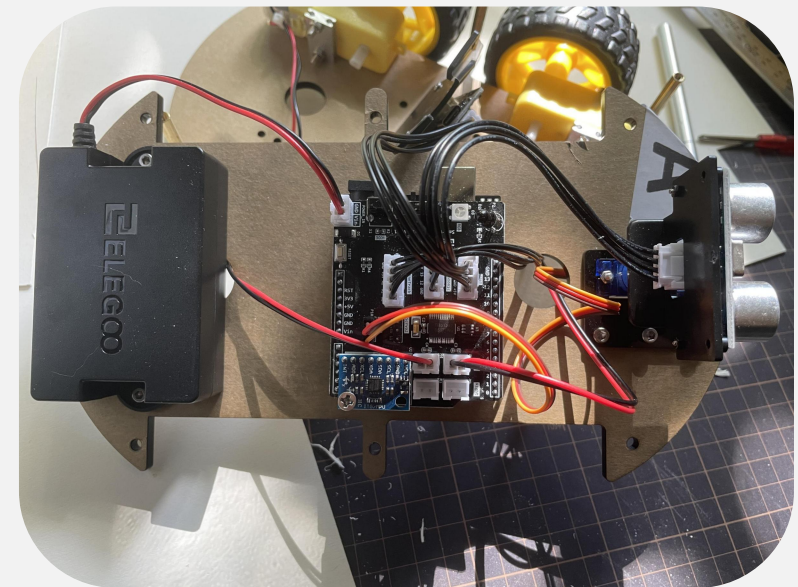
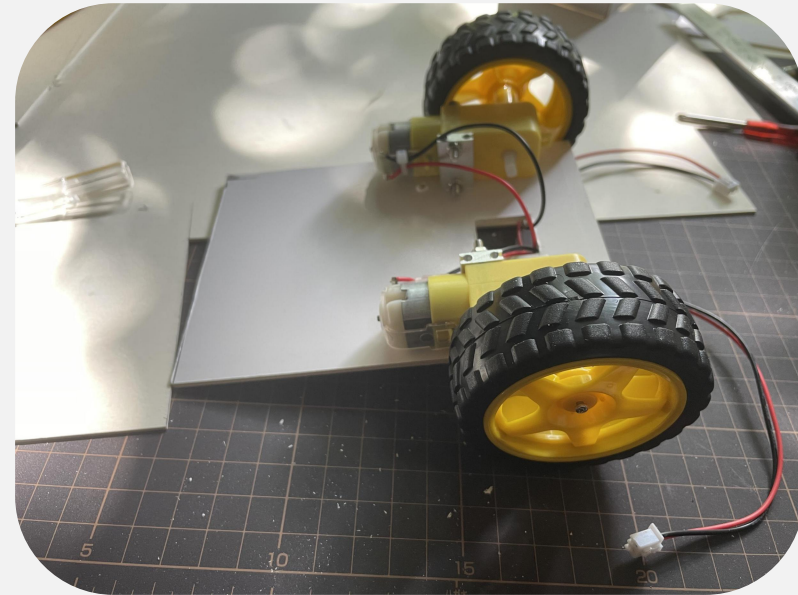
The camera detects the situation in real time



Prototype improvement

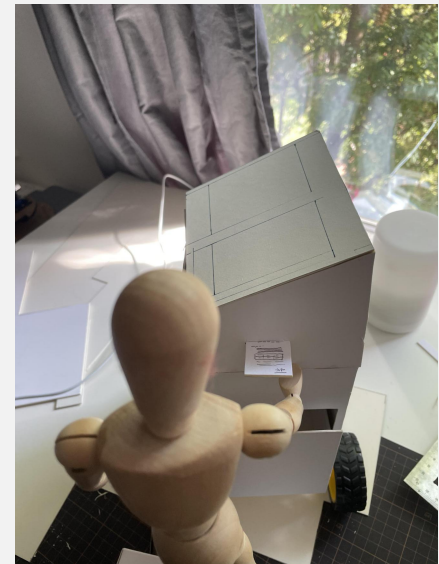
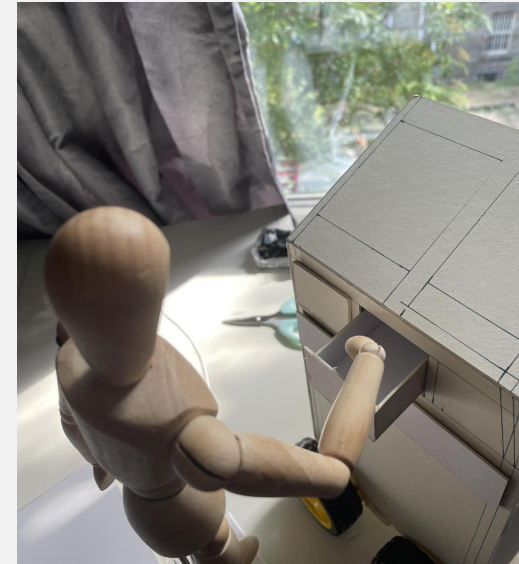
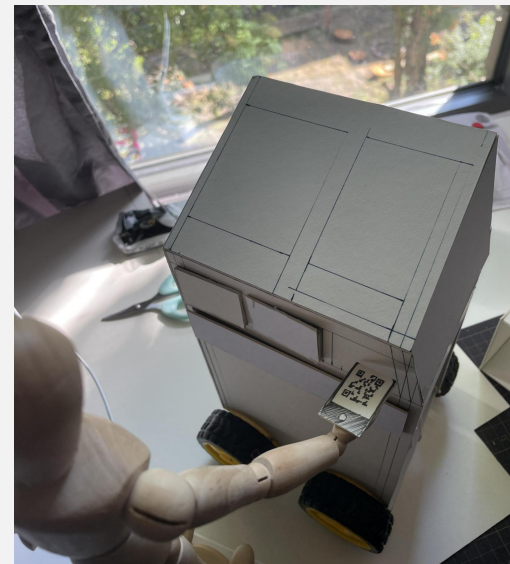
The results show that the whole product can achieve the expected functional effect, but there are limitations in tracking and obstacle avoidance. In practical life, more sensors are needed to realize the normal operation of the whole product. At the same time, it was found in the experiment that the four-wheel drive system could be completely replaced by two-wheel drive, so in the following experiment, the number of motors was reduced to 2.

Later, on the basis of the initial model, the rest of the model was made using hard plastic plates, while the assembly conditions of different parts were recorded.



Scaled prototype illustration

And then a scaled mannequin to demonstrate



- Select functions on the Operation page

- Scan the QR code to register your identity

- Hold the QR code and stick it to your submission
- (e.g. your test tube samples, documents)

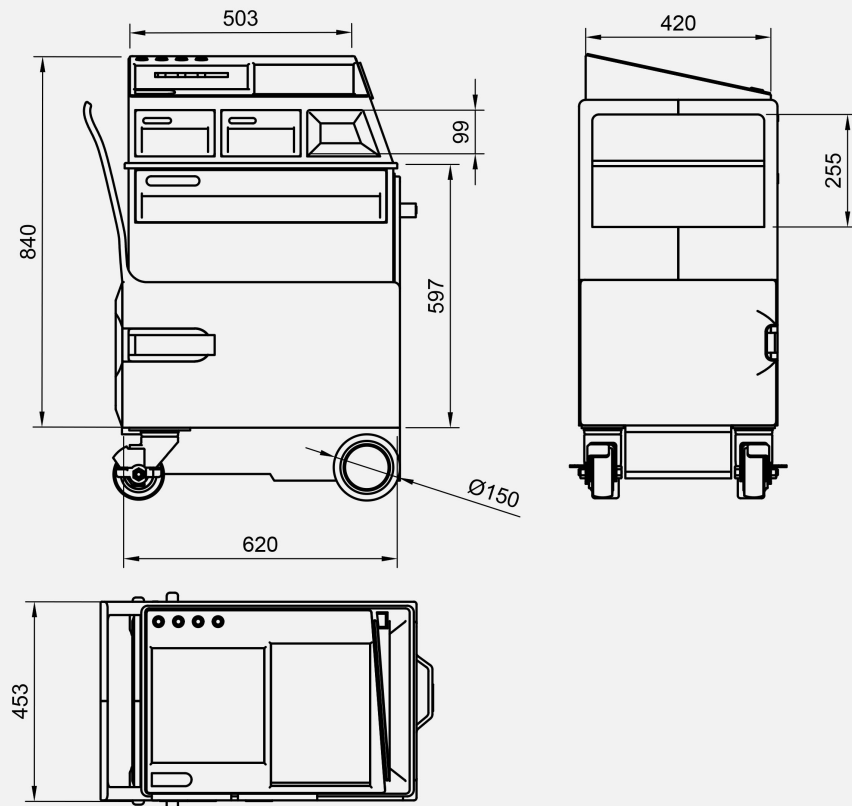
- To put (take out) an item

- Print your receipts or reports

INTELLIGENCE AND SAFE

3D model details and dimensions

Finally, there is the actual rendering and three views as well as the dimensions.



- Automated transporters can follow the patient to give navigational assistance
- Truly achieve doctor-patient independence.
- Convenient printer, so that the issuance of official reports more quickly.
- Print QR code labels.
- A hook that can be dragged.
- The drawer of different specification, let use more convenient.
- And separate garbage disposal space.