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# Smart Infirmary Trolley

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**Abstract -** *In this paper we have proposed a system called "Smart Infirmary Trolley", which focuses on solving the problem of frequent touch when delivering artifacts such as things ordered or food-to-be-delivered. The project focuses on minimizing the spread by following one of the standard operating procedures - maintaining distance. This is a autonomous line following robot which has Arduino UNO, 12V UPS battery, ultrasonic as well as IR sensors and UVC lights.*

***Keywords: infirmary trolley, covid-19, contactless, delivery, automatic sanitization, sterilize***

## 1. INTRODUCTION

Everyone throughout the globe is affected by COVID-19. The impact of the global pandemic has not only agitated our lifestyles as individuals but also its consequences have perturbed our vulnerability to epidemics. Only by acting unanimously can we save lives and overcome the detrimental socio-economic impacts of the virus. Since the outbreak of the novel corona virus, social distancing and quarantining along with frequent sanitization is now the "new normal". Frontline medical workers are exposed to the contagion daily as countries around the world grapple with COVID-19; these workers can deploy robots, and other technologies to help contain the pandemic. Furthermore, the advancement of technology plays a critical role in our lives and has brought major strides in bringing emancipation to the divergent human wants and gratifications. These advances in technology can enhance our health care systems because not only the future of health care systems is shaping up now, but also digital technology could help transfigure unsustainable healthcare systems into sustainable ones, equate the relationship between medical professionals and patients, and provide cheaper, brisk and more effective solutions for diseases. Since the outbreak of the novel corona virus which has affected throughout the globe, social distancing and quarantining along with frequent sanitization is now the "new normal".

To tackle this perplexing yet a quandary situation, the proposed solution is to build a line/human following robot so that there is "no-contact" (considering the fact that the covid-19 pandemic was a rapid widespread because of coming in close contact with infected people) and so it is an autonomous remotely controlled robot.

## 2. OBJECTIVE

Mobile workstations are designed to enhance the daily routines and workflow of today's healthcare providers. Autonomous carts that can carry food or other items without involving any physical contact or transfer of the virus would be efficient and beneficial.

Our project named "Smart Infirmary Trolley" is a remotely controlled autonomous robot with an automatic sanitizer dispenser machine and a sterilizer box for tools and kit for disinfection. After mapping the environment, such as hospital corridors and patient rooms, it moves around autonomously shining a 360 degree Ultra Violet Ray- C light (UVC).

## 3. SCOPE

- The Smart Infirmary Trolley provides a modest and a sophisticated solution for the people who are in need of medication, food and other supplies from time to time, on a daily basis by making them partially independent which reduces the human contact and the workload of the caretaker.
- For hospitals, the machine can be used to carry bed sheets, towels, toiletries and clothes. Food can be delivered to the patient's table with a satisfied temperature if heating plates are installed on the machine and in this case, the machine can be served as a temporary oven as well.
- For elderly care centers, it can be modified into a bigger size with powerful motors for transporting heavy medical equipment like blood pressure machines and electrocardiogram machines.
- A trolley can simply satisfy different purposes conveniently and also sanitize throughout -

therefore lesser human contact and lesser chances of being affected and an improved healthy living and a comfortable lifestyle can still be achieved even during these problematic periods.

## 4. DEVICE DESIGN

As the smart infirmary trolley is in its development stage now, we know that there have been slightly similar projects taken before. They aren't absolutely similar but they follow a same ideology. The references part at the end of the paper mentions three of these papers: As a part of our literature survey, we came across SADR[1] and smart trolley: there have been proposals for a "SADR" (Sidewalk Automated (or Autonomous) Delivery Robots) which are pedestrian sized robots that deliver items to customers without the intervention of a delivery person. Taking a similar credo from the SADR, the two questions that guide this research effort are:

(a) What are the technical capabilities of existing autonomous trolleys used if any, in the healthcare and

(b) Given the existing capabilities and regulations, what are the time/cost savings and efficiencies that the Smart Infirmary Trolley can bring about?

The trolley is designed in such a way that it follows the unique sticker provided for the user to recognize and stop when required. It also maintains a consistent distance from the user. Some sensors are used in the proposed solution. Each trolley will receive a one-of-a-kind sticker. Only the sticker allocated is detected by the trolley, and it is programmed to follow path. It will detect moving object by using a mix of ultrasonic and infrared sensors. The sensor used on the head and mini servo motor rotates at 180 degrees: when an object moves or gets close to the sensors, the micro servo motor rotates at 180 degrees and continues on its path.

The trolley is being put together by dividing the tasks and exertions into three categories and four stages:

- Device Design
- Prototype configuration: Sanitization, Sterilization.
- Hardware & Software: Layout, Construction, Organization.

Stage 1: Defining the objectives of the trolley:

The line following trolley's key goals are as follows:

1. Save on labor costs - Wages are one of the most significant expenditures of running a business, particularly in the hospitality industry, which requires a high level of individualized care. For simple operations like delivery, replacing individuals with machines could save money. Traveling time for employees can also be saved.

2. Offer accurate and dependable services. - The trolley can follow a predetermined path and determine where it needs to stop. A trolley, for example, may travel through a hospital floor and stop in front of each room. The location is precise, and the course is quite predictable. Because routine work is straightforward and predictable, a programmed computer can complete the task without the need for human mistake. This provides users with dependable services.

3. Acclimate to several uses - The machine should have a flexible design that allows it to adapt to various uses. The machine can transport bed linens, towels, toiletries, and clothing in hospitals. If heating plates are mounted on the machine, food can be delivered to the patient's table at a comfortable temperature. In this instance, the machine can also be used as a makeshift oven. Devices can be converted to a larger size with powerful motors for hauling heavy medical equipment such as blood pressure machines and ECG machines in elderly care facilities. A trolley can easily fulfill a variety of functions. As a result, instead of employing a real trolley with high-powered motors to carry huge loads, a model car is employed to portray. With minor tweaking, it is thought that the same concept can be applied to a variety of uses. The majority of the design is based on the concept of a human-following robot, with the trolley being able to follow a human with luggage loaded.

Stage 2: Device Design: In this stage of our project we designed a structure of the trolley, the below image shows the appearance of the trolley.

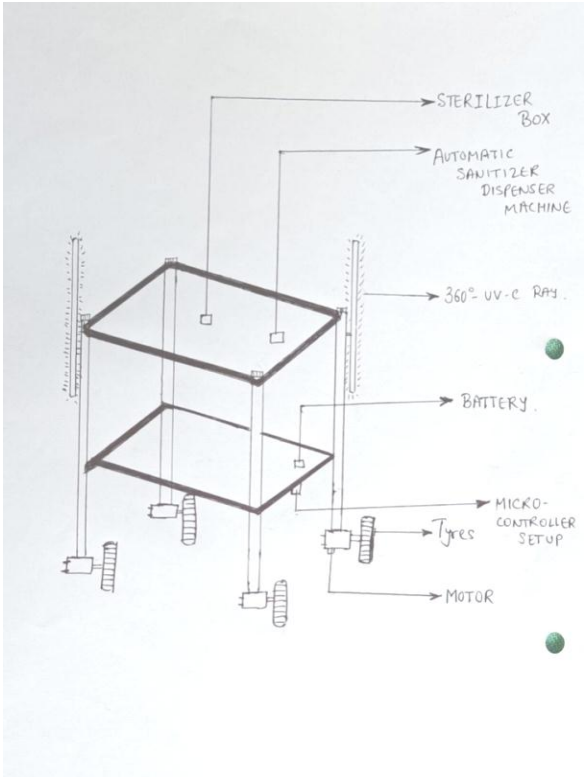


**Fig -1**: A diagram showing how the smart infirmary trolley will look.

We need to ponder over various questions and other research in order to determine whether the robot will be able to perform the said tasks. How efficient would it be? What will be the approximate ETA from one point to another? Adding divergent features will complicate the process of making it and so even if it is kept just to the point, it should deliver its best. The main obstacles that are being tackled by this robot are: contact-less sanitization, contact-less sterilization, delivering accessories without more contact.

We need to design the robot such that it does not harm the environment and is not over-expensive.

The following are a few things that we've kept in mind while designing the structure and designed as shown in the above figure 1.

- Compact, efficient design: A compact robot design makes integration easier. In addition, designs with complex integrations will not protect them from wear and damage, which would increase the overall costs.

- Robot controller features: We are looking forward to make the robot in a way that it is not heavy and bulky instead it is lightweight and compact in structure. Apart from this we would take into account the ease of integration i.e., if we were to accommodate more features, how modular and expandable it is without the expense of a new controller.

- Inexpensive offline programming software: The programming software that will be used should be cost effective. It should not include any intricate or state-of-the-art features which would then be unnecessary.

- Low energy consumption: The robot's energy consumption - efficiently designed, slim and lightweight robot arms require less power, so their motors draw less electrical current, which can result in significant long-term cost-savings.

- Continuous-duty cycle time: The robot cycle time should be either in continuous duty, or only shorter bursts of an hour or less.

Once we have our basic frame and have decided on the materials to be used, developing a prototype will help in knowing any vulnerabilities and flaws in the system and what will be the further future changes, if any. After this, we need to write the algorithm or the program code that will define the movement of the trolley. An algorithm is a series of instructions that defines the way to complete a task. Robots require comprehensive instructions, so developing the algorithm and then the program code is crucial. Writing instructions and coding them in the software about how the robot will respond to specific inputs.

Stage 3: Here, the block diagram and the working of the trolley were planned and it also includes the requirement analysis for developing the trolley as well as the circuit diagram of the automatic sanitizer dispenser machine.

The requirement analysis is as shown below:

- Square Hollow Aluminium frame
- 4 tyres
- 4 Gear motors
- Arduino Uno
- Motor Driver Shield L293D
- Wires
- Battery- 12V / 2200 MAH Li-ion 3.7V
- Male Female Wire Connectors
- Servo Motor
- Ultrasonic Sensor
- Switches
- UV-C RAY tube light

Components that are used for making the automatic sanitizer dispenser machine:

- 5v Charging Module
- Ir sensor
- 6v submersible pump
- Switch
- Battery 18650 li ion 3.7V
- Transistor- TIP 32C PNP or NPN 31c
- Acrylic box
- Sterilizing Box

The block diagram of the trolley is shown below:

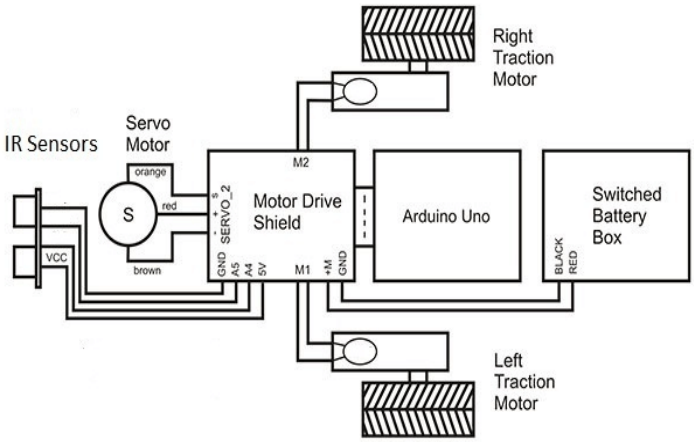


**Fig -2**: Block diagram

The switching battery box provides power to the motor driver shield.

The line follower robot follows a line, and to do so, the robot must first detect the line. To detect the line, we attach two infrared sensors on the robot's left and right sides, as shown in the diagram above. The line follower robot has two motors, one on the left and one on the right. Both motors revolve in response to the signals from the left and right sensors, respectively. The robot must move ahead, turn left, turn right, and come to a complete stop in four different motions. The following paragraphs detail the various scenarios:

When both sensors are on a white surface, the robot should move ahead since both motors should rotate.

The left sensor is on top of the dark line in this scenario, whereas the right sensor is on the white part, so the left sensor detects the black line and sends a signal to the microcontroller. The robot should turn left because the signal came from the left sensor. As a result, the left motor rotates in the reverse direction while the right motor rotates ahead. As a result, the robot shifts his weight to the left.

This scenario is similar to the left case, except that only the right sensor recognizes the line in this case, indicating that the robot should turn right. The left motor rotates forward and the right motor rotates backwards to turn the robot in the appropriate direction. As a result, the robot turns in the right way.

In this case, the sensors are on top of the line and they can detect the black line simultaneously, the microcontroller is fed to consider this situation as a process for halt. As a result, both motors are turned off, causing the robot to stop moving.

The line follower robot is based on the concept of light. The behavior of light on a black and white surface is used here. The color white reflects all of the light that falls on it, whereas the color black absorbs it.

We use infrared transmitters and receivers in this line follower robot (photodiodes). They're used to transmit and receive light. When infrared rays hit a white surface, they are reflected back to the IR receiver, causing voltage fluctuations. When IR rays collide with a black surface, they are absorbed by the black surface, and no rays are reflected, so no rays reach the IR receiver.

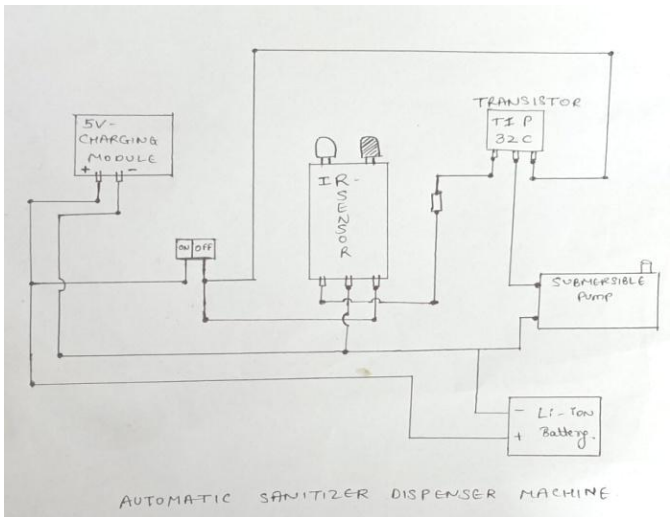


**Fig -3**: Circuit diagram of the automatic sanitizer dispenser machine.

Stage 4: This is the verification stage which is the formal check of the system development capability in accordance with the criteria and constraints, as well as that the planned system is secured in a degree of knowledge that is connected from a specific access point and has a specific quantity of resources is provided by verification.

## CONCLUSION

The smart infirmary trolley is an integrated solution for patient care, help, and monitoring that is based on a comprehensive, interdisciplinary design approach. Research in this field is critical in the context of global ageing, and it is fuelled by a spike in the potential for accessibility solutions. When seamlessly integrated into the healthcare system, smart trolleys present a one-of-a-kind ability to contribute to the caregivers work more efficiently, while also providing more responsive and safe environments for patients.

## REFERENCES

1. https://www.researchgate.net/publication/333538320_Automated_medical_surgical_trolley/fulltext/5de51b73299bf10bc3390e31/Automated-medical-surgical-trolley.pdf

2. https://www.irjet.net/archives/V5/i3/IRJET-V5I3596.pdf

3. Park, KeeHyun& Lim, SeungHyeon, (2012) "Construction of a Medication Reminder Synchronization System based on Data Synchronization", International Journal of Bio-Science and Bio-Technology, Vol.4, No. 4, pp1-10.

4. R. S. Sutton and A. G. Barto. Reinforcement Learning: An Introduction.The MIT Press, Cambridge, Massachusetts, 1998