

## Innovation Report

# Sister Robots - food and medicine carriers

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**Abstract:** Sister Robots - 'Food and Medicine Carrier Robot' are manually controlled robots which can be used in Corona Testing Hospital where health representatives or medical professionals need to carry food and medicine from the kitchen of the hospital to the patient isolation room. Robotics Association of Nepal [RAN] along with Team Robonauts, Team Kantibir and Team Oztec have developed the different versions of Sister Robots. The first version of the Robot - Sister V.1 is now working at the provincial hospital of Province no. 3, Hetauda Hospital. The Robot was built in support of Nepal Engineers' Association [NEA] and handed over to Honorable Chief Minister, Province No.3 Dormani Poudel. Sister V.1 can help frontline health professionals communicate with COVID-19 suspected/infected patients in the isolation room, deliver essential foods and medicines as well. Sister V.1 took 20 days for its completion. The development team further developed second version of Sister Robot [Sister V.2]. First piece of Sister V.2 has been completed and 5 more are on the verge of development. Armed Police Force [APF] Hospital has made a trial of Sister V.2. Sister V.2 has been upgraded with a double 12V 8000MAH battery system for higher power performance, dual FPV camera system for Top 90 degree rotation back view and Front 180 degree bottom view. Food and Medicine can be easily delivered and COVID-19 can sanitize their hands with automatic sanitizer as well. Phase 1 product development has been completed and Phase 2 small scale production is currently running. The phases are defined based on the upgrade of the Robots as the team believes in iteration of the robot and customization as well. Mass scale production of Sister Robots on phase 3 Version 3 [Sister V.3] will consist of different lines of Robots with different specifications. More cost effective technologies will be introduced and automation will be a priority of Robot development. Research Center for Applied Science and Technology (RECAST) and Sagarmatha Engineering College collaborated with RAN for 6 more robots to develop financially. Phase 3 focuses in bringing Sister V.3 at each and every hospital in Nepal through collaborative partnerships and safety campaigns.

**Keywords:** carrier robot; COVID-19; mass scale production; Sister V.2; Sister V.3

**सारांश:** सिस्टर रोबोट 'फूड एंड मेडिसिन क्यारियर' मैन्युअल्ली कन्ट्रोल्ड रोबोट हो जुन कोरोना जांच गर्ने अस्पतालमा प्रयोग गर्न सकिन्छ जहाँ स्वास्थ्य प्रतिनिधिहरू वा चिकित्सा पेशेवरहरूले अस्पतालको भान्साबाट विरामीका अलग्गै कोठा (Isolation Ward) मा खाना र औषधि पुराउछन् । रोबोटिक्स एसोसिएशन अफ नेपाल [RAN], टीम रोबनाउट्स, टीम कान्तिवीर र टीम ओजेटेकले सिस्टर रोबोटको विभिन्न संस्करणहरू विकास गर्दैछन्। रोबोटको पहिलो संस्करण (सिस्टर V.1) अब प्रदेश नं ३ को प्रादेशिक अस्पताल हेटौँडा अस्पतालमा सेवा प्रदान गर्दै छ। यो रोबोट नेपाल ईन्जिनियरहरूको संस्था [NEA] को समर्थनमा निर्माण गरिएको थियो र माननीय प्रदेश नं ३ मुख्यमन्त्री डोरमणि पौडेललाई हस्तान्तरण गरियो। सिस्टर V.1 ले फ्रन्टलाइन स्वास्थ्यकर्मीहरूलाई अलग कोठामा COVID-19 संदिग्ध / संक्रमित विरामीहरूसँग संवाद गर्न, आवश्यक खाना र औषधिहरू पुर्याउन मद्दत गर्दछ। सिस्टर V.1 ले यसको निर्माणको लागि २० दिन लाग्यो। विकासटोली सिस्टर रोबोटको दोस्रो संस्करण [Sister V.2] मा काम गर्दैछ। सिस्टर V.2 को पहिलो अंश पूरा भएको छ र थप विकासको कगारमा छन्। सशस्त्र पुलिस बल [APF] अस्पतालमा सिस्टर V.2 को परीक्षण गरिएकोछ, सिस्टर V.2 उच्च शक्ति क्षमताको लागि दुई १२V ८००० MAH ब्याट्री प्रणाली, शीर्ष ९० डिग्री रोटेशन पछाडि दृश्य देखिने र फ्रन्ट १८० डिग्री तल्लो दृश्यको लागि दुई FPV क्यामेरा प्रणालीसँग अपग्रेड गरीएको छ। खाना र औषधि सजिलैसँग डेलिभर गर्न सकिन्छ र COVID-19 आफैले स्वचालित सेनिटाइजरको साथ उनीहरूको हातहरू सफा गर्न सक्छ। चरण १ उत्पादन विकास पूरा भएको छ र चरण २ सानो स्केल उत्पादन हाल चालु छ। चरणहरू रोबोटको अपग्रेडको आधारमा परिभाषित छन् किनकि टोलीले रोबोटको पुनरावृत्ति र अनुकूलनमा पनि विश्वास गर्दछ। तेश्रो V.3 संस्करण [Sister V.3] मा सिस्टर रोबोटको मास स्केल उत्पादनले विभिन्न विशिष्टताहरू साथ रोबोटको विभिन्न संस्करणका प्रकारहरू समावेश गर्नेछन्। अधिक लागत प्रभावी टेक्नोलोजीहरू ल्याइनेछ र स्वचालित रोबोट विकासको प्राथमिकता हुनेछ। रिकास्ट र सगरमाथा ईन्जिनियरिंग कलेजले आर्थिक रूपमा थप ६ सिस्टर रोबोट विकासलाई समर्थन गरेको छ। चरण ३ मा सहयोगी साभेदारी र सुरक्षा अभियानहरूको माध्यमबाट नेपालको प्रत्येक अस्पतालमा सिस्टर V.3 ल्याउने कुरामा केन्द्रित छ।

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## 1. Introduction and Objectives

**Robotics Association of Nepal (RAN)** is the only national-level non-profit association that provides an outstanding platform for students and enthusiasts all over Nepal in 2010 A.D with the vision of representing Nepal Globally in the field of Robotics and Automation Technology. RAN is established to promote, educate, explore, and compete in the field of robotics. Their mission is to create platforms, partnerships and possibilities to enable Nepali organizations and individuals to understand the implications of science of mechanics, electronics, robotics and coding and implement them to find solutions to everyday life problems. Their objective is to provide a problem based learning environment where youths can explore solutions to automate and mechanize everyday processes and build effective and efficient systems that lead to better and dignified lives.

**The Robonauts** is a hobbyist and robot maker in Nepal. They have been actively participating in robotics competitions since 2016. They are progressing day by day and winning domestic competitions and reached the international Olympics robotics platform “FIRST Global Challenge” nominated by RAN for the competition. They have been leading robot fight games since the establishment.

**Kantibir** is a team of Robotics Enthusiasts initiated from Kantipur Engineering College. This team was formed in order to bring Robotics to the front line in our country, thus working continuously to establish the Robotics Industry in Nepal. Kantibir has participated in several national and International competitions and has represented the country proudly in different platforms.

**Oztec** is a team of Robotics and Drone Enthusiasts of Nepal which is led by Mr. Richan Joshi who is currently studying in Bangalore. This team was formed to bring both Robotics and Drone Solutions supporting the work in creating Robotics Industry in Nepal. Oztec has been successfully winning the National and International Robotics Competition at its best.

Robotics Association of Nepal [RAN] is working together with these informal groups of young technopreneurs to solve existing challenges in the Health Care System through Robotics Technology. The main objective of this Report is to present the use of high end technologies in crisis situations like COVID19 Pandemic.

### Innovative Works for Combating COVID-19

Story covered by Himalayan Times on Sister Robot: *Bikash Gurung, President of Robotic Association of Nepal (RAN), was happy to see nurses excited to use Sister Robot in Hetauda Hospital for medicine and*

*food delivery on May 5 when Nepal Engineers' Association (NEA) handed over the robot to the hospital. “We taught the nurses how to use the remote once and went for brunch. When we returned, we found them teaching each other,” said Gurung. The robot can be used to provide medicine and food to COVID-19 patients thus protecting healthcare workers to a large degree (The Himalayan Times, 2020).*

After Hetauda Hospital, the Robot is now deployed at APF Hospital as Sister Version second (Sister V.2). Testing of robots started from June 3, 2020. Development team focused on identifying all the faults in the Robots for two days in the office space. The robot will be in operation on June 11,2020 on the Isolation ward where there are a total 5 active cases. 5 other Robots are in the phase of development and will be deployed to APF hospital, Madhyapur Thimi Hospital and Hospitals in Province 1,2 & 5. The doctors at the Hospital said the use of robots will not also reduce the cost of PPE but also save lives. Their frontline health workers are important for them and they don't want to risk their lives, yet want them to fulfill the responsibility.

## 2. Sister V.2 Robot Components

The different components of Sister V.2 Robot were built simultaneously as described below.

**Metal Framework:** The base of Robot is made from Iron for motor mounting where the iron plate is welded and the wheel is attached to it . Electronics components are also placed safely in the base compartment. Metal Framework was completed on May 16. For the hardware part assembly of base and upper part was completed by 19<sup>th</sup> May 2020 (**Figure 1**).



**Figure 1.** The base of Robot is made from Iron for motor mounting where the iron plate is welded and the wheel is attached to it . Electronics components are also placed safely in the base compartment. Metal Framework was completed on May 16. For the hardware part assembly of base and upper part was completed by 19<sup>th</sup> May 2020.

**Upper Body:** Full Furnished Wooden body of the Robot is completed. This is the Upper body part of the Robot. The Glue, used to attach **sanmaica** with the wood is still not completely dried yet.

**Custom Shaft:** Custom iron shaft needed for holding the motor strongly is completed (**Figure 2**).



**Figure 2.** Custom iron shaft

**Motor Testing:** Testing of Motors for all six robots were completed and working completely fine. Fixing of the motor was completed by 25<sup>th</sup> May 2020 (**Figure 3**).



**Figure 3.** Motor testing

**3. Completion of Electronics Work:** ESC Testing, ESC circuit testing, battery level indicator, automatic sanitization, camera switching and PCB fabrication for sanitizer are the electronics components used as part of the Robot. Electronics were assembled in the base of the Robot by 25<sup>th</sup> May 2020.

Brief description is shared as below:

**ESC Testing:** ESC for driving motors have been tested and working fine.

**ESC circuit Testing:** ESC circuit for all six robots have been tested and is working properly.

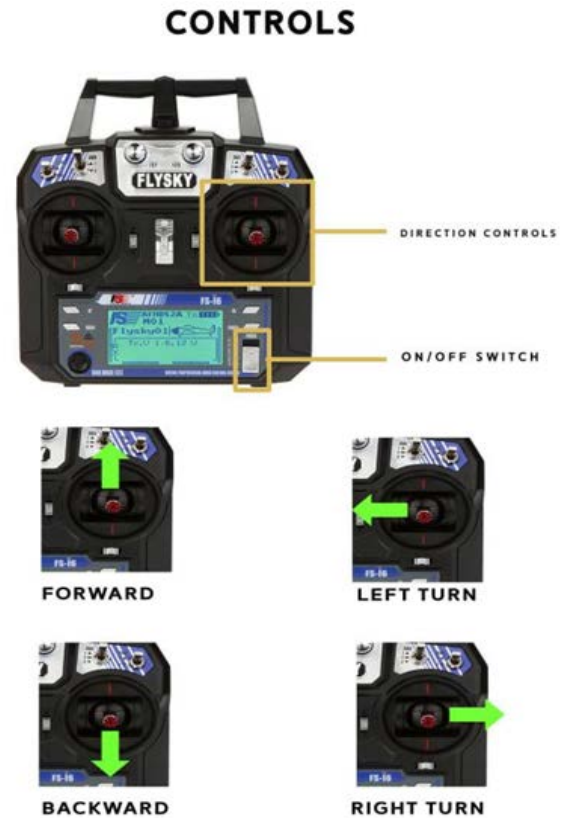
**Battery Level Indicator:** Four different LED for showing battery level have been used and have been tested successfully.

**Automatic Sanitizer:** Automatic sanitization is an

important aspect of the Robot and circuit for it is ready.

**Camera Switching:** Two different cameras are currently being used in our Robot, first one is at the bottom for easy control and second for video communication between Patient and the Nurses in isolation ward. Circuit of the camera switching is completed.

**4. Completion of Robot Control Mechanism:** Important aspect of the Robot is user friendly control (**Figure 4**). For the easier and smooth control without any damage to the Robot, RC Control, VTX, Camera System, OTG Receiver and Camera Wiring has been planned so far. RC control: Remote Control system is used for controlling the robot. The RC control has light of sight 2-3 Km smooth control range without obstacle and 200-500m range with obstacle.

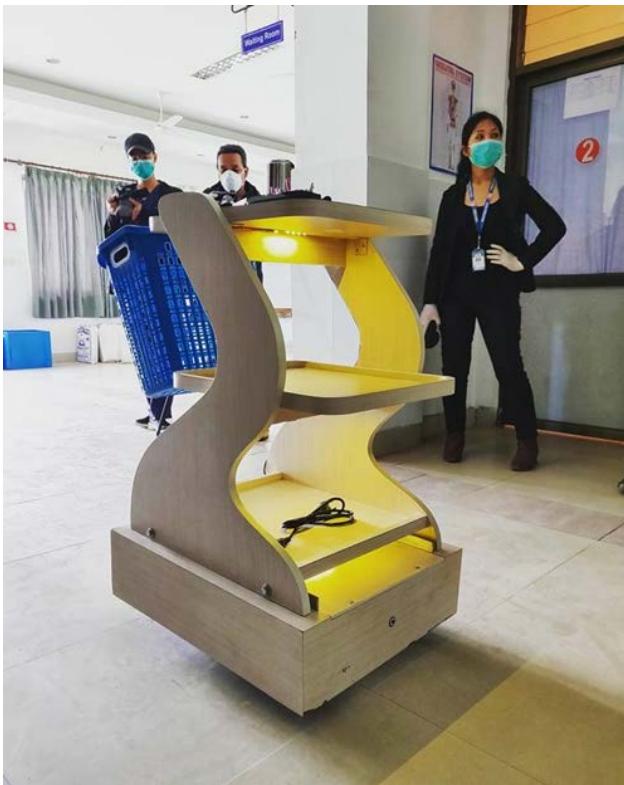


**Figure 4.** Control mechanism

**Video Transmission:** All six sets of Video transmitter are available and Testing of the cameras is completed. OTG receivers are used for video feed in the monitor and testing of it for all 6 robots was done successfully. The monitor could be in house desktop, laptop or simply smartphone of the health professionals.

**Full Testing and Robot Trial at APF hospital:** Testing of robots started from June 3, 2020. Development team will focus on identifying all the faults in the Robots for two days in the office space **Figure 5**.





**Figure 5.** Full testing at APF hospital

## 5. Product Description

### Features of the Food and medicine carrying Robot:

1. With the help of this robot we can easily carry food and necessary stuff up to the patient who is in an isolation room and quarantine room.
2. This robot is manually controlled and can be controlled by the remote from the distance of 300-500 meters. So that this feature helps to prevent from spreading viruses to people who used to go instead of robots.
3. Due to the presence of wireless cameras and Tablet for video call in robots we can easily monitor the condition of the patients.

### Specifications:

#### a) Battery and Charging Methodology

- i. Battery of 8000 Mah will be used for this robot and it can last for around two hours
- ii. It will take around two and half hours to full charge
- iii. Anyone can operate a battery and can put it in charge, it is an easy process.
- Iv. Weight of Robot is 30KG and it's load capacity is 40KG.

#### b) Control Mechanism

- i. Robot will be controlled with Remote controller and it is easy to control robot
- ii. Anyone with practice of around 1 hour can control the Robot or previous experience on a normal remote controller can use it.

#### c) Video Feed

- i. For video Feed we will be using a FPV set.
- ii. Camera will be set in Robot which will give direct feed to the controller.
- iii. Video of pathway will help controller to see the way and control it easily

#### d) Speed and Smoothness

- i. Speed of Robot will be adjustable, Controller can adjust the speed with ease
- ii. This Robot can be used only in one floor, it cannot climb stairs
- iii. We have considered smoothness of Robot as it will be used to carry food and medicine
- iv. Robot will be stable and with it there won't be any problem with stability.

#### e) System Engineering

- i. The robot will be kept in each floor of the Hospital or outside where the patient is kept.
- i. The Robot will be controlled by Remote with the help of video in FVP.
- ii. This Robot will minimize the human interference between Patient and Health Workers.

**f) Design of Robot:** The robot is designed with elegant look and efficient use (**Figure 6**).



**Figure 6.** Design of robot

## 6. Challenges and Problems Encountered and Lessons Learned

Developing Sister Robots was not an easy task, COVID19 journey has been full of ups and downs. Right after we planned to work on Robots, we faced difficult situations like we may not be able to return back home as we were already asked by community people not to come back home before COVID19 spread out. Similarly, we ran out of cash while working on the product version of the Robot and faced an economic crisis as well. Similarly, the robot we developed failed when we deployed at Hetauda Hospital due to mishandling of the Robot from the nurses and faced a situation of mistrust for our work. Similarly, other challenges are mentioned below:

### **Competitors:**

In Nepal two other organizations are working on this, one is Paaila technology who have made an automatic Robot and National Innovation centre who is still in the Research and Development phase of Nursing Robot. The robot from Paaila will operate automatically without manual intervention, will initiate communication between patient and medical staff via video call and deliver food and medicine to the patients. The robot from NIC will operate manually with the help of transmitter and serves food and medicine to the patient as well. The stiff competition definitely made us face competition, yet we worked on developing the Robots as per our need.

### **Mobility:**

The Robot can move from one place to another on a plain surface without any obstacles. We handed our first Robot to Hetauda Hospital and tested it on a plain surface but the isolation room was built on rough surface for which it was hard to move. Through this learning we made ground clearance in order to make sure Robot move perfectly fine.

## **7. Future Works and Way Forward**

The project is sustainable and has a plan to go for the long run. Robotics Association of Nepal [RAN] has prepared two different financial models for the sustainability of the project.

### **Model 1:**

RAN with other team members will seek support from different organizations within the nation and around the world for the purchase of the components required. They can also donate the hardware requirements of the Robot. RAN will charge hospitals for the remaining cost for the development of the Robots. Hospitals will promote donors/fund providers as the supporter of the Robot deployed.

### **Model 2:**

Similarly, RAN will launch a **Donate a Robot** campaign targeted for big corporate houses, industry leaders, and leading governmental and non governmental organizations who are willing to support the Robot development and deployment.  
Donate a Robot Campaign: Robotics

### **Model 3:**

Sister Robots are multi-purpose robots designed to reduce nurses from COVID19 suspected/infected patients. Sister Robot is built and designed with quality materials having high durable capacity. The estimated effect of COVID19 in the lack of vaccine is more than two years as per different research

articles published. WHO has warned Coronavirus may never end as well. The effective uses and necessity of Sister Robots were highlighted in National Dailies of Nepal (The Himalayan Times, 2020; The Rising Nepal, 2020, UNDP, 2020). There is growing interest in use of robots in health care service worldwide (Forbes, 2020; Singularityhub, 2020). Therefore, Sister Robots can be used in during as well as post COVID state to deliver the food and medicine to the patient in the isolation ward so that Nurses can reduce the exposure time with the patient.

**Acknowledgments:** Sister Robots could not have been possible without support from different collaborative partners who believed in the mission of making our frontline health workers safe and protected. We are thankful to Nepal Engineers' Association [NEA] for the support they have shown for the development of the first product version of the Robot. Our gratitude also goes to Mr. Rajesh Acharya, Biomedical Engineer at Tribhuvan University Teaching Hospital who supported in testing the prototype version of the Robot.

Our heartily thanks to Honorable Chief Minister Dormani Paudel whose presence boosted our confidence for developing more such Robots in days to come.

We are also thankful to Mr. Ramesh Shrestha, Principal, Sagarmatha Engineering College who supported the development of Robot without any hesitation.

This journey would have been not that adventurous without the support from Prof. Dr. Rameshwar Adhikari, Executive Director, RECAST, Tribhuvan University for supporting us highly for development of 5 more robots. This really helped us in Small scale production of the Robot.

Our heartily thanks also goes to team members of UNDP Nepal Accelerator Labs who helped us in shaping the project details and providing us with valuable feedback and comments.

We are also thankful to APF Hospital who trusted the Sister Robot and deployed it in the isolation ward where there are more than 10 active cases.

Our thanks also goes to Nurses who have been working tirelessly at different hospitals as the frontline health fighters protecting the lives of thousands of Citizens.

Similarly, we would like to thank Technology Development and Innovation Group [TDIG] who supported us constantly during this COVID-19.

Our final gratitude goes to all the members of Robotics Association of Nepal [RAN], Robotics and Tech Community for their constant support and

critical comments.

**Author Contributions:**

Robotics Association of Nepal [RAN] with Prithvi Chaudhary from Team Robonauts planned and designed the Robot structure. Pankaj Japrel from Team Kantibir developed the electronic control circuit and data and signal transfer mechanism. The robot shows battery level as its functionality and rotate 360 degree camera to make a perfect view for Navigation in the isolation ward of the hospital. Richan Joshi, Oztec designed the real time live video feed mechanism. The robot can be controlled through FPV, both with FPV Goggles or displayed on the Desktop/Camera. Similarly Anil Singh from Team Robonauts is leading the project as Project Manager, managing all the resources required for the Sister Robot development, working on documentation and reporting of the project. Er. Bikash Gurung, President at RAN worked on building partnerships with different organizations and taking the work on Sister Robot to the next level. Mr. Gurung made final edits of the paper after Mr. Anil Singh wrote the paper.

**Conflicts of Interest:** We would like to declare this report is prepared by a team of members from Robotics Association of Nepal [RAN], Kantibir Tradelink, The Robonauts and Oztec.

**Funding:** The project received support Rs.86,500.00 from Nepal Engineers' Association[NEA] for the first Product. Similarly Sagarmatha Engineering

College [SEC] supported Rs.86,500.00 for the second piece of the Robot and we signed a letter of agreement with Research Centre for Applied Science and Technology [RECAST] and received Rs. 4,15,000.00 for the development of 5 other Robots. Robotics Association of Nepal [RAN] also signed an agreement with UNDP Nepal for the development of 2 more Robots.

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