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The BOBO Project: Hexa-Eagles

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Introduction

The consumer business has undergone a substantial shift in how customers to shop since the introduction of online shopping. When the world was affected by Covid-19 in 2020, one of the most major repercussions was in the Food & Beverage (F&B) and grocery industries. As a result of the pandemic, many cities were put under lockdown, and everyone remained indoors. Consumer purchasing patterns changed dramatically, with malls closing or operating with limited access, and customers avoiding common spaces for fear of getting the virus. As the global epidemic progressed, several firms were forced to close their physical locations due to huge losses arising from a lack of consumer purchases. However, many firms relocated their products and services online, giving courier and delivery services a major boost. This gave the last-mile or last-quarter-mile delivery industry a chance to demonstrate its efficiency, convenience, and safety. These are the parts of the delivery process when goods or services are delivered directly to customers from local stores or a satellite consolidation and re-delivery center. Riders and drivers for delivery services rose to the occasion and assisted in keeping life as normal as possible.

About GNSS

GNSS or Global Navigation Satellite System (GNSS) is any satellite constellation that delivers worldwide or regional positioning, navigation, and timing (PNT) services (Other Global Navigation Satellite Systems, n.d.). The signals from space consist of data regarding the positioning and timing, and these signals are received by a receiver that uses the data to determine the position. It is based on the concept of trilateration and using satellite constellations. Trilateration can be observed in *Figure 1*. Simply put, GNSS receivers compute their location by calculating the distance between four or more satellites. These satellites would have originally all been from the same GNSS, although multi-GNSS receivers are now popular (Thornton, 2021).

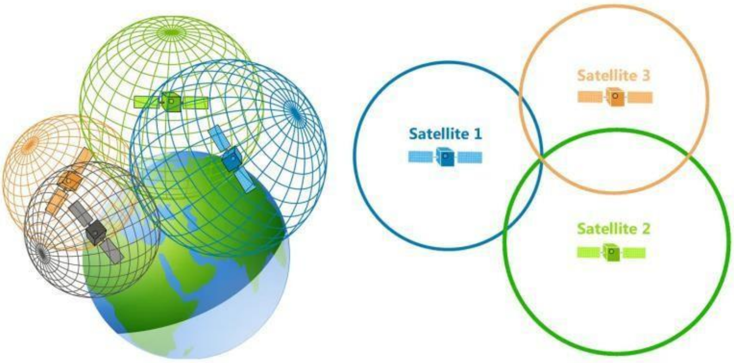


Figure 1: Trilateration (GIS Geography, 2021)

GNSS Performance Criteria

According to the European Union Agency for the Space Programme, four criteria are used to evaluate GNSS performance:

- **Accuracy** – the discrepancy between a receiver's measured and real position, speed, or time
- **Integrity** – a system's ability to give a level of confidence and, in the event of a data anomaly, an alarm
- **Continuity** – the ability of a system to operate without interruption
- **Availability** – the proportion of time a signal meets the accuracy, integrity, and continuity standards mentioned above

Importance of GNSS

Many outdoor applications that require location-based geospatial data employ the Global Satellite Navigation System (GNSS) as the multi-positioning enabler. It is used every time a mobile application is installed without the user having to do anything. In reality, if GNSS is off on the mobile device, many applications that require location information and data will not function. Without GNSS, navigation software that allows us to find our way or hunt for a landmark locally will be impossible. This demonstrates how prevalent GNSS has gotten in our daily life.

Application Benefits

Positioning is the basis of autonomous mobility platforms and systems. These platforms must know where and how to get to a specific location. Many sensors can offer this information but only in a relative sense, relying on reference points or objects in the environment to propagate the next location. If the reference points of objects are of poor quality, the accuracy and precision of placement and movements on the platform will diminish. GNSS is the only absolute positioning sensor that can offer autonomous positioning for mobility platforms, and approaches like Real-Time Kinematics (RTK) can then deliver accurate and precise positioning.

About SiReNT

SiReNT is an infrastructure network designed to aid with real-time high-precision Positioning, Navigation, and Tracking (PNT) and GNSS demands. SiReNT is also built using differential technology, which increases global navigation accuracy and reliability. Initially established by the Singapore Land Authority's Survey Services department in 2006, there are currently about 8 reference stations according to *Figure 2*. It is a multi-purpose, high-precision positioning infrastructure that offers both Post-Process Differential Global Navigation Satellite System (DGNSS) and Real-Time DGNSS services. All GNSS locating modes and formats are supported by the system. SiReNT can be used in a wide range of applications. With the help of GNSS technology, it gives data reliability, efficiency, and productivity of survey operations. It also provides a variety of GNSS data services, ranging in accuracy from meters to centimeters, to suit a variety of applications ranging from location to tracking and monitoring. It also offers various services such as Post Processing (PP) On-Demand, Post Processing (PP) Archive, and Real-Time Kinematic (RTK) to suit different application

Figure 2: Existing Reference Stations of SiReNT in Singapore (SLA Singapore, 2020)

Idea Overview

Our Bobo app is based on our Bobo Enterprise. This project explains the various steps where the food or groceries are ordered through the Bobo App. The catered audience includes people in HDBs, condominiums, public parks, beaches, landed houses, etc.

There is one main warehouse situated at Seletar and 8 sub-branches located in various areas of the island for the Bobo Enterprise, as shown in *Figure 3*. The main warehouse is where the robots are manufactured, maintained, and repaired. Programmable and ready-to-go Bobo robots are placed at the various sub-branches where they can be deployed to deliver or recharge before the next delivery. Hotspots such as malls and coffee shops will consist of a designated area for these Bobo vans. Additionally, the Bobo vans and their robots will be programmed every day to begin operations from its sub-branches to the parking area at these populated spots. For every hotspot, there is a food collection point at which the robots can be loaded with the orders/items.

Figure 3: Sub-branch warehouse locations in Singapore

Moving on, the customers will order through the app, and upon ordering they will receive a 5-digit number code which will be used as a confirmation in the last-mile delivery. Once the store receives the order, the order is prepared by the store personnel or assistant. The Bobo App assigns this code to customers based on the number of items that they have ordered. Each robot will be numbered, for example, Bobo A1, Bobo A2, etc. Simultaneously, the store personnel also receive the same code along with the designated robot number, which enables them to load the food inside the designated compartment of the robot which is waiting at the food collection point.

Upon being loaded, the Bobo robots will then board the autonomous vans. The vans will depart from the food collection point and stop nearer to the deployment points in every neighborhood. These deployment points are designated for the robots to alight and move towards delivering their order. As for customers who stay in high-rise buildings, such as HDB flats, the robots are designed and equipped to go up to their respective housing levels. They can go up levels using elevators, which is elaborated on more in the *"Delivery via Elevators"* section below. Upon reaching their customer, the customer will have to key in the code assigned to them in the app, on the robot. Once the code matches, the designated compartment opens, and this way the customer will receive their order. The aforementioned process can be cross-referenced with *Figure 4* below. The following sections will explain in-depth the design of the Bobo Robots, the Self-Driven Vans, and the last mile delivery process.

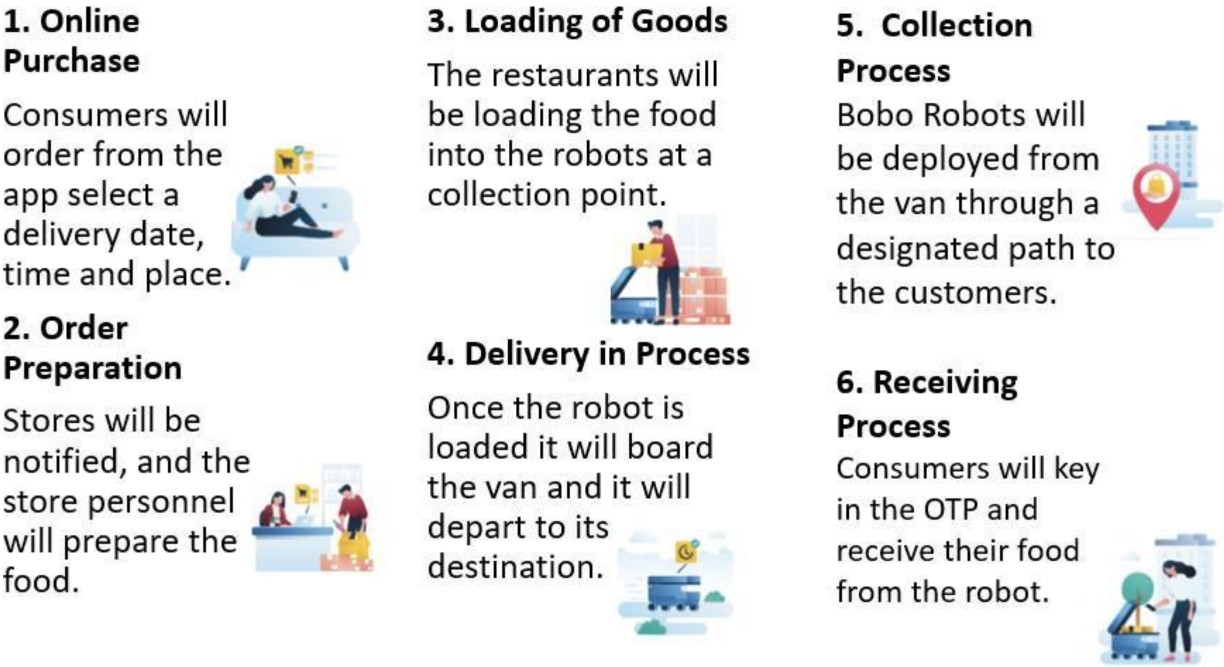


Figure 4: Last-Mile Delivery Process

Design of Robot and Delivery Van

Robot Delivery Solution

The autonomous self-mobility platform that will be implemented for this last-mile delivery is Bobo - the friendly delivery robot. The primary purpose of this autonomous robot is to deliver F&B and groceries efficiently and effectively to customers.

Dimensions & Capacity

Bobo has been designed in a way that is cost-effective, sustainable, safe, and interactive. The robot weighs 34 kg, and it is 54 cm in length (60 cm including the tires), 51 cm in width (58 cm including the tires), and 87 cm in height, as shown in *Figure 5*. The robot consists of three compartments and hence, it can deliver three orders at a time. The height of these compartments is 20 cm, and the depth is 37 cm. These particular dimensions have been chosen owing to the maximum food & beverage, and grocery occupancy. In this case, the robot can carry a maximum weight of 8.3 kg of food and/or beverages, or groceries in each compartment. The height allows Bobo to even carry a venti Starbucks drink or a large bubble tea drink. The cup holder is elastic and adjustable to allow the drinks from spillage. In terms of range and speed, the robot can travel up to 3 miles at a maximum speed of 7.5 miles per hour. The inside of each compartment, where the food or grocery will be placed, will be insulated to keep the food warm or cold until it has been delivered.

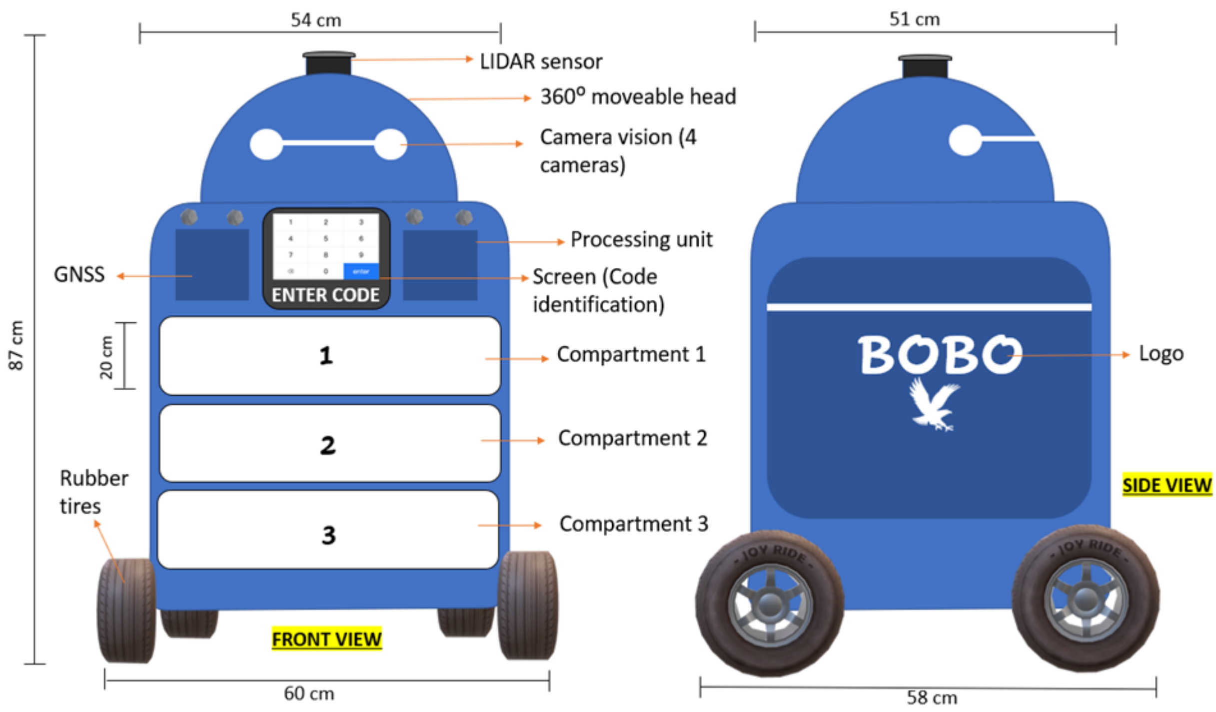


Figure 5: Design of the Bobo Robot

Power source

Bobo is powered by electric energy, and it consists of onboard batteries that offer it an operational time of a maximum of 6 hours. When the battery drains, the Bobo robots will be placed back into the van and sent to the charging stations to wirelessly fuel up. There will also be standby batteries within the robot to act as an emergency power source in case the battery is drained halfway or malfunctions. Since the robot moves at a maximum speed of 7.5 miles per hour, it loses much less energy compared to a car. As a result, such robots do not require large batteries, thus reducing the hardware and electricity costs. The charging port which is located behind the robot will be properly sealed and watertight as seen in *Figure 6*.

Figure 6: Back View of Bobo Robot

Physical Design

In terms of the overall design, Bobo is a cuboidal box with curved-edged shoulders, a semicircular head with two connected eyes, and rubber tires on each side. The colors chosen for this design are blue and white to make the robot look calm and appealing to the human eye and not overpowering.

Technologies Implemented

The technologies implemented in this robot include 4 cameras, a LiDAR sensor (light detection and ranging), a processing unit, GNSS, 360^0 moveable head, and a touch screen.

- The 4 cameras are embedded inside the eyes of the robot and are stitched together to form a panoramic view.
- In this design, instead of using a 360^0 camera vision, the head of the robot will be allowed to rotate in a 360^0 direction in a horizontal plane, thus allowing the robot to capture everything around it.
- The LiDAR sensor is placed on top of the robot's head. This remote-sensing

technology uses a laser beam to retrieve information about surrounding objects and beings and map it in a 3-D layout. This way, the robot will be able to locate and identify obstacles and track their movement, thus avoiding any crashes or collisions. The sensor's use of light enables it to map the surrounding quickly and more accurately. Another advantage of using LiDAR is that it can also be used in rain, with the help of its waterproof capabilities.

Figure 7: Touch-screen number keypad

- The robot equips a touch screen on the front that includes a number keypad, as seen in *Figure 7*, for customers to enter the code sent to them via the app for verification and collection of the food. All the compartments have been programmed in a way such that once the customer keys in the number code, the compartment compatible with that particular code will automatically unlock and the customer can collect their food. The screen will switch on and off only when it detects the mobile device through GNSS. Else, once the range between the device and robot is undetectable, the screen will switch off.

Use of SiReNT

The signals are transmitted from the satellite to the Bobo robot. However, for more precise positioning, navigation, and tracking, the signals from the satellite are transmitted to a nearby reference station which allows for more accuracy. GNSS, which is a sensor, plays a vital role in providing the robot with an absolute position on the Earth's surface. To refine the accuracy of GNSS, Real-Time Kinematic (RTK), which is a technique included in SiReNT, is used. It uses data from navigation satellites, advanced error correction from the DGNSS, plus advanced algorithms, to generate a much more accurate signal.

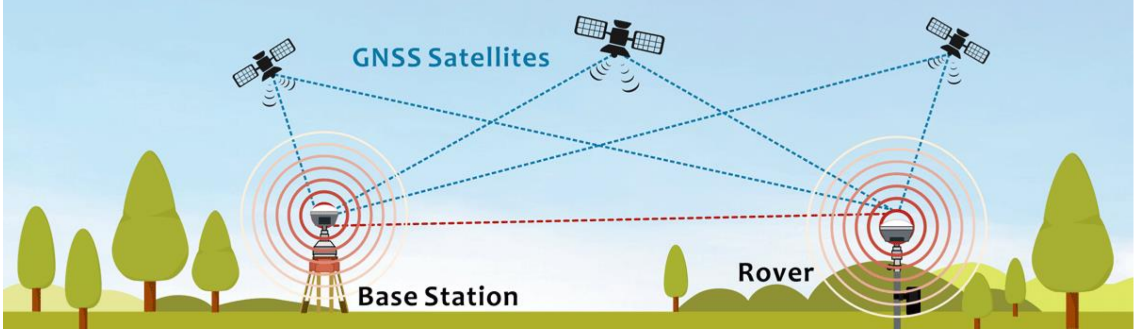
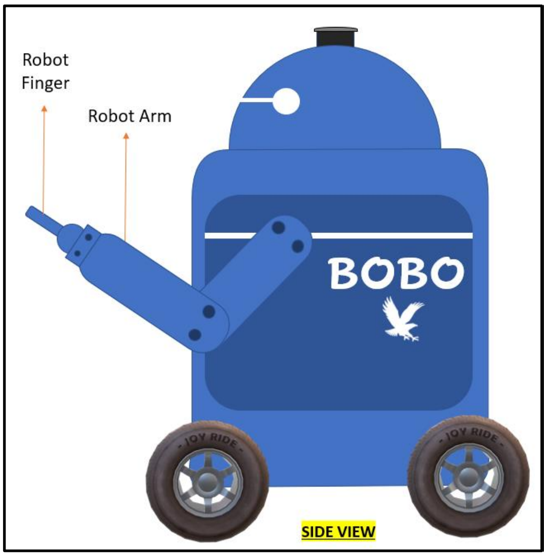


Figure 8: Bobo using SiReNT & GNSS

Delivery via Elevators

In locations such as Housing & Development Boards (HDBs) and Condominiums (condos), some elevators allow people to move up or down floors. While the design of the Bobo robot restricts it from climbing stairs, the next solution to deliver the package to the customer on a higher floor from ground level is to use the elevators. Bobo is fitted with an extension, on the left side of the body as seen in *Figure 9 (a)*, that works as an arm. The arm is retractable and extendable, that is it can be folded back into the body when not in use as seen in *Figure 9 (b)*. The hand portion of the arm is designed in the form of a cylindrical finger to allow the robot to push buttons. While this function can allow the robot to push an elevator button, it needs to know when and how to recognize it. The role of computer vision is essential in this case so that the house numbers can be identified.



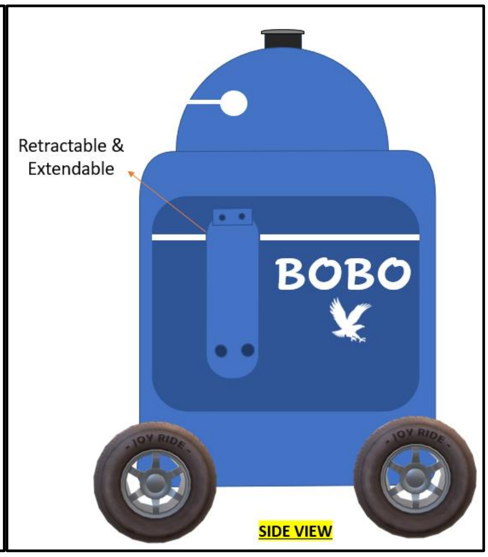


Figure 9 (a): Bobo Arm *Figure 9 (b): Arm Mechanism*

Computer vision is a field of artificial intelligence (AI) that trains computers to interpret and understand the real world. By using the digital images from Bobo's cameras, the robot can accurately identify and classify objects and react to what they see. Once the robot is in front of the target lift, it uses the LiDAR sensor to guide itself to directly face the button panel (BP). Then the robot uses its vision to do button panel recognition. If it is too far for the robot to press the target button it moves closer to the button panel. Robots move closer, and BP distance measurement and BP detection are looped until the robot is close enough to BP as seen in *Figure 10*. Then the robot's finger presses the target button.

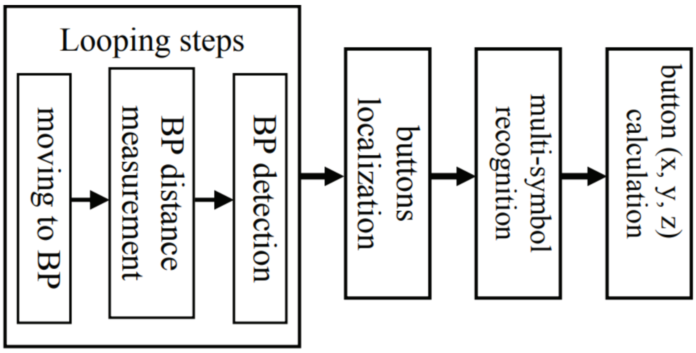


Figure 10: Detection, Recognition, and Localization for a specific button

Final Delivery

Once the robot goes up to the particular floor and comes out of the lift, it will proceed to locate the house by scanning and reading the house unit numbers via computer vision. To ensure that the robot is on the correct floor, the robot will have to scan the floor number on the wall near the lift. If it has arrived at the incorrect floor number, it can proceed to take another trip in the lift. The correct floor number can be compared with the incorrect floor number to determine whether it is higher or lower to press the button, “up” or “down” The customer would have already keyed in their address through the app during payment. Hence, this address will be stored in Bobo’s database and allow it to detect and locate the unit numbers as it moves across the corridors. In the unfortunate instance where the robot was to accidentally gets off the wrong floor and not be able to find the correct client and house, it can configure itself to go back to the first level of the flat and try again. Once it finds the house, a notification will be sent to the customer on the app stating that Bobo is waiting outside the house for the collection of the package. As stated previously, the customer will key in the code on the robot’s touchscreen keypad and the compartment associated with that code will open thus enabling the customer to collect their item (s). Once the collection is completed, the customer will be asked to close the compartment, and Bobo will proceed back to the van the same way it came to the house - through the elevator.

Automated Delivery Van

The primary purpose of this self-driven van is to carry the Bobo robots around their location. The target audience for this project is people in HDBs, condominiums, public parks, beaches, landed houses, etc.

Physical Design

These vans are Regular Bodies (RB) with low roofs. A Regular Body (RB) van can accommodate up to 6 robots. Here, the RB van dimensions are 269 cm in length and 175 cm in width, as seen in *Figure 11*. The robots can be arranged in three rows along the width (horizontally), in which each row will consist of two robots. Furthermore, these vans could be electrically powered where their operational time could be a maximum of 15 to 18 hours, similar to that of the robots. The colors chosen for this design are blue and white to synchronize with the Bobo robots.

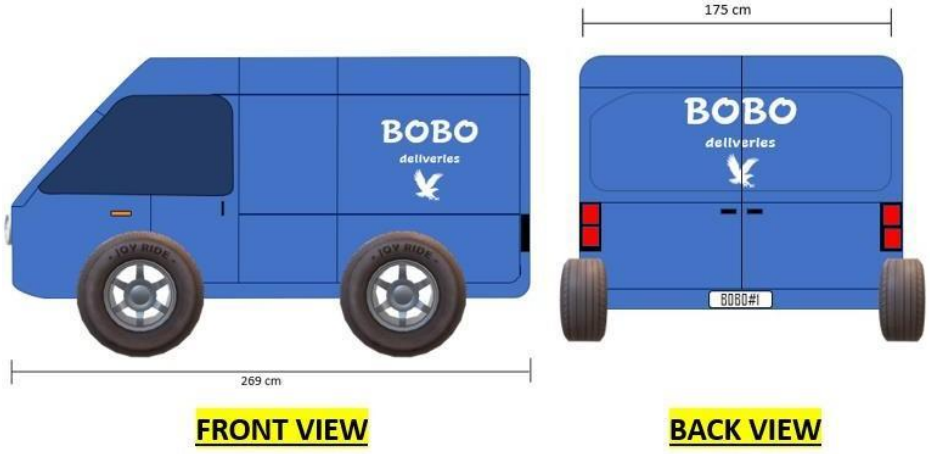


Figure 11: Design of Bobo Van

Van's Operation

Our autonomous vans operate with the help of two techniques/capabilities, namely Real-Time Kinematic (RTK) position and Advanced Driver Assistance System (ADAS). RTK enhances the accuracy of position data from the SiReNT and provides real-time corrections, and accuracies up to a centimeter. Moving on, the vans are equipped with an inbuilt Advanced Driver Assistance System (ADAS) whose sensors provide a 360-degree field of view of its surroundings. This allows the ADAS to process the information collated and react accordingly, whether to apply brakes to prevent a collision. With the help of GNSS active navigation software, vehicle data is transferred immediately to the Bobo Enterprise servers, to be aware of the whereabouts and specifications of the van.

When it comes to operations, these vans are equipped with self-sliding doors and self-moving platforms to enable the passage of the small Boots. These vans will be programmed to have certain pit stops, including the food collection spots. At these food collection spots; the robots are allowed to enter the van and to their designated spots inside the van. Once the robots are in their spots, their wheels are locked to prevent moving. Furthermore, upon collecting the robots at the food collection points, the vans are programmed to stop nearer to the deployment points in the assigned neighborhood. The wheels are now released. The sliding doors enable the robots to be able to alight. The van is programmed to wait until the robots arrive, in its designated parking spot closer to the robot trail. Whilst waiting, the vans can be configured to go into power-saving mode.

Every robot function to interact with the van regarding its coordinates, wirelessly with the help of an active Wi-Fi. Both autonomous platforms interact with one another regarding their coordinates. Once the position of the robot is closer to that of the van, the van can recover from its power-saving mode, and automatically open its sliding door and sliding platform to let the robot in. Here the robots are capable of reaching different timings. So, once all six Bobo robots' coordinates synchronize with the van's coordinates, the van can retract its sliding platforms, close its doors, and begin to depart back to its designated food collection point for the same routine. Once all the six Bobos have traveled back into the van, disinfectant sprayers are present on the top corners of the van that will disinfect the Bobos. The disinfectant being used is odorless and alcohol-free to prevent any damage to the robot's sensitive hardware such as the sensors. This feature has been added owing to the ongoing Covid-19 situation and also as a precaution to prevent the spread of germs.

Real-time Kinematic (RTK) positioning

Real-Time Kinematic positioning or RTK is a technique with which the accuracy of a GNSS receiver can be improved. This RTK is a technique of the Singapore Satellite Positioning Reference Network (SiReNT). GNSS receivers can be found in mobile phones where the accuracy has a two to four meter accuracy. In self-driven vehicles, the chance of two to four meter accuracy cannot be taken since there are higher possibilities of accidents in busy locations. With the help of RTK, a centimeter-level accuracy can be achieved. Two receivers play a major role in RTK where one is the Base Station (static) and a rover (dynamic). The Base station (SiReNT Reference station) consists of a GNSS receiver, and it is installed at a particular location. The location of this base station receiver is computed with the help of other precision measuring methods. Furthermore, the base station receiver transmits its location and correction data from the DGNSS, to the rover (Bobo Van). The rover, with the help of the information obtained from the base station receiver, excludes atmospheric errors from the calculation to obtain an estimate of its precise location. With the help of the base corrections and the RTK algorithms, the accurate location is calculated with centimeter tolerance.

Collision Avoidance with Advanced Driver Assistance System (ADAS)

One of the major ethical dilemmas faced when it comes to autonomous vehicles is the possibility of accidents. There are many roadkills despite being driven by humans, and driverless vehicles multiply the dilemma. To overcome that issue, the Bobo vans are being fitted with Advanced driver-assistance systems (ADAS). This system uses sensors such as radars or cameras to observe the environment and takes automatic action. On rare occasions, if the vehicle is drifting out of its lane, a lane departure warning is present to alert the Bobo enterprise, who can control the vehicle's path. The active safety system of the ADAS enables the vehicle to actively control braking and steering. This system has several useful functions depending on the environment, such as advanced cruise control where it can automatically accelerate or slow down, park the vehicle with the input of several sensors (Parking Assist), reduction of speed to avoid collision (Braking Assist), and blind-spot indication. The following *Figure 12* of the ADAS, shows a fusion of sensors to identify and process objects. With the help of the combined data collected from the cameras, LiDARs, Ultrasound sensors, and radars, the technology can respond faster than a human driver.

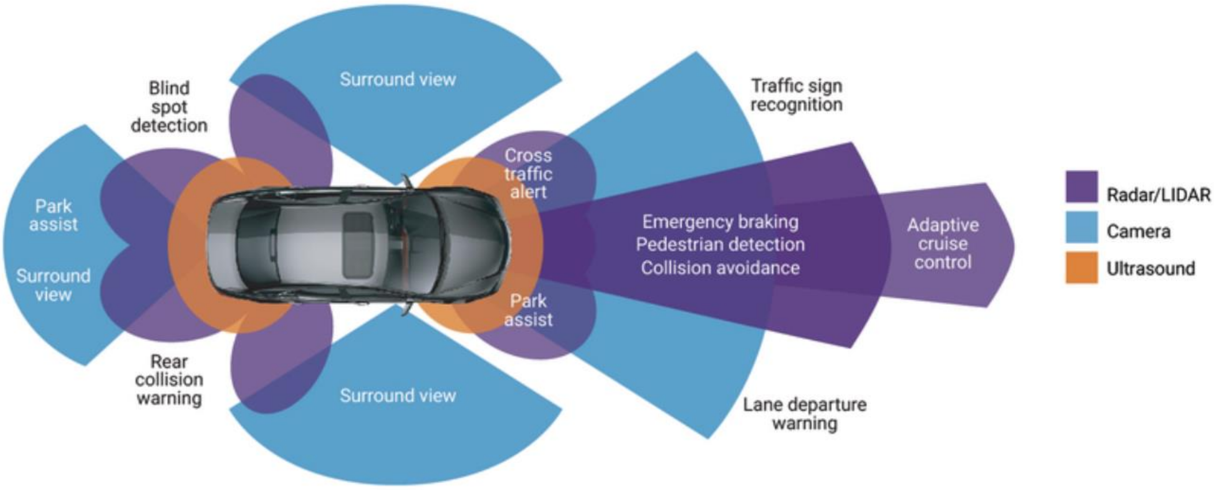


Figure 12: Advanced Driver Assistance System

Power saving mode

Nowadays we can see electric cars being plugged into power sources to charge them. At the sub-warehouses, power sources can be made available to plug the autonomous vans for charging purposes, by humans. Charging via power sources may not be ideal for autonomous vehicles. Electric cars only can warn the driver regarding battery drain-out conditions, and unlike conventional cars, they have a lesser range. In that case, an automatic power-saving mode can save the day. Instead of providing a warning, the model can be an adaptive design that can switch itself on automatically whenever the Bobo robots are out for delivery. This is to ensure that the vans do not have to face any battery drain-out conditions during the delivery process.

Last-Mile Delivery Process

Step 1: Order through the app

The user interface (UI) design of the Bobo app includes icons for the users to click based on what type of delivery they would like from registered patrons. If patrons are interested in using the Bobo delivery process to market their goods, they can directly contact Bobo Enterprises to be able to offer their products to customers. They can get groceries from supermarkets like Giant and NTUC, fresh seafood and vegetables from local farmer markets, and also food packages from food courts and restaurants. Customers who have limited mobility need not worry if they live in high-rise buildings, such as HDBs or condominiums, as the robot can come up directly to their flat using the elevator. In a country like Singapore where most estates are developed, and older estates are constantly being upgraded to be fitted with elevators and other functions to make them more user-friendly for the older generation, there is no worry for the elderly as well. The size of the icons in the app, theme, and color can be adjusted to fit the needs of users so that it is easier for them to navigate through the application without straining their eyes too much or having trouble making an order. For customers who will be using this service frequently and do not want the burden of having to key in their order and address details every time, there is the “Favorites” function, where they can save frequently bought products and served locations.

There is also the “Surprise me!” function that allows food to get randomized, which is great for hosting gatherings and caters to a younger audience who are more open to variety and trying out new options. For example, if a customer wishes to host a birthday party at East Coast Park, they can type in their location, then “Surprise me!” to get the app to show a bakery near the park. The customer then just has to type in the number of people that will attend the party (1-10 pax), then the app will automatically choose the food items like pastries and drinks that the Bobo robot can deliver to the location. This process can be tracked using the SIRENT technology consisting of the Global Navigational Positioning System (GNPS), as seen in *Figure 13* below.

The customer is allowed to choose a timeslot for their delivery. The app will organize the orders based on the delivery timing and the customer’s address.

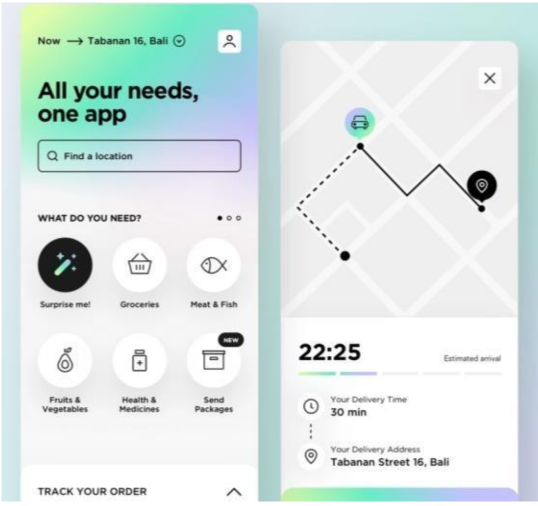


Figure 13: Bobo App

Step 2: Store gets notified and loads up the robot

Next, the store gets the notification of the order made by the customer above in Step 1, through the same app, but in the version meant for the store personnel. They will then proceed to either make the food or procure the groceries around their store. Along with the notification, a 5-digit number code will be sent to the personnel, and they will then enter the code onto the touch screen keypad. Based on the number of order items, the compartments will open, for the store personnel to load the food. If the compartment has been loaded with food and has been closed, it cannot be opened again until the customer keys in the code, at his location. This is to prevent the probability of the food or groceries getting tampered with.

Step 3: Food collection points for loading robot

Furthermore, there will be at least one collection point in the mall or food joints for the robots to collect food and beverages from the different restaurants. Personnel from the restaurants will be loading the products onto the different compartments in the robot, according to the customer. Once it is loaded the server will seal it with the code that was sent to the customer previously. Each compartment will have a different code for the customers so that the robot can handle multiple orders at once.

Step 4: Food Dispatch

Personnel from the food establishment will pack the food packages into the robots. The robots will board the van through the self-moving ramp. These robots have the capability of self-locking their wheels in order to prevent any sudden movement, which might result in food spillage within the robots and also cause damage to equipment. The vans then leave for their destination, the robot trail. Upon reaching the destination, the Bobo robots will alight from the van to reach their customer through the deployment points.

Step 5: Collection Process

The robot will arrive at the planned time at the collecting point. Customers will receive notifications via the Bobo application when the robot is on its way to its destination, as well as when it arrives. Customers may use the offered code to get their delivery from the robot. This guarantees that only authorized individuals have access to the robot's allocated container and its contents.

Difference between in-person delivery and autonomous delivery

For in-person delivery, the food or groceries get delivered directly by a human. For any problems faced during or after the delivery, the delivery person can be directly contacted to address the matters. For example, if the food delivery has been missing for a long time, the customer can always directly call the driver or delivery person to enquire about the food.

As for autonomous delivery, since it is all done digitally, human contact is minimized and done through technology. This technology includes delivery through self-automated vehicles, drones, and even robots, just like the idea displayed in this report. With autonomous delivery, labor expenses and the need for delivery riders will be less because this type of delivery will concentrate on delivering products to customers.

Limitations of the Bobo Project

1. **Limitation 1:** Touchscreens pose a risk to hygiene as multiple people touch them.

   Possible Solution: There are two solutions to tackle this limitation. One would be to install automated UV light cleaning equipment at the main hub where the vans and robots are stored and cleaned after their entire delivery. This way, the robots can automatically go through a conveyor belt fitted with this cleaning equipment and the touchscreens get cleansed. Another would be to employ a person to manually clean the vans and robots using a disinfecting cloth to clean the germs off the bodies and screens.

2. **Limitation 2:** While self-driving vans can reduce human effort and can cut down the amount of manpower required; they also pose a serious threat in terms of danger. Self-driving vehicles have not been approved for use in Singapore just yet due to a possible chance of accidents. The technology utilized in self-driving vehicles has not been fully developed too.

Possible Solution: Every transportation mode has its own set of risks. So, a proper and routine risk assessment is required. Having said this, as a safety precaution, Bobo enterprise can monitor and plan the safest routes for the robots. These employees can be notified if there is any malfunction with the Bobo vans or robots.

3. **Limitation 3:** The autonomous vans and Bobo Robots would communicate through a wireless network, tapping signals from the nearby signal tower, to share coordinates about the robot's whereabouts. In doing so, there is a higher possibility of hacking.

Possible Solution: As a solution, we could establish a wireless network with minimum risk, where there are strong firewalls to protect from such hacking. The communication between the robots and the vans will be under continuous surveillance by the Bobo Enterprise, to prevent such hacking or other viruses.

4. **Limitation 4:** Some of the target markets of the delivery system are people in public parks, attraction parks, and beaches. The team identified that the Bobo robots may not be able to climb stairs in old HDB housings.

Possible Solution: If the Bobo robots can be programmed to have computer vision to determine levels in a building and installed with the ability to scan and press buttons, the target market and locations of the delivery system can be directly expanded further to the market of people wanting to get goods delivered in commercial buildings, condominiums, and HDB housing.

5. **Limitation 5**: Although the entire process of using elevators and locating house unit numbers makes it easier for the customers to collect their packages, it is time-consuming and not a cost-effective solution. Moving through corridors to locate the house unit number will keep the customer waiting and the energy used by the robot will also be drained. If there are two more orders in different HDB blocks, in the same neighborhood, the robot needs to conserve its energy to successfully deliver all packages. Moreover, the cost to implement highly advanced computer vision techniques and the robot arm extension will be very expensive.

Possible Solution: An alternate solution would be to not implement computer vision or Bobo's arm. In this case, the robot will wait on the ground floor near the lift of the specific HDB block or Condo block and notify the customer 5 minutes in advance that they must come to the ground floor to collect their package.

Conclusion

In conclusion, Bobo Enterprise aims to reduce human effort and increase efficiency through the use of SiReNT, a state-of-the-art technology that is an infrastructure network launched by the Survey Services section of the Singapore Land Authority in 2006. It is a multi-purpose high precision positioning infrastructure that provides both post-process Differential Global Navigation Satellite System (DGNSS) services and Real-Time services. It will help to simplify the delivery of goods to certain groups of people, such as the elderly or disabled, who do not have much means for mobility. This is a growing concern, especially in countries like Singapore where the problem of having an aging population is of real concern. By making our application very user-friendly and simple, whilst making the delivery process smooth with the use of DGNSS, the above-mentioned group of people will be able to appreciate the Bobo delivery service. Our project allows customers to have deliveries at their preferred time regardless of circumstances such as a global pandemic, bad weather, and festive days where drivers may not be readily available. Therefore, this solution is seamless, innovative, and sustainable, meets the growing technological needs of Singapore, and is ready to bring a new perspective to the market of delivery services.

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