Product Test Review

FX - Functional eXperience test.

BellaBot Food Service Delivery Robot

A food service delivery robot for staff augmentation.
The vendor website can be found here.

Product Description

Updated May 2023

The BellaBot delivers on its promise of expediting food delivery and table clearing in a fun, engaging and highly functional design. Navigation and collision avoidance work flawlessly to ensure safe operation, while the bot workflow software enables intuitive service direction. BellaBot is a practical and pleasant addition to the team.

Target Market

The product targets the hospitality segment of the market:

1) Retirement Home market - operators can deploy BellaBots for staff augmentation, to supplement existing staffing levels for dining room, pub, and activity support, with food service delivery, bussing, and event service.

Test Results

Although delivery robots are just recently starting to appear in more substantial numbers in the Canadian market (you may have seen one in a sushi restaurant), they have been quite common in the US, and overseas in Chinese, Japanese, and some European markets for several years.

Pudu Robotics has been building and selling robots in China since 2016, so has a relatively long history of product development and real-world feedback that they've used to optimize robot performance, navigation, user interface, design, and usability.

Our testing was done in a senior living community over several weeks. We initially deployed one BellaBot, but a few weeks later added a second BellaBot for additional assistance. These BellaBots, when connected to WiFi, coordinate service support together across the dining area (area of interest).

Commercial Readiness

The BellaBot is a mature and fully functional product that we consider to be market ready. Additionally, the testing SPARC has done in the Canadian market to ensure the product works in harmony with our local norms made us more confident about suitability to our markets.

Local Canadian Market Testing & Support

The local supplier, SPARC Technologies (website here), based in St. Catharines, Ontario, tests each type of robot for 3-6 months in Canada to ensure the robot works as advertised, is adapted from the Chinese market to the Canadian market, and is as operationally tested. SPARC selectively deploys and tests certain robots, like the BellaBot, in their sister company's sushi & Thai restaurants which are full production environments.

We partnered with SPARC specifically because they are locally based, which is critical for implementation and ongoing support. They also have a restauranteur background, so they know what works well in production environments. We found them to be easy to work with, responsive, and willing to go the extra mile.

We believe there is strong product-market fit for Retirement Home operators looking for staff augmentation, improved food delivery capabilities, and improved resident satisfaction and staff retention.

Review Details

Packaging

The robot comes in its own cardboard box that was deliver by SPARC. They also unboxed the robot and set it up, as described below.

Design

In general, in the broad industry, food service robots come in 2 flavours: (1) those with animations ("faces") and (2) those without. The BellaBot comes with animations and resembles a cat in its appearance and expressions. Based on operations' team feedback, they preferred the BellaBot over alternatives.

Pudu Robotics (website here), the BellaBot manufacturer, calls this robot a "premium" delivery robot. We found the design to be pleasant, sleek and functional, and certainly nicer looking than other robots that are simply trays on wheels. We feel this design is well suited to restaurants and dining room environments where customers (residents) will see and interact with the robot.

According to the manufacturer, the robot torso can be branded using "skins" that can be ordered from the supplier, though this is not something we tested or tried. You can see various appearances and implementations of the BellaBot and other robots in this video (here).

Configuration & Setup

This was much more straight forward than we anticipated, and was completed by the supplier within a few hours for a sizeable main floor dining room space. The steps consist of determining (1) the destinations the robot will travel between (kitchen, servery, dish pit, tables, etc), and (2) moving the robot to each destination to "teach" it each location, along with placing reflective markers on the ceiling in select locations to assist with orientation. Let's review each of these in turn:

1) Determining destinations

The first decision operators need to make is to envision how the robot with help with delivery, and specifically whether delivery will be to table-side so that residents can self-serve their own plates from the trays (as is often done in sushi restaurants), or if the robot will stop at "depot" locations so that servers can retrieve the plates from the robot and deliver them the final few steps to the residents.

In our testing we chose to have the robot deliver to depot locations - essentially areas near a cluster of tables but not close enough for residents to be tempted to self-serve, since the desired outcome is to increase the time servers spend with residents and the quality of those interactions. Depot locations are chosen so that they are unobstructed, accessible to the robot, and in proximity to a good number of tables.

2) Teaching the robot the destinations

Once the destinations have been selected, the robot is wheeled (pushed) to each location, and the location is given a short name, like “D1” (Dining 1). If the ceiling is of regular height (8-10 ft), reflective dots are stuck on the ceiling, and the robot takes a picture of them. The robot has an upward facing camera to do this. It associates the sticker image with the location, which helps it reorient itself if it gets confused as to where it is. (This is akin to a waypoint, and is standard with these types of robots).

This process was repeated for each of our depot locations (~10-15), after which we tested that the robot would go to each location from a starting point (any other mapped location).

Note that for a la carte table-side service where the robot arrives to each table individually, each table would need to be mapped in a similar fashion as above. Typically this is not needed nor practical for senior living operators.

Overall Functionality

Delivery & Bussing Programming

The BellaBot is equipped with 4 fixed trays for carrying plates to locations. Each tray can hold up to 10 kg per manufacturer's specification, and we could fit 3-4 entrees on each.

Typical service starts in the servery, by loading plates onto the trays. Each tray can be associated with a depot location so that when the robot arrives at that location (say D1), the associated tray lights up to indicate which meals are destined for this location (the trays have blue led rim lighting). This can be skipped if all meals are the same for the entire dining room (e.g. soup, entrees, etc).

Associating trays to table destinations makes sense in restaurants (or a la carte service), where each tray has a 1-to-1 association to a table. We did a brief test of this functionality, just to see how it worked, but for senior living operators using depot locations, the association of tray to tables is 1-to-many, so this feature was not used.

In practice then, the server would load plates onto the trays, and send the robot to one or more depot locations by selecting them on the robot's touch screen. For example, a server could load all 4 trays with entrees, and select D1, D2, D3, and D4 (locations in the dining room). The robot would then proceed to each location in that sequence (if the sequence selected on the touch screen were D2, D1, D3, D4, then the robot would proceed to each location in *that* sequence). Once the robot arrives at each location, it pauses for offloading (familiar icons are used to represent robot states, like "||" for pause). When ready, a server can send the robot to the next destination by hitting the play icon on the touch screen or on the top back of the robot. Alternately, a new destination can be selected by cancelling that program and picking a new location.

Once all locations have been visited, the robot can be sent "home" to the servery or to another location.

Bussing dishes at the end of a service works in a similar fashion where the robot is sent to one or more locations to pick up/load empty dishes onto the trays, then sent to the dish pit to have them unloaded for washing. We chose to bus only at the end of a meal service so as to avoid cross-contamination (dirty to clean).

Cleaning

All parts of the robot's exterior can be wiped down using commercial cleaners, except for the touch screen for which a mild screen cleaner is recommended. Trays have removable rubber mats that can be sanitized using appropriate cleaners. The trays are fixed in place but can be wiped down using the same cleaners.

SPARC offers a quarterly deep cleaning service for a fee, which we did not try but it sounds like it would be a good idea, at least for the first year.

Stability & Smoothness

Of key importance to good food delivery is ensuring the food arrives as plated in the kitchen, meaning it hasn't been noticeably jostled on its way to the table. This requires the robot to be stable and smooth in its movements. The BellaBot has a self-levelling capability and an adjustable speed setting, with a "smooth" setting which could be used when delivering soup and other liquids. The smooth setting causes the speed of delivery to decrease, and makes the stopping more gradual. We played with the speed setting and found a happy mid point that balanced a good pace with minimal jiggle of the dishes, not using the smooth setting.

As part of the initial assessment for use at an operator's location, consideration has to be given to the floor types, and most importantly the transitions between them. The robot can run on tile, ceramic, hardwood, engineered floors, and short-hair carpets that might be found in dining rooms. If there are multiple floor types in a given area, the transition between them should be gradual and no more than 1/4" in difference, otherwise the ride could be a bumpy one and traction compromised.

Collision Avoidance

An important consideration is how well the robot can avoid or adjust to obstacles, so that no residents or staff are injured through collision. Most robots come equipped with sensors similar to those found on modern self-driving cars: cameras, lidar, and high power computer processing.

The BellaBot is no exception - it has forward facing cameras and sensors, and laser detection and ranging (the lidar), which it uses to assess its 3D environment and make collision avoidance decisions in real-time. The manufacturer calls this

functionality “SLAM”, which is an acronym for Simultaneous Localization and Mapping, using both cameras and laser.

In a practical test, we placed people and objects in the path of the BellaBot as it travelled between two locations, and it successfully navigated around these stationary obstacles at speed - in fact it did not appear to slow down at all.
If it was not able to navigate around an object, it would simply stop and wait for the object to move.

We also traversed the path of the robot while it was moving, causing it to stop momentarily before resuming it’s path when cleared. Overall we found the collision avoidance to work well and without incident.

Emergency Stop

Good news though, the robot has an emergency stop button that anyone can activate - just press the big red plunger button on top of the robot to halt it immediately. Note that this stops the robot on the spot, which may cause plates to move or resettle, and liquids to spill. Use only in emergency - we tested it and it works.

Animation & Personality

The BellaBot has an animated screen “face”, and raised “ears”, which give it a cat-like appearance. There are dozens of animations (the manufacturer calls these “Smart Expressions”) that the robot adopts when happy, delivering, and otherwise. We found these engaging and somewhat endearing. The manufacturer has also included some other fun features in keeping with the expressive nature of the BellaBot - for example if you tickle its “ears” it purrs and shows a happy face, but don’t do it excessively as then it gets mad.

A fun and engaging feature is the ability of the robot to sing Happy Birthday to residents, by uploading an audio file to its memory. In fact, it has a birthday mode, in which it can play any music uploaded to it, and deliver cake, etc, with the corresponding screen animations.

Residents for the most part responded positively to the appearance, animations, and personality of the BellaBot, which initially was perceived as a novelty, but soon was just “part of the team”.

Charging & Battery

The robot needs to be plugged in to charge, using an easy to access charging port on the side of its body, and a laptop-like charger. We chose to charge it in an office near the dining room, and set up a map location near there, which we sent it to at the end of dining service. Charging took about 3-4 hours, though typically we were not starting from a completely empty battery. Our process was to leave it charging overnight in the office. A battery charge indicator gives a visual representation of the charge level.

The battery can be easily removed and charged separated from the body of the robot.

The robot does not come with a docking station, meaning a charging dock that it can navigate to on its own and initiate charging, which we felt would have been an interesting option, though it does need to installed in one spot.

Recommendation: Make a charging dock available as an option, so that the robot can charge autonomously when not working.

Videos

Pudu Robotics has a fairly extensive YouTube channel here, with product overview videos and one showing a brief factory tour (here).

Analytics

Analytics are available through a mobile app ("PUDU Link"), which provides both tabular and graphical representations of some of the basic data the robot tracks, such as working hours, distance, and tasks. These are compared against a previous timeframe graphically. Data from multiple robots is displayed in different colours. Statistics are shown for the various modalities of use: deliver, cruise, guiding (host), and interaction.

Data can be shown for preset timeframes of yesterday, last 7 days, last 30 days, or a selectable range for up to 12 months.

There is a data export feature, where a timeframe range is selected, and the report sent to the email specified.

The resulting report is sent as an Excel spreadsheet. The data contained shows the summaries for the period selected, e.g. total hours worked, etc. This really isn't useful for any post processing or further analytics, or even to recreate the visuals shown in the mobile app. This mobile app feels like they met the low bar of minimal information, but it can hardly be deemed analytics, certainly not from an enterprise perspective.

Recommendation: If Pudu is serious about providing any analytics to enterprise clients, it needs to do so through a robust web app that allows for filtering, some slicing, and exporting of granular data.

Other Use Cases

The principle use case we have examined was staff augmentation for dining room service. For many senior living operators this occurs twice per day, lasting 2-3 hours each, so there are several hours of opportunity time for the BellaBot to be useful in other ways, especially since a battery charge lasts 12+ hours.

Other uses of the robot (see video here) include serving snacks or drinks during activities, using its "cruise" mode. In this mode it follows a pre-set path, stopping at certain locations for residents to serve themselves, before continuing. This type of service can be useful during activities in areas other than the dining room (note that each of these areas would also need to be mapped to set them up).

Purchase Options

Purchasing is available through SPARC and includes set up and some support.

Nominal pricing for a BellaBot at the time of our testing was around $24,000 CAD. This is a good budgetary number for operators to consider, and can be recouped in a matter of months, depending on how much the BellaBot is used.

We found SPARC to be very helpful and responsive during our initial discussions and throughout the set up and operations stages, occasionally dropping by to to see how the robot was performing and to speak with the local team.

Feel free to reach out to us at info@agetechlabs.ca.