Smart Robotics Solutions for a Multi-Branch Bank

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Introduction

Banks with high customer volumes face recurring challenges such as long queues, inefficient customer redirection, and staff overload. These problems are amplified in high-traffic branches such as airport locations and remain present, albeit at a smaller scale, in suburban and rural branches.

This project proposes a Smart Robotics Customer Guidance System designed to automate customer flow management using autonomous mobile robots. The system integrates a ticketing mechanism, autonomous navigation, and service-specific guidance, reducing human workload while improving customer experience.

The solution is tailored for multi-branch deployment, with scalability for high-traffic environments through the use of multiple cooperative robots operating simultaneously.

System Overview

The developed system focuses on customer guidance rather than transaction execution, ensuring simplicity, safety, and reliability. Once a customer receives a ticket, a robot autonomously escorts them from the waiting area to the appropriate service point.

Targeted Services

- ATM Services
- New Customer Registration

- Problems & Enquiries
- VIP Customers
- Loan Services

Each service is assigned a predefined destination along a shared navigation path.

Core Objectives

- Reduce queue congestion
- Automate repetitive customer guidance tasks
- Improve accessibility and clarity for customers
- Support high-traffic branch operations

Robot Specifications

The **Bella service robot** from Quill was used to simulate real-world navigation and mapping (Quill, 2026).

Key Specifications

- **Navigation:** Autonomous SLAM-based navigation
- **Sensors:** LiDAR, depth sensors, obstacle detection
- **Speed:** Medium operational speed for safe obstacle avoidance
- **Control System:** Predefined waypoint navigation with dynamic obstacle handling
- **Interface:** Visual and audio interaction (ticket number calling)

Figure 1: Quill Bella Robot

Safety Measures

- Virtual borders around service offices
- Collision avoidance through sensor fusion
- Controlled speed to ensure customer safety

System Architecture and Flowcharts

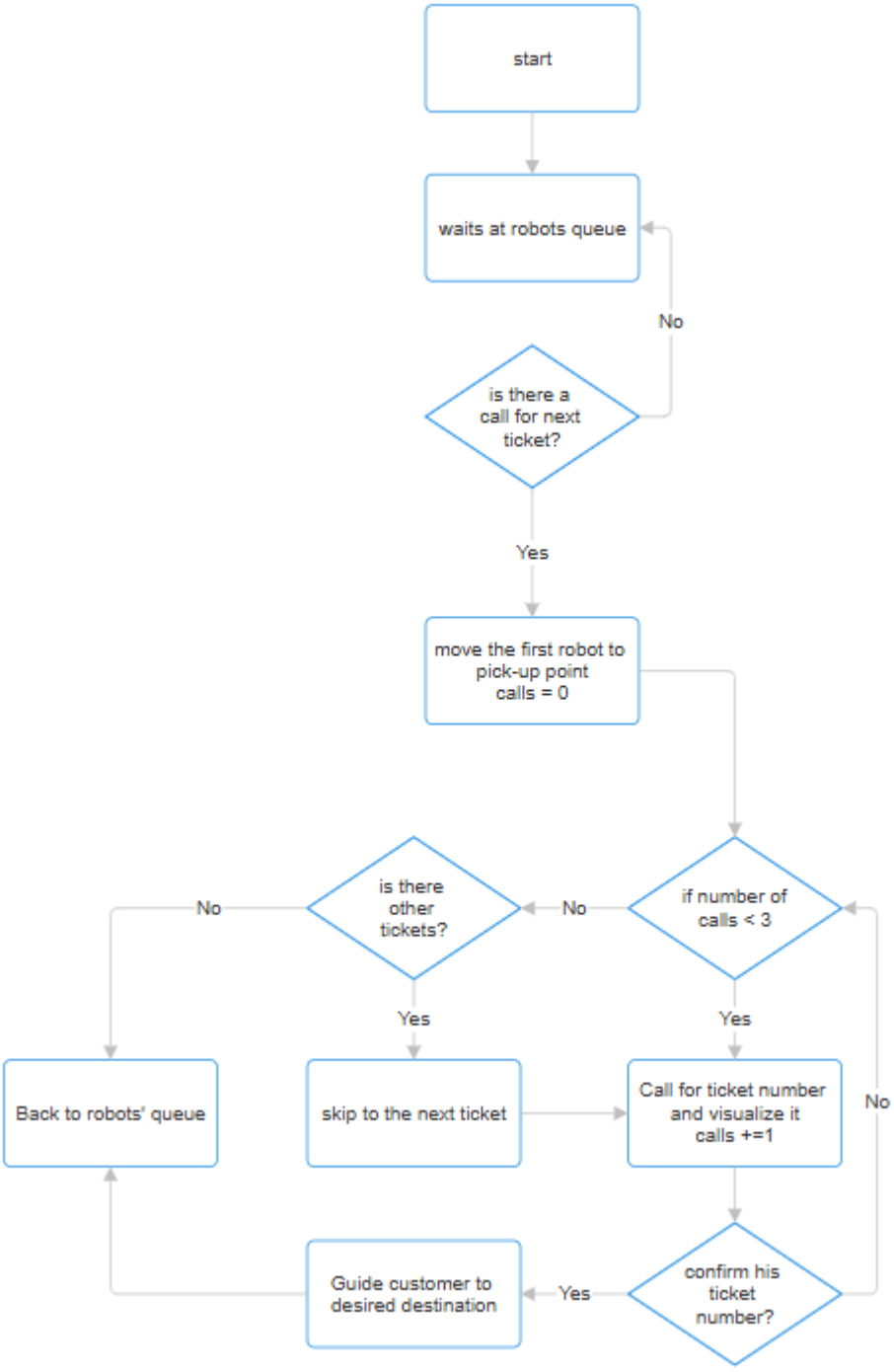

Figure 2: flowchart of the system operation (Adapted from smartdraw, 2026)

System components

The system consists of:

1. Ticketing System
2. Robot Fleet Manager
3. Navigation & Mapping Module
4. Obstacle Avoidance System
5. Service Point Database

Operational Flow

1. Customer takes a ticket and waits in waiting area
2. When the service office is available, they request the next customer
3. Robot calls the ticket number
4. If the robot calls the ticket number three times and got no matching with the ticket, it skips to the next ticket, if there is no next ticket, it returns to the robots' queue
5. Customer approaches robot
6. Robot escorts customer to the assigned service on the ticket
7. Robot continues along the predefined route
8. Robot returns to the pickup queue

Navigation Logic

- All robots follow a the shortest looped path, if there is collision with another robot, it waits until the other robot crosses the collision point
- Service destinations are fixed points for each path
- Robots complete the full rotation before returning
- Multiple robots operate concurrently to handle high traffic

This approach ensures predictable behavior, reduces navigation conflicts, and simplifies system scaling.

Working Scenarios and Branch Integration

Airport Branch (High-Traffic, Multilingual)

- Multiple robots deployed simultaneously
- High-frequency ticket calling
- Fast customer turnover
- Reduced dependency on human staff
- Clear visual guidance for travelers under time pressure

Suburban / Rural Branch

- Fewer robots required
- Slower interaction pace
- Robots act as both guides and information points

- Improved service consistency despite lower staffing levels

Integration with Bank Systems

- Ticketing system synchronization
- Potential integration with CRM systems
- Real-time service availability updates
- Analytics for peak-hour optimization

Challenges and Solutions

There are some challenges that exist in most of the current banks that can be addressed via the system we introduced, the following table demonstrates the challenges and the solution for each of them.

Table 1: Challenges and Solutions

Challenges	Solutions
High customer density	**Multi-robot deployment**
Collision risk	**Virtual borders + obstacle avoidance**
Navigation complexity	**Fixed-loop path planning**
Customer confusion	**Ticket number calling + visual cues**

Conclusion

This project demonstrates how smart robotics can be effectively applied to banking environments to enhance customer experience and operational efficiency. By focusing on autonomous customer guidance, the system avoids unnecessary complexity while delivering tangible value.

The use of the Bella robot validated the feasibility of real-world deployment, especially in high-traffic branches such as airports. The modular design allows easy adaptation across different branch sizes and traffic conditions.

Future improvements may include voice-based multilingual interaction, AI-based service prediction, and tighter integration with banking information systems.

References

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