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QR Based Ship Remote Monitoring Algorithm

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Abstract
daily ship data and real time value of marine vessel

1. Introduction: The Need for Real-Time, Reliable Data

Modern maritime operations demand **precision, accountability, and real-time insight**. Traditional manual logging, often performed on paper or static computer terminals, is prone to human error, delays, and inconsistencies. This paper outlines a proposed **QR and Barcode-Based Ship Analysis and Reporting System** designed to solve these issues. By utilizing standard mobile phones in a controlled environment and strategically placed QR codes, the system ensures data is collected accurately, linked to a specific location and time, and instantly synchronized once connectivity is established.

2. System Architecture and Components

The system is designed around a core principle: **collect data offline, validate it, and synchronize it securely.**

2.1. Required System Components

- **Mobile Phone:** Standard mobile device running a proprietary application. Crucially, the phone operates in **Flight Mode** to ensure data integrity during collection, preventing external interference (calls/messages) and ensuring the app's internal clock is the primary time source.
- **In-built Software:** A custom application capable of scanning QR/Barcodes, storing input data against predefined parameters, and managing the synchronization queue.
- **Printer:** A dedicated printer (onboard or shore-based) for generating and printing unique Barcodes or QR codes for specific machines, locations, or tasks.
- **Data Server (Shore-based):** The central repository for all data. This server handles authentication, synchronization, data analysis, and stores the **Overriding Authority** parameters.

2.2. Parameter Storage and Synchronization

- **Offline Storage:** All collected data (scanned code, entered value, **date/time stamp**) is stored locally on the mobile device while in Flight Mode.
- **Synchronization:** Upon switching **Flight Mode Off** and connecting to Wi-Fi/cellular, the app automatically:
  . **Synchronizes** the local date and time with a central time server.
  . **Uploads** the stored, time-stamped parameter readings to the shore-based server.
- **Security Principle (Data Integrity):** Once a value is saved (stored locally), it **cannot be changed** by the onboard user. Any required correction or override must be executed by the **Shore-Based Team** (Overriding Authority) on the central server.

3. Operational Workflow: Data Collection

The strength of this system is its simplicity and reliability based on physical location verification.

1. **Location/Task Identification:** A unique **QR Code or Barcode** is affixed near every machine, device, tank, or location that requires monitoring (e.g., Main Engine Unit 5, Cargo Tank 3 Vent, Bridge Entrance).
2. **Scanning:** The User (Ship Officer/Crew) initiates the app, scans the code using the mobile phone.
3. **Data Prompt:** The software immediately identifies the associated parameter based on the scanned code (e.g., SCV Temp of ME Unit 5, or 'Handing Over' task).
4. **Data Entry:** The user is prompted to **type the desired value** (e.g., the temperature reading).
5. **Time Stamp and Store:** The system automatically saves the following record locally:
   - **Scanned Code ID** (Machine/Location)
   - **Entered Value** (Parameter Reading)
   - **User ID** (Logged-in Officer/Crew)
   - **Date and Time** (Generated internally, to be synced later)

4. Real-Time Applications and Monitoring

The data collected provides unparalleled **real-time insight** into critical ship operations:

4.1. Core Operational Data

Application	Parameters Monitored	Insight Provided
Cargo Ullaging	Ullage, Temperature, Tank Status	Loading/Discharging accuracy and safety.
Bunkering	Ullage, Sounding, Tank Used, Temperature	Accurate recording of received fuel quantity and quality.
Ballasting	Pump Running Hours, Time/Location of operation	Compliance with Ballast Water Management Plan.
Watchkeeping	Noon Report parameters, Watch-round data, Handover/Takeover data (Bridge/ECR)	Verification of essential checks and accountability during shift change.

4.2. Crew Management and Safety

- **Real-time Duty Officer Position:** Scanning a code upon entering/exiting a location (Bridge, ECR, etc.) provides a real-time log of the duty officer's whereabouts every hour, enhancing situational awareness.
- **Rest Hour Monitoring:** Scanning a unique code upon **starting work** and a **separate cabin QR code** upon **entering for rest** provides an accurate, verifiable log for rest hour compliance, mitigating fatigue risks.

4.3. Predictive Analysis and Performance Interpretation

The system's true power lies in the interpretation of running hours and combined data:

Collected Data	Interpretation Example	Performance/Issue Identified
Compressor Running Hrs: 22 hrs/day	**22 hours** running is excessive.	**Air leakage** in the system identified.
2 Auxiliary Engines (AE) Running at Mid-Sea	Typically, only one AE should suffice.	**Low performance/inefficiency** of one or both AEs.
Excess Power Generated by Main Engine (ME)	High power needed to maintain speed.	**Fouling** on the hull or propeller issue.
Excessive Number of 'Kick' Maneuvers	High rudder/engine actions during berthing.	**Poor maneuvering** by the pilot or master.
Comparison of IG Data (ECR vs. Bridge)	Difference in O_2 content or pressure readings.	Sensor error or calibration required.

5. Security and Authentication (Algorithm Design)

Security is paramount to ensure data reliability and prevent unauthorized changes.

5.1. User Authentication and Roles

- **User Group:** All Ship Officers and Crew.
- **Onboard Initial Authentication:** Software is authenticated and configured by the **Chief Engineer (CE)** or **Master**.
- **Crew Login:** Once a crew member logs in, their actions are authenticated and monitored by the **Shore Superintendent**.

5.2. Control and Override Authority

- **Shore Superintendent:** Has **Major Authentication** for the entire system, controlling user access and data validation parameters.
- **Overriding Authority:** Exclusively held by the **Shore-Based Team**. They can correct or modify values only on the central server, maintaining an immutable audit trail of the original reading and the override.

5.3. QR/Barcode Management

To prevent proliferation of unauthorized codes:

- The system restricts onboard users from generating new codes.
- The **Master** is the sole person authorized to print and deploy new physical Barcodes/QR codes onboard, ensuring control over new data entry points.
- The shore-based Superintendent can **limit the scanning** rights of specific users.

6. Conclusion

The implementation of a **QR/Barcode-Based Ship Analysis Report System** represents a vital step toward digitizing ship operations. By ensuring data integrity through offline collection and non-editable parameters, and by leveraging simple QR code scanning for location-based logging, the system provides both **operational efficiency** and **unprecedented performance diagnostics**. This transition from reactive reporting to **proactive, data-driven management** is essential for the future of safe and profitable shipping.