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Research Article

Maintenance and Repair of BMV Brand Patient Monitor Equipment, Type BMO-200 at STIKES Semarang

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Abstract: This research aims to carry out maintenance, and repair, on the BMV BMO 200 Patient Monitor used at STIKES Semarang. This device is vital in monitoring patients' physiological conditions such as heart rate, blood pressure, body temperature, and oxygen saturation. The identified issue was a blurry LCD screen caused by aged backlight components. The study employed a hands-on approach and direct observation. The stages included damage analysis, replacement of the backlight and polarizer components, and calibration using a fluke meter and voltage measurement. The repair results showed that replacing the entire LCD module restored a clear display and returned the device to proper working condition. This research highlights the importance of regular maintenance and calibration in ensuring the reliability of medical equipment for patients.

Keywords: BMV BMO 200; Maintenance; Patient Monitor; Repair.

1. Introduction

The development of science and technology in all fields, including healthcare, has resulted in medical equipment with numerous functions and sophisticated specifications to support the diagnosis and monitoring of patient conditions (Syifak Zahirzan Sigit, 2018). One of the most important medical devices in medical services is the Patient Monitor. The Patient Monitor functions to monitor blood pressure, heart rate, temperature, respiration, and oxygen saturation in real time (Dody Wahyudi et al., 2024). The accuracy and reliability of this device are crucial, so medical devices must function properly and comply with service standards, general requirements, quality, safety, benefits, security, and suitability for use (Fitria et al., 2023).

During use, Patient Monitors require regular maintenance and testing to ensure they operate according to established specifications. Medical device maintenance is the activity of maintaining the condition of medical devices to ensure they meet quality, safety, efficacy, and usability requirements, while preventing damage that could disrupt their function (Syifak Zahirzan 2018).

In reality, many healthcare facilities still do not carry out optimal maintenance and repairs, either due to a shortage of technical personnel or a lack of awareness regarding medical equipment maintenance and repair. This can lead to errors in patient care. Therefore, understanding the standard procedures for maintaining and repairing patient monitors is crucial for improving the quality of healthcare services and patient safety.Hotromasari et al., 2025).

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Figure 1. BMV BMO-200 Patient Monitor Tool

The image above is a Patient Monitor brand BMV BMO-200, before we make repairs, it is a good idea to know the specifications of the device, including:

Name	: Patient Monitor
Brand	:BMV
Type/Model	:BMO-200
Power supply	:A 45W Output 15V, 3A
Battery	:Li-ion (14.8V×2.2Ah)
Display	:0.5 to 35 HZ
Artificial	:China
Size	:12 inches

1.1 Patient Monitor Function

The function of a Patient Monitor is to monitor blood pressure, heart rate, temperature, respiration, and oxygen saturation in real time (Dody Wahyudi et al., 2024). The accuracy and reliability of this device are crucial, so medical devices must function properly and meet service standards, general requirements, quality, safety, benefits, and suitability for use (Fitria et al., 2023).

1.2 How Patient Monitors Work

A patient monitor is a medical device that monitors a patient's physiological condition, including heart rate, blood pressure, body temperature, SpO2, and respiratory rate. This monitoring process is carried out continuously, allowing for real-time information on the patient's condition. Patient monitors are also equipped with alarm features, making it easier for medical personnel to monitor patients for any deterioration or abnormalities in vital signs. Other features include an internal rechargeable battery (usually lasting 2-3 hours), USB and RS232 ports for communication and data export, and internal memory for storing patient data (Shabot et al., 1994).

This device works by attaching sensors to the patient's body according to the parameters to be monitored. The sensors capture physiological signals (e.g., heart rate via ECG). The data is then converted by an internal electronic system into numerical or graphical information. The results are then displayed on the screen in the form of numbers and curves. An alarm is activated if there is a deviation from the normal threshold. (Shabot et al., 1994).

2. Repair Method

Equipment maintenance includes all actions performed on the object being maintained, such as the BMV BMO 200 patient monitor. There are two types of maintenance: planned and unplanned. Routine activities include repair and maintenance. The work steps to be taken are as follows:

- Provide toolbox and measuring tools to carry out the dismantling and checking process.
- Identify and repair damage that occurs to patient monitors, such as problems with sensors, cables, or other internal components.
- The next step after repairs is to carry out a functional test of the tool. Perform functional tests on important parameters such as blood pressure, oxygen saturation, and temperature to ensure accuracy.
- Compile a report containing research on improvements to the BMV BMO-200 brand Patient Monitor.

2.1 Repair Flowchart

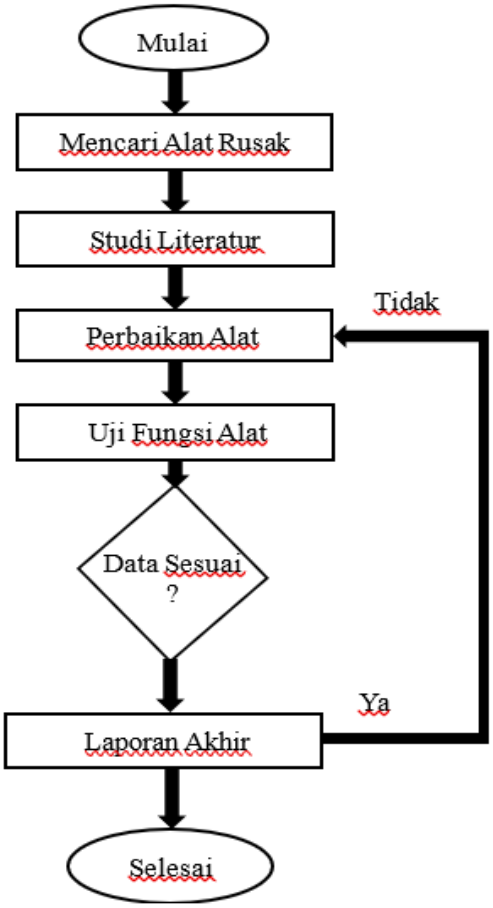

Figure 2. BMV brand Patient Monitor device

2.2 Damage Analysis

The data testing and analysis stage is the most crucial step in any research. This is because data testing and analysis serve to draw conclusions from the research results. Data testing and analysis can be conducted through the following stages:

- Analyze damage to the tool according to the procedure or manual book.
- Perform repairs and clean dirty components, such as the filter on the NIBP or the SPO2 sensor.
- Perform a complete functional test of the tool to ensure that the repair results are correct and the tool can be used properly.

After the maintenance process, the patient monitor was found to be clean, with all cables and sensors in good condition. No physical damage or dust buildup was found on the ventilation system. Tests of basic functions, such as buttons, alarms, and menu displays, indicated the device was responsive and functioning properly. This maintenance also helped identify any preventable damage early, before it escalated to more serious problems..

Based on the damage that has been further analyzed by the author, the author found damage when the device was connected to the PLN network and the ON button was pressed, spots or noise were visible on the LCD screen display, this was caused by the age of the backlight glass mica being used for too long.

Figure 3. Noise on the LCD layer

The image above shows damage that has been further analyzed by the author. The author found damage when the device was connected to the PLN network and the ON button was pressed, spots or noise were visible on the LCD screen. This was caused by the age of the backlight glass mica being used for too long.

3. Results and Discussion

The following are the results of the analysis and repair of the BMV brand Patient Monitor type BMO-200 which was carried out based on the damage analysis which suggested replacing the LCD layer on the damaged device according to the type of BMV BMO-200 LCD.

3.1 Replacement of LCD on Patient Monitor

The initial step in repairing a BMV BMO-200 monitor experiencing noise or spots on the LCD screen to ensure safety is to turn off the power and unplug the power cord from the PLN source. The monitor unit casing is opened using a suitable screwdriver carefully so as not to damage the internal components. After the casing is opened, an initial inspection is carried out on the power supply system using a multimeter to ensure the output voltage is according to specifications, such as 5V, 12V, or 24V DC, and to detect any ripple voltage which is usually caused by a weakened filter elco. If a damaged elco is found, it is immediately replaced with a new capacitor that has the same value and working voltage. Next, the LCD flexible cable is carefully removed, cleaned using isopropyl alcohol or contact cleaner, then reinstalled by ensuring tight and secure connections. The inspection is then continued on the inverter or LCD backlight circuit to ensure stable voltage output and normal backlight function. If the inverter is damaged, the component must be replaced immediately.

If noise or spots on the screen persist after all these steps, then the damage is most likely to the polarizer or LCD module. The polarizer is a film layer on the LCD that functions to filter light and affect image clarity. If the polarizer is damaged or worn, it is replaced with a new polarizer layer using a special liquid or heater (heat gun), and the new polarizer is installed precisely so that the polarizer angle is correct. If the damage to the LCD driver IC or LCD module cannot be repaired, then the final step is to replace the entire LCD module with a new one that is compatible with the monitor patient. This new LCD replacement must be done by matching the code according to the manufacturer. After all repair steps are completed, the monitor casing is neatly reassembled, the cable connections are checked for security, and the monitor is turned on to ensure the screen display is normal without noise or spots.

Finally, re-measurements were performed on the BMV BMO-200 patient monitor. These measurements were taken to confirm the improvements made. Furthermore, the overall functionality of the patient monitor was tested to ensure optimal performance and safety in monitoring patient conditions.

3.2 Functional Test Results

Functional test results are the stage after the device repairs are complete. In this stage, the author conducted a functional test of the device using a patient monitor as follows:

Table 1. ECG Parameter Function Test

Parameter	Standard Settings	Measurable	Tolerance
ECG	30	30	10%
	60	60	
	80	80	
	100	100	
	120	120	
	160	160	
	180,	180	

4. Conclusion and Suggestions

Based on the results of the research that has been carried out, the author draws the following conclusions:

- The repair process is carried out by replacing these components until finally replacing the entire LCD module, which successfully restores the visual function of the device to its original state..
- Voltage testing and function testing show that the power supply system and the device's sensors are still in good condition and comply with technical standards..
- Carrying out routine maintenance has proven to be important for maintaining cleanliness, safety, and readiness of equipment in monitoring patient conditions..
- Calibration also plays a significant role in ensuring the accuracy of each parameter measured by the device. Therefore, a combination of regular maintenance, proper repair, and regular calibration is crucial in supporting the reliability of medical devices, ensuring patient safety and improving the quality of healthcare services.

4.1 Suggestion

The creation of this scientific work is not yet perfect and has several shortcomings, so the following suggestions will be provided.

- Educational institutions or health services need to schedule regular maintenance activities, both daily and quarterly, to prevent premature damage to patient monitor equipment and ensure that the equipment is always in good condition and ready to use..
- Calibration of the equipment must be carried out routinely at least once a year, in accordance with KAN and ISO/IEC 17025:2005 standards, in order to maintain the accuracy of patient vital parameter measurements and to meet accreditation requirements..
- Institutions should have complete documentation regarding the history of maintenance, repair, and calibration of equipment.

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