



IoT BASED SALINE LEVEL MONITORING SYSTEM

Ashwini R¹, Rithika R², Rosy S³, Sangavi R⁴, Vijayalakshmi R⁵

**Assistant Professor, Department of C.S.E, Jansons Institute of Technology,
Coimbatore, India¹**

**UG Students, Department of C.S.E, Jansons Institute of Technology,
Coimbatore, India²⁻⁵**

ABSTRACT

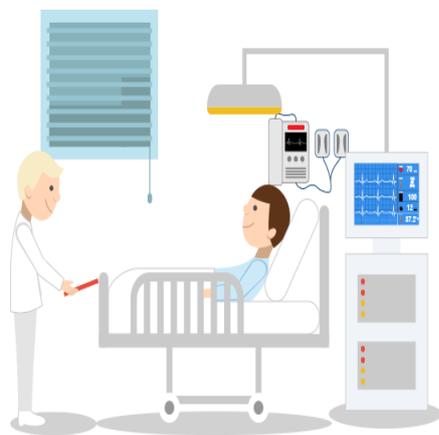
There are many cases where patients are being harmed due to the staff inattentiveness, as their absence does not notice the completion of saline level in the container. The E- saline Bottle monitoring system is used to monitor the level of the saline in the bottle to reduce the risk of patients. It is mainly useful for the doctors and nurses to monitor the saline bottle of the patient in the situation of airborne disease. Here the Saline bottle is monitored using IOT devices. If any large deviation happens from the normal condition, an automated alarm system will be assigned to the doctor about the patient condition. A prescription reminder order is added in our android app to notify the patient to take the prescribed medicine by the doctor at proper time. In case of emergency patient can also call the nurse and there is a control given to the patients to change the bed position according to their comfort. The level of saline injected to the patient is monitored in to inform the nurse at the time of being finished. The microcontroller system is used for monitoring the saline flow rate automatically. A wireless message is sent to the nurses or doctors' computer and display the results in the form of saline droplet rate and the number of droplets coming from saline bottle, saline solution that is given to the patient in the form of ml and remaining time to empty the saline bottle with the help of serial port test software. This system is remunerative, loyal, and comfortable for nurses. The system can be reused for the next time saline bottle. It is helpful for both nurses and doctors in rural hospitals. It helps the nurses to monitor the saline level easily from distance. It mainly helps the nurses at night time as there is no need to go to the patient's bed to check the saline level in the bottle.

INTRODUCTION

Overview

Patient monitoring systems are any set of systems and/or processes that enable healthcare providers to monitor a patient's health. During treatment, it is highly imperative to continuously monitor the vital physiological signs of the patient. Patients most frequently face this problem in the hospitals. This may even lead to patient's death. So to overcome this problem there is a necessity to develop saline level monitoring system which reduces the dependency of patient on nurses.

Patient monitoring systems hold an important position in patient care. The consistent developments in technology not only help us in transmitting the crucial physiological signs to healthcare workers and also simplifies the measurement and therefore results in raising the monitoring efficiency of patients.



Patient Monitoring

Medical treatments delivered in the intensive care unit make it necessary for constant monitoring of patients. For constant observation of the patient, patient monitoring systems provide continuous visibility of the subject's physiological condition and provide immediate treatment whenever required. It is possible to monitor the vital signs of patients remotely using

a wireless health monitoring system or patient monitoring system. As a result of the use of telecommunication devices in healthcare, doctors are able to monitor multiple patients at the same time with ease. So, they can keep an eye on patients virtually, whether in the hospital or at home. Heart rate, body temperature, ECG, respiratory rate, non-invasive blood pressure, and oxygen saturation are just a few of the vital signs monitored by the devices. Due to the widespread use of wireless health monitoring, geographic obstacles to expert treatment have been removed. Using wireless health monitors, medical professionals may get crucial physiological indicators while simplifying measurements and increasing patient monitoring efficiency.

While measuring time is reduced, it also assists in receiving care at the optimal moment in emergency circumstances, which can lead to improved treatment outcomes. During treatment, it is vital to keep track of the patient's health at all times.

Objective of the Project

In the past decades, the requirement in the health care field is rising rapidly and therefore we need well equipped efficient monitoring systems for health care centres. Primary object of the present invention and project is to provide a method and wireless device for health and saline monitoring system. The aim of this project is to develop cost effective and standalone wireless sensor node which monitors saline levels and alerts doctors/nurses in hospital by sending warning messages wirelessly using various wireless technologies. The project focuses on making Plug and play system which is ready to be installed and integrated with hospitals. Project also develops heart rate and temperature

monitoring sensor node which can send these two vital parameters to doctors and nurses. Wireless sensor node developed here is standalone to be installed in the hospital. Multiple such nodes can be given to each patient who can monitor all patient's saline levels and keep informing nurses about it, thus forming a wireless sensor network. System developed here also has estimation property that is it can estimate when saline bottle is going to get empty and notify user about it.

- To acquire physiological data frequently or continuously, such as blood pressure readings
- To communicate information from data-producing systems to remote locations (e.g., laboratory and radiology departments)
- To store, organize, and report data
- To integrate and correlate data from multiple sources
- To provide clinical alerts and advisories based on multiple sources of data
- To function as a decision-making tool that health professionals may use in planning
- the care of critically ill patients
- To measure the severity of illness for patient classification purposes
- To analyse the outcomes of ICU care in terms of clinical effectiveness and cost

Effectiveness

Problems Statement

As the world population increases, the need for health care services also enhances. However, the care people with adequate skill in the hospital are not sufficient. Since medical technology has been

improved significantly during the past few decades, a number of health monitoring systems have been developed.

Intravenous infusion is one of the most important clinical treatments. The progress and flow rate of intravenous infusion must be strictly controlled to avoid serious medical accidents. Therefore, when normal saline is placed intravenously into any patient, the saline level must be constantly monitored by nurses or patient's relatives. If there is no change of a new saline bottle as soon as it is totally consumed, the blood from vein will move back into the saline bottle due to the difference between the pressure inside the empty saline bottle and the blood pressure. This may cause tiredness from lack of red blood cells (RBCs) in the patient's blood. Fortunately, some specialized medical devices such as infusion pump can solve these problems. The infusion pump is capable of controlling the flow rate of the infusion fluid, and cutting down infusion tube in case of reflux. Almost in all of the hospital, a nurse or caretaker is responsible for monitoring the saline level continuously without any interruptions. Due to the negligence and inattentiveness towards saline completion by doctors, nurses or caretaker of the patients and lack of nurses with sufficient skills in hospitals and their excessive workload, a huge number of patients are dying and are being harmed in the hospitals. Hence to prevent the patient from getting harmed and protect their lives during saline feeding period, the saline level monitoring system have been developed. However, the infusion pump is quite expensive so the large-scale applications are limited. Also, it is not able to display the current saline volume on the screen and it cannot send the notification to the medical staffs personally through Wirelessly. Hence to

protect the patient from getting harmed an IoT based saline level monitoring system has been

LITERATURE SURVEY

Yajing Zhou, Yuemin Zheng, Jin Tao, Mingwei Sun, Qinglin Sun, Matthias Dehmer and Zengqiang Chen, Servo Health Monitoring Based on Feature Learning via Deep Neural Network. This presents a feature learning-based health monitoring method using a deep neural network. Firstly, we combine the wavelet packet decomposition and support vector machine to synthesize the sample segment label. And then, the sliding window is employed to enlarge the sample size, and the auto-encoder is utilized to reduce the data dimension. Moreover, the Softmax classifier is used for health monitoring. At last, the numerical simulations demonstrate the effectiveness of the proposed method.

S.Velmurugan, G.Shanthi, L.Raja, S.Nirmala, Fully Automated Single Window Saline Fluid Flow Control and Automatic Container Changing System. It is a fully automated android and IoT based continuous monitoring, fluid flow control and automatic saline container changing using single window system is proposed. Multiple intravenous fluid can be injected in a single phase through a single window flow control based on Arduino and IoT Gateway. This need of invention will help the next era nursing and care takers to monitor the IV fluid feeding system fully automated method.

Kenta Suzuki, Takumi Ito, Kohei Koike, Mengnan Ke, Kenjiro Mor, Improvement of Generalization Performance for Timber Health Monitoring using Machine. This study, we investigated the generalization performance of

developed.

the system, which is indispensable for practical applications. Previous studies have yet to confirm this type of performance. We prepared 90 timber pieces as we expected that the system's performance would be improved if more timbers were learned. We divided the pieces into nine classes, representing no damage and damage to eight different positions, respectively.

Rab Nawaz Bashir, Imran Sarwar Bajwa, Malik Muhammad Ali Shahid, Internet of Things (IoT) and Machine Learning based Leaching Requirements Estimation for Saline Soils. Soil salinity is a soil degradation phenomenon with severe impact on crop production. Internet of Things (IoT) assisted solution is proposed to determine soil salinity level and environment conditions to recommend irrigation water, with a purpose to leach down the salts from the root zone of crops in saline soils. Internet of Things (IoT) and Machine Learning (ML), based leaching water requirements estimation for saline soils is made using the in-situ monitoring of the salinity level and crop field temperature. Food and Agricultural Organization (FAO) proposed method of leaching requirement is implemented for efficient leaching water estimation

George A. Oguntala, Raed A. Abd-Alhameed, Yim-Fun Hu, James M. Nora, Nnabuike N. Eya, SmartWall: Novel RFID-Enabled Ambient Human Activity Recognition Using Machine Learning for Unobtrusive Health Monitoring., A simple, the novel ambient HAR framework using the multivariate Gaussian is proposed. The classification framework augments prior information from passive RFID tags to obtain

more detailed activity profiling. The proposed algorithm based on the multivariate Gaussian via maximum likelihood estimation is used to learn the features of the human activity model. The twelve sequential and concurrent experimental evaluations are conducted in a mock apartment environment. The sampled activities are

Existing System

In current health care measures, nursing professionals are responsible for managing, monitoring and providing care to the patient receiving saline. The roller clamp is used to manually control the saline infusion rate in hospitals. If the roller clamp rotates one way, it compresses the intravenous tube harder, which makes the tube thinner and allows saline fluid to flow through a slower rate. If it is rolled in another direction, it loosens or releases saline tubing, which makes the tubing thinner and allows saline fluid to flow through a faster rate. In today's world, there is no monitoring system that reduces patient dependence on nurses, doctors, and also reduces the need for nurses to go to the patient's bed every time to check each patient's saline status.

- **Existing Wireless Technology Proposed**

It has a wireless sensor node which monitors saline levels and alerts doctors/nurses in hospital by sending warning messages wirelessly. It may use the wireless connectivity GSM messages, Bluetooth, Xbee Radio for sending notifications to the user.

Disadvantages

- Needs TDM system to monitor coma patients.
- The current system is used for normal inpatients only.

predicted using a new dataset of the same activity and high prediction accuracy established. The proposed framework suits well for the single and multi-dwelling environment and offers pervasive sensing environment for elderly, disabled, and carers.

- Under abnormal conditions, patients depend on nurses or doctors.
- The system checks the saline level only.

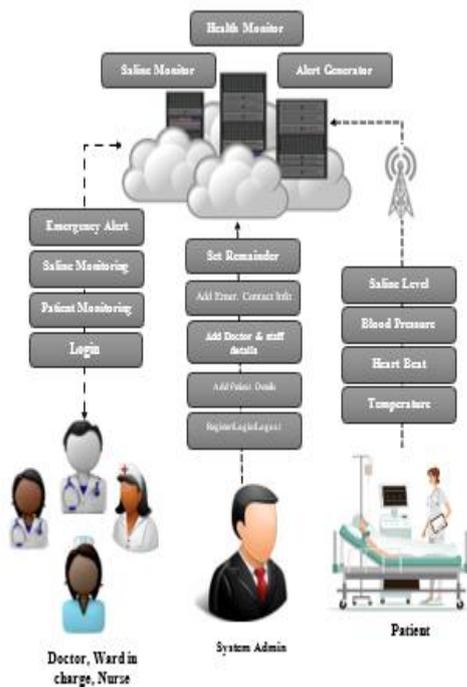
Proposed System

The proposed system of the project is developed a cost effective and standalone wireless sensor node which monitors saline levels and alerts doctors/nurses in hospital by sending warning messages wirelessly using IoT technologies. The project focuses on making Plug and play system which is ready to be installed and integrated with hospitals. Project also develops heart rate and temperature monitoring sensor node which can send these two vital parameters to doctors and nurses. Wireless sensor node developed here is standalone to be installed in the hospital. Multiple such nodes can be given to each patient who can monitor all patient's saline levels and keep informing nurses about it, thus forming as wireless sensor network. System developed here also has estimation property that is it can estimate when saline bottle is going to get empty and notify user about it. The proposed system comprises of sensors which will act as a level sensor for monitoring the critical level of the saline in the saline bottle. Whenever the level of the saline reaches to the pre-defined critical level, then the nurses will be alerted through the buzzer and an alert message will be sent through the use of internet to the concerned nurses that there is a need for replacement of the saline

bottle. This proposed system can be utilized efficiently in homes as well as hospitals.

Advantages

- Every time it is not necessary to watch a patient who is injected Saline bottle. Continuous monitoring of bottle is not required.
- The system is simple to use.

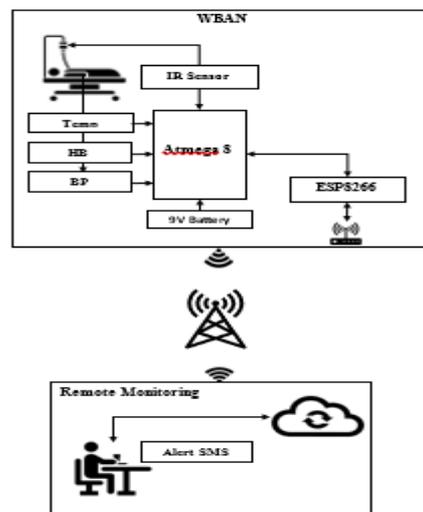


Block Description

In the proposed system, a coordinating node was attached to the patient's body to collect all signals from the wireless sensors and send them to the base station. The sensors attached to a patient's body form a wireless body sensor network (WBSN) and are capable of detecting heart rate, blood pressure, and so on. This system can detect abnormal conditions, alarm the patient and send an SMS / Email to the doctor. This may initially be inferred as a casual phenomenon, but the consequences are often fatal. Shortly after the saline has finished, blood returns to the saline bottle due to the difference in blood pressure and the empty bottle. Thus, innovative health

- As our web page gets Notification, the staff get alerted immediately. There is no chance of backflow.
- Man power can be reduced.
- User friendly.
- Free of noise.
- This system is reliable and cost effective.
- No safety requirements are being needed as our system is purely software oriented

Block Diagram



monitoring systems are being developed with less human intervention, which will be available at low cost in rural and urban areas. The proposed system aims to solve problems of the above mentioned problem effectively. With this, the nurse can monitor the amount of saline even in the control room. Automatic salt level monitoring consists of level sensors that are used to determine the status of the liquid in the bottle, either normal or alert. The detection of saline drop rate is quite reliable. The output obtained from the sensor is processed to verify that the saline bottle is empty.

Module's description**End user Modules****1. Patient Module**

Registration: The Registration module is an integrated patient management system, which captures complete and relevant patient information. It is used to create new users, who can login to the webUI.

Login: This module deals with the security matters, user logons and authentications.

2. Doctor Module

In this module it contains doctor details such as id, name, qualification, Specialization, designation and department etc. The doctor gathers patient's requirements and prepares a requirement report in the developers' comprehensible form and sends that to him. Doctor's system contains the main database for all patients. And also this system will contain the biography and health history of a particular patient up to date. Patients can be identified by their identity card number.

3. Guardian Module

This module belongs to the patients care taker, who can view their patients' health condition by login into the webUI. This module can also receive the emergency alert message and drugs in take notification.

4. Admin Module

The person who maintains all these functions in between actors and will take care of overall system. Proper authorization will be done to take care of who is accessing the database – Administrator, CMO, doctor, operator or patient.

Interface Module**5. IoT Module**

This hardware module is used to interface the web UI and the sensors. The data acquisition portion of the IoT process involves selecting the sensor value and updates this data to the web UI for the corresponding patient.

Health Status WebUI**6. Health Monitoring**

Heart beat sensor is used for measuring the heartbeat of the human; In this project we are using the LM35 temperature sensor. It gives the digital outputs, which indicate the body temperature of the patient. Pressure sensor is used to monitor the pressure of the patient at time interval; these three data from the sensors are monitored here.

7. Saline Monitoring Module

Smart saline bottle level monitoring and the alert system has to be developed to protect their lives during feeding hours. Here the proposed system has a suitable method of measuring the saline flow rate and remotely monitoring it using the IoT platform. The proposed system determines the levels of the saline and indicates at the partial and critical levels with the help of an IR Sensor, buzzer, level LED and sent notification to the hospital staff/control room using Health and Saline Monitor Dashboard (IoT platform) over Wi-Fi. This automatic system implements a mechanism that will stop reverse flow when the bottle goes empty.

Notification System

8. Alert Module

Alert service is introduced for reminding the patient about his or her drugs in taking times to guardian. Normally people forget these because of their work or elderly. It would be very helpful to the patients to maintain their health status healthy. User can set date and time by adjusting

date picker and time picker. User can set repeat alarms by setting repeat time by seeking the seek bar. Whenever patient needs medical advice from doctor he or she can be able to send Short Message Service (SMS) to the doctor including blood pressure and blood glucose data. Temperature and heartbeat. Here patient need not to attach the reading manually.

Hardware System Design

The block diagram of the proposed system is shown. The sensors of Temperature, Heartbeat and Blood pressure are connected to the Arduino board. The values from the Microcontroller is given to the Web Server using Wifi-Connectivity. The parameter values can be viewed by the Android Application installed in doctors and patient's smart phone. In our system Arduino Board is used. The microcontroller is connected with all other hardware units in the module.

HealthCare Medical Device Components

Description

Heart rate sensor:

Monitoring heart rate is very important for athletes, patients as it determines the condition of the heart (just heart rate). There are many ways to measure heart rate and the most precise one is using an Electrocardiography. But the easier way to monitor the heart rate is to use a Heartbeat Sensor. It comes in different shapes and sizes and allows an instant way to measure the heartbeat. Heartbeat Sensors are available in Wrist Watches (Smart Watches), Smart Phones, chest straps, etc. The heartbeat is measured in beats per minute or

bpm, which indicates the number of times the heart is contracting or expanding in a minute.



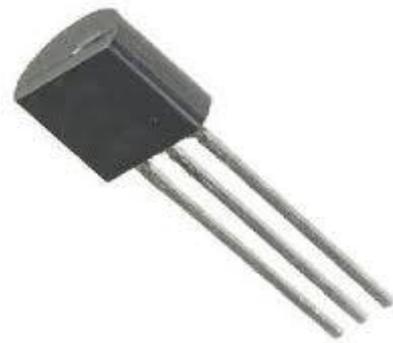
The principle behind the working of the Heartbeat Sensor is Photo plethysmography. According to this principle, the changes in the volume of blood in an organ is measured by the changes in the intensity of the light passing through that organ. Usually, the source of light in a heartbeat sensor would be an IR LED and the detector would be any Photo Detector like a Photo Diode, an LDR (Light Dependent Resistor) or a Photo Transistor. With these two i.e., a light source and a detector, we can arrange them in two ways: A Transmissive Sensor and a Reflective Sensor. In a Transmissive Sensor, the light source and the detector are place facing each other and the finger of the person must be placed in between the transmitter and receiver. Reflective Sensor, on the other hand, has the light source and the detector adjacent to each

other and the finger of the person must be placed in front of the sensor. A simple Heartbeat Sensor consists of a sensor and a control circuit. The sensor part of the Heartbeat Sensor consists of an IR LED and a Photo Diode placed in a clip. The Control Circuit consists of an Op-Amp IC and few other components that help in connecting the signal to a Microcontroller. The working of the Heartbeat Sensor can be understood better if we take a look at its circuit diagram. Every heartbeat will alter the amount of blood in the finger and the light from the IR LED passing through the finger and thus detected by the Photo Diode will also vary. The output of the photo diode is given to the non – inverting input of the first op – amp through a capacitor, which blocks the DC Components of the signal. The first op – amp acts as a non – inverting amplifier with an amplification factor of 1001. The output of the first op – amp is given as one of the inputs to the second op – amp, which acts as a comparator. The output of the second op – amp triggers a transistor, from which, the signal is given to a Microcontroller like Arduino. The Op – amp used in this circuit is LM358. It has two op – amps on the same chip. Also, the transistor used is a BC547. An LED, which is connected to transistor, will blink when the pulse is detected.

Temperature Sensors

Temperature sensors are vital to a variety of everyday products. For example, household ovens, refrigerators, and thermostats all rely on temperature maintenance and control in order to function properly. Temperature control also has applications in chemical engineering. Examples of this include maintaining the temperature of a chemical reactor at the ideal set-point, monitoring the temperature of a possible

runaway reaction to ensure the safety of employees, and maintaining the temperature of streams released to the environment to minimize harmful environmental impact. While temperature is generally sensed by humans as “hot”, “neutral”, or “cold”, chemical engineering requires precise, quantitative measurements of temperature in order to accurately control a process. This is achieved through the use of temperature sensors, and temperature regulators which process the signals they receive from sensors.

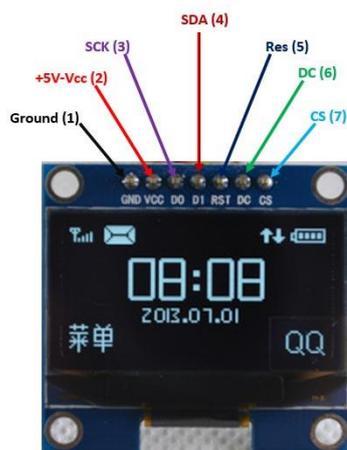


From a thermodynamics perspective, temperature changes as a function of the average energy of molecular movement. As heat is added to a system, molecular motion increases and the system experiences an increase in temperature. It is difficult, however, to directly measure the energy of molecular movement, so temperature sensors are generally designed to measure a property which changes in response to temperature. The devices are then calibrated to traditional temperature scales using a standard (i.e. the boiling point of water at known pressure). The following sections discuss the various types of sensors and regulators. Temperature sensors are devices used to measure the temperature of a medium. There are 2 kinds on temperature sensors: 1) contact sensors and 2) noncontact sensors. However, the 3 main types are thermometers, resistance temperature

detectors, and thermocouples. All three of these sensors measure a physical property (i.e. volume of a liquid, current through a wire), which changes as a function of temperature. In addition to the 3 main types of temperature sensors, there are numerous other temperature sensors available for use.

OLED

OLED (Organic Light Emitting Diodes) is a flat light emitting technology, made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. OLEDs are emissive displays that do not require a backlight and so are thinner and more efficient than LCD displays (which do require a white backlight).



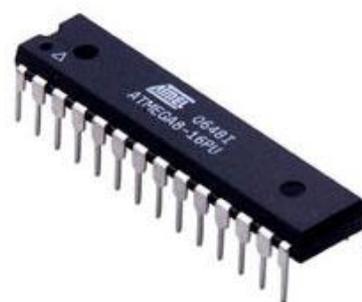
ESP8266 Wi-Fi Module

The ESP8266 is a System on a Chip (SoC), manufactured by the Chinese company Espressif. It consists of a Tensilica L106 32-bit micro controller unit (MCU) and a Wi-Fi transceiver. It has 11 GPIO pins* (General Purpose Input/output pins), and an analog input as well. This means that you can program it like any normal Arduino or other microcontroller. And on top of that, you get Wi-Fi communication, so you can use it to connect to your Wi-Fi network, connect to the Internet, host a web server with

real web pages, let your smartphone connect to it, etc ... The possibilities are endless! It's no wonder that this chip has become the most popular IOT device available.

Atmega 8 IC

It is an 8 bit CMOS technology based microcontroller belongs to the AVR family of microcontroller developed in 1996. It is built on RISC (Reduced Instruction Set Computer) architecture. Their main advantage is it doesn't contain any accumulator register and the result of any operation can be stored inside any register, defined by an instruction.



Atmega 8 Microcontroller

Conclusion and Future work

With automatic saline monitoring system, the manual effort of continuously monitoring of patients injected with saline by the nurses will be reduced. As the whole proposed framework is automated it requires very less human intercession and endeavours in the centre. It also includes the smart health system, which gives the information about body temperature, blood pressure, heart rate and also the pulse rate. This help in deciding whether the patient requires another saline bottle or not It will be more invaluable at nights as there will be no such prerequisite for the nurses to check level of saline in saline container every now and again which is an apprehensive undertaking. It also saves the patients getting them harmed from the backflow

of blood into the saline container which sometimes can have a deadliest impact. This will lessen the worry in persistent observing by the medical caretaker at a reasonable expense.

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