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Smart Glove for Elderly Patients

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Smart Glove for Elderly Patients

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Abstract. Each and everyone in this world should take care of elderly patients and treat them how they need to be treated. Due to aging, most of the elderly persons are facing health related issues and sent out to homes and orphanages. Elders cannot be able to visit doctors regularly to monitor health status. This article comes up with a solution for the elderly patients around by assisting them and helping them to be fearless. Here the proposed system makes use of different parameters like GPS and GSM modules, Pulse Oximeter, Accelerometer, Touch Sensor, Bluetooth that interface with the Arduino. The proposed smart glove is used to measure temperature, fall detection, pulse rate for the elderly patients, if they are facing any health-related troubles. This will help these patients to escape by altering the caretaker.

Keywords-Embedded System; Arduino; Tracking System; Smart Glove, Global Positioning System (GPS)

1. Introduction

One of the universal processes is aging, and it affects each and every human being in the world by physically and psychologically. The issue with the elderly people is their mental health. This has become an increasing concern withthe rapid growth of the aging population. The raisingproportion of them in both developed and developing countries is creating new health care challenges. As people get older, the body tends to cause changes in all part of it, including the brain. Degeneration of cells and cell connections of the brain starts to happen and die, destroying memory and other important mental functions eventually. Here Memory loss and confusion are the main symptoms and Forgetfulness can be a normal part of aging as well. They don't remember information so that they will lose their directions. Theproblems faced by memory loss patients are Stress, Depression difficulty in concentrating and otherproblems that cause disruption in their daily activities. These difficulties make them physically and mentally unstable. They need full care and attention, but it is quite impossible inthis busy world. As a result, the elderly peoples are sheltered in old age homes, nowadays old age homes areincreasing rapidly which results in 728 old age homes in India today. Due to this evolving lifestyle many of their childrenaree not ready to take care of their elderly parents. Although, there are many homes, these patients don't seem to able to be monitored 24/7. As a result, a lot of circumstances are faced.Because to the stress and depression their heart beat, temperature, blood pressure rate increases suddenly and even cause death.

2. Need for the Study

To overcome all these problems, smart glove has been designed which helps to monitor aged people in an old age home or diseased patient's or for all those who need 24 hours care and attention. As it continuously monitors patient's health, it will help to reduce the death in old age homes. Its aim isto reduce the death rate caused mainly due to sudden health issues like heart attack, stroke etc. Since it analyses body's change at its beginning stage itself, it is very easy to diagnose the patients as soon as possible.

2.1. Technical aspects of Digital Health

The Smart glove assessment requires a data collection or acquisition system that will collect sensor data relevant to important analysis for the purpose of alerting the care taker. The technical aspects of the Digital sensing system are mainly important, as the lackof this sensing system may causes insufficient ideas to use the system and reduced dataquality. Particularly, an efficient management of power is very essential to reduce the frequency of required charging of the devices, which is precisely related to all the technical acceptance of the system. Wireless communication of all the processed data that has been collected helps to avoid technical manipulation of the device by patients, and simultaneously acts as a gateway of data to push the obtained data to the storage or cloud. This field area and collection of data have been intensively studied in the field of Body Sensor Networks**.**

3. Literature Survey

Sunehra A, Sretha V, Shashank V (2020) proposed a Security System which has embellish a significant concern for the people of elders, women, and even children in all aspects. In this study, a smart device with wearable technology is executed with the help of the Raspberry Pi3 processor for the purpose of protection and reliability for women or children. It operates by alerting those who are close by to the user (person who is wearing the smart device with wearable technology). The system makes use of GPS tolocate the women and sends the location through SMS to the caretaker's contact number and the cop's using the GSM/GPRS technology, the image of the assault gets captured using a Web Camera which is interfaced with the device. As soon as the woman presses the emergency button which is present on the Smart wearable device system, it sends an alert message to the caretaker.

P.E.Sankaranarayanar, G.sundari (2013) described about GPS based tracking system on traffic breaking and its misfortune, especially in railway Zones. This issue can be controlled if anyone monitors all the trains periodically for 24/7, but unfortunately this task cannot be implemented manually. So they implemented a gadget combined in the train seems to be a possiblele one. This designed device which is integrated with the train will send alert messages related to safe and secure to the train driver and also allow regularly updating the status of its location. This paper proposes a GPS based real time train tracking system and information of communication through concepts of Ethernet.

Rifki Wijaya, Ary setijadi, Tati L.Mengko, Richard K. L.Mengko (2014) proposed the Data collection for various health care problem. Heart rate is used as a parameter for identifying what proportion of calories burned in which initially the pulse data is collected using method called directobservation. This data which is collected kept for further research in systems of heart rate time series sensing which are based on mobile health technology and mixture of communications, information, transducing or sensing technologies made by human mobile interaction. This targets at treatment and monitoring patients. To supply a remote surveillance for the elderly as well as patients which are suffering with illness and enrich performances of athletes, diagnosis made through caring clinical professionals and made analysis is the primary goal. Our foot is made up of complex structure helps in supporting entire

body load. But a poor foot or toe position can make us feel pain around the legs, patella, hips. A walk or parade analysis could also be useful in some scenarios. It is challenging and is not simple exactly locate the problem while our physical body remains in standing position. But when our body tends to be in mobility, sharp pain tends to appear while we walk or run.

S Saidani, R Haddad, N Mezghani (2018) conference happened on sensing systems which talks about insole sensing system in a form of shoe. This has been made on technology named mobile health, mixture of communications, information, transducing or sensing technologies made by human mobile interaction, in which treatment given and patient monitoring is the primary target. The aim is to produce a distant surveillance for patient with intensifies illness which improve performances of atheletes, through helping medical/ critical care professionals in both diagnosis and analysis.

K Aziz, S Tarapiah, Sh Ismail (2016) presented a system which is smart enough to observe and monitoring subject/patient present conditions of their health, and it is made with well-known technology of GSM and GPS. Survey shows that hypertensive cardiac condition non-invasive blood pressure values lead to high risk factors and prime fatality rate to minimize it as a preventive measure. This provides a instant and quick health analysis data to save patients life and monitor at acceptable time. This article provides an excellent model of system used to trace, track, monitor or detect patient vital signs so as to provide best and efficient medical services in correct moment. With the help of sensors, the capture and comparison of acquired information will be made with a threshold of predefined values. This proposed system focuses on the pulse sxdd1 rate, and heat profile of the body, thus just in ccritical condition a message is made to reach the physician mobile with measured values and position of the patients. Thus, the likelihood of providing an efficient system on healthcare monitoring by using various sensors with wide range for more vital parameters of human health to connect patient with physicians if there is any emergency.

4. Methodology

The below Fig 1 clearly describes the transmission of data from elderly person to a care taker.
This can achieve in two different modes namely

- Sending location via GPS Module
- Sending SMS via Bluetooth Module

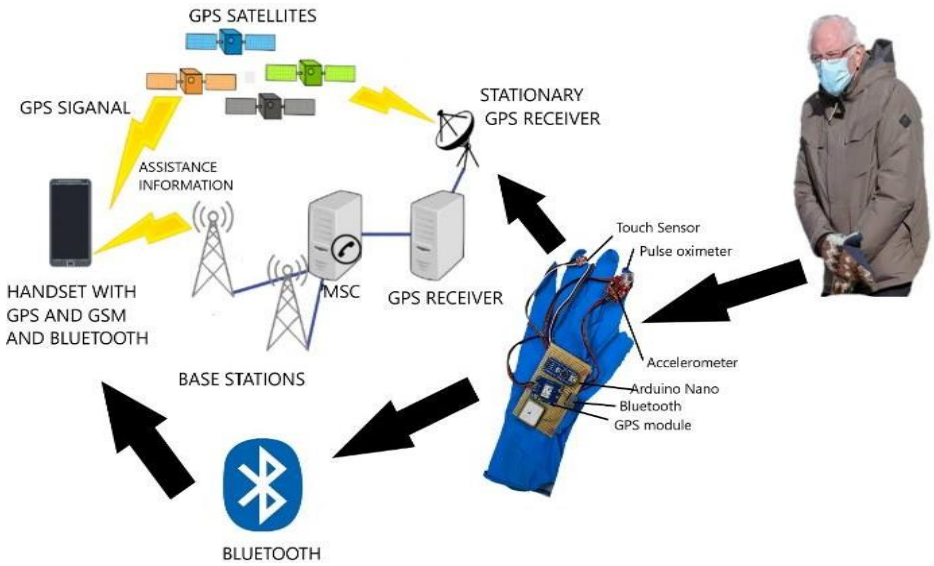

Figure 1. Smart Glove Pictorial Flow

4.1 Sending Location via GPS Module

GPS receiver module, a device in which the information from GPS satellites is received and provides the geographical position of the device. This type of transmission of data occurs when the care taker is much far from the subject. This is often helps in locating the subject whenever they aren't found.

The information is being obtained as a wholeNMEA format text by the GPS receiver. Only the latitude and longitude coordinates are taken using the Arduino Tiny GPS library. Then the GSM module sends SMS tothe contact specified in the code.

4.2 Sending SMS via Bluetooth Module

Here the Bluetooth Module is being connected with the Arduino based interface through the UART-Interface. The Arduino wants to send the entire message is directly passed to the Bluetooth module initially, which forward the message in wireless mode of communication. This data transmission type occurs when the subject is nearto the care taker. It helps in getting information in the form of a text message.

5. Proposed System

The general arrangements of the parts or components of a smart glove are shown in Figure 2. Here in the microcontroller, the Rectifier and Regulators are inbuilt; the rectifier's job is to provide variable DC voltage from AC source to control the system. The accuracy rate tends to increase, which can drive the control and regulator. This basically cuts the connection between input and output. If input voltage is below the reference, input and output are connected. This function performs when the power supply is given to the microcontroller. Furthermore, the pulse oximeter, temperature sensor, touch sensor will detect the fall or raise in the threshold level and send the data to the microcontroller then it will trigger the GPS and Bluetooth and sends location and data via messages using mobile app. The battery used here is lithium-ion battery which will provide power supply to the entire system.

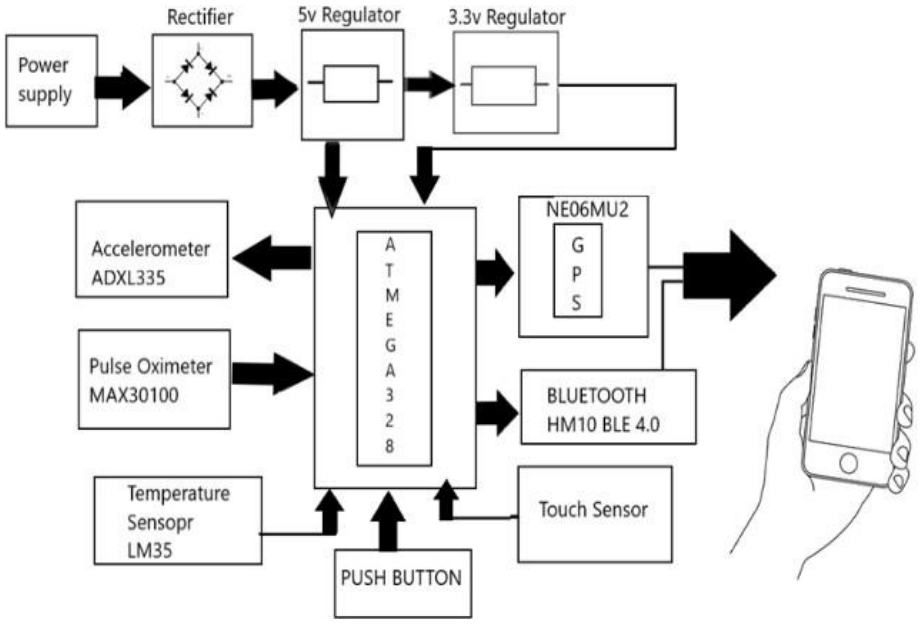

Figure 2. proposed system model

6. Circuit Diagram

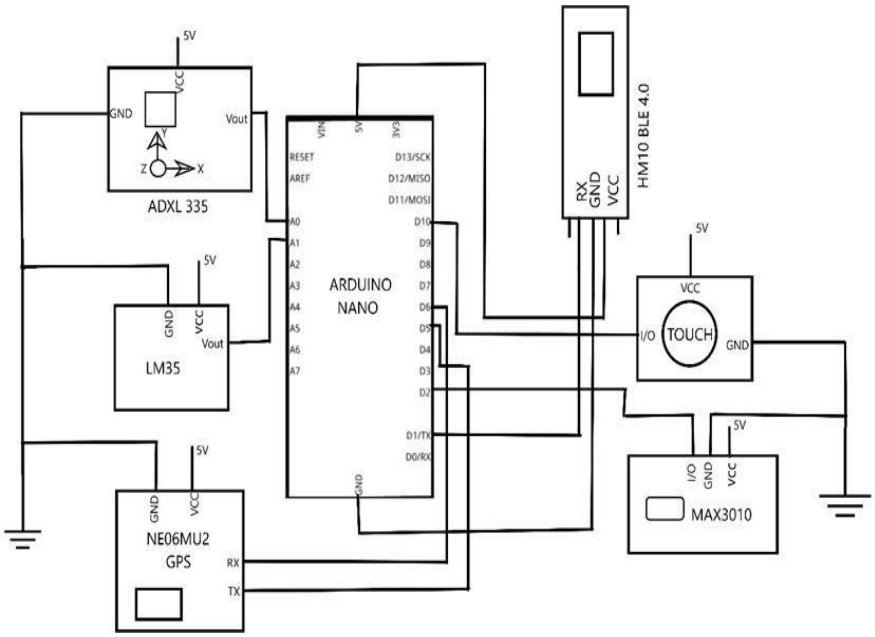

Figure 3. Proposed circuit Diagram

Here all type of sensors are linked to the Arduino NANO. Arduino NANO is best known for its simplicity and compatibility. All the sensors are given 5v as power supply and therefore the grounds are grounded. The input of the pulse oximeter MAX30100 is joined to the Digital Pin D2 and the touch sensor pin with Digital Pin D6, Where LM35 fall direction sensor is connected to the Analog Pin A1 and also the ADXL accelerometer to the Analog Pin A0.

HM10 BLE4.0 is a Bluetooth module in which it's Rx is connected to the Tx and Tx is attached to the Rx of the Arduino NANO, and the NE 06MU2 GPS, Rx pin is attached to the Digital type Pin D6 and its Tx pin is attached to the Digital type Pin D5. Here we are using 3.7v, 350 mAh lithium-Ion batteries to power up the whole system. If we supply below 3v it will not work and the Bluetooth works at 3.6v to 6.5v. Pulse oximeter is also connected to the microcontroller during the pulse difference value will change, which is attached to the analog side of the microcontroller. The pulse oximeter sends value to the microcontroller then it sends to the Bluetooth and as a result it will send the information to the mobile app. This function is same for all the four sensors. The person at the receiving end will receive the health status of the person. Through this entire system it is easy to measure health status of the person who is working under the area or far away from them.

7. Architecture

7.1 System Overview

The proposed smart glove system is a cost effective and efficient wearable technology, which address the recent problems in patient's health care and security. It is lightweight and weighs above 2.08 grams, hence the form factor is good and it is easily portable. The smart glove system integrated the pulse, Temperature and motion sensing-based components inside the glove. With the algorithm based on smart and rapid analysis, all prime human care analysis feature can be recovered from sensing data. Therefore, the proposed cost-effective smart glove system will detect all types of day-to-day activities without any disturbance in the standard living life of the person or subject

7.2 Hardware Architecture

The smart glove system is made in a motive as a cost-effective sensory, efficient and application or utilization software on both smart devices and system which helps in getting alert. The smart glove coemprises of an arrangement of transducers or sensors, an MCU which is an lowest power control unit and a BLE, a low-energy Bluetooth wireless transmission module, and USB link module. Vvisualization and real-time is provided by the software application which is then guided as feedback/response to the user. The Secure Digital card (SD) helps in the storage of data which is then used to study health behaviours. Our glove is capable of measuring pulse, temperature which helps in the analysis of risk factors by potential fall in day-to-day free-living life.

There are two main subsystems involved during this system; the primary subsystem is a sensor for detecting pulse, fall, and temperature which is cost-efficient. This will be integrated withinn the smart glove system effectively. This uses inertial sensors namely accelerometer and gyroscopee which may measure the mobility profile of the subject. The second subsystem is that the transmission module with signal acquisition, the sensor data which is obtained and quantified will be then streamed instantly to a data accumulator or aggregator. With the help of one of 1200-mAh Lithium battery1, it can work for over 24 hours easily at a stretch. This helps the Smart Glove system to be used daily without any disturbances like interruptions and without charging the battery. The sensor aggregation and processing module is the third subsystem handles to store and examine the data when it receives on the smart devices or smart phone.

8. Results and Discussion

The scientific procedures undertaken on Smart Glove with five different subjects and hereby the outcome test results are to be demonstrated / discussed to get better understanding of the inferences made on the experiment.

8.1 Testing

Table 1. Evaluation values of the subject

Sensor	Threshold level
Fall detection	Vout1 >400 (t/sec)
Temperature	t1 > 36(ºC)
Pulse Rate	Rate > 100 bpm
Touch	nil

The results are taken once the subject wore with gloves, here the gloves is integrated with five different sensors and it's threshold levels are shown in Table 1. Evaluation is done for three times on a periodical interval for 1min on each subject.

A prototype is implemented based on the design of smart glove shown in Figure 4 shows the serial type monitor or detector of the Arduino based IDE when operate the system and view the results in smart phones.

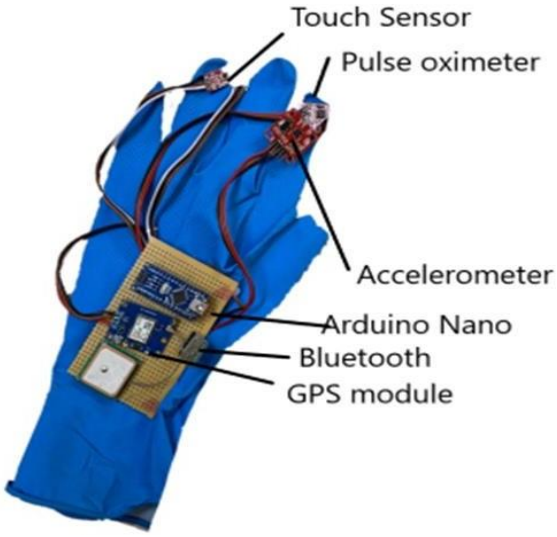

Figure 4. Prototype of Smart glove

The patient readings are continuously monitored, if there is an increase in threshold level it automatically sends alert message to the caretaker; identify his/her vehicle position by calling the system. In case1 the heart rate of the patient is above the threshold level, The location-based information includes altitude, latitude, longitude, and current data is sent to the website which will also be forward directly to the caretaker as an SMS (short messaging service) as shown in Figure 5. In case2 the patient's heart rate is above the threshold level, the location based information like altitude, latitude, longitude and current data is forward to the website which will also be transmitted directly to the caretaker as an SMS (short messaging service) shown in Figure 6.

In case3 the subject had a fall, the location information including altitude, latitude, longitude and current data is sent to the website which will also be communicated directly to the caretaker as an SMS shown in Figure 7. In case 4 the subject wants to alert the caretaker, so he touched the TOUCH sensor. The location information like altitude, latitude, longitude and current data is sent to the website which will also be communicated directly to the caretaker as an SMS shown in Figure 8. In case 5 the caretaker wants to locate the person, , the location based information like altitude, latitude, longitude is transmitted to the caretaker as an SMS shown in Figure 9.

From the above cases, the subject doesn't feel any discomfort when they continuously wore the glove 24/7. This is due to the microfiber sheets which are good for sensitive skin type and provides extremely good comfort. It is very soft and double-brushed so that, it is even softer than usual.

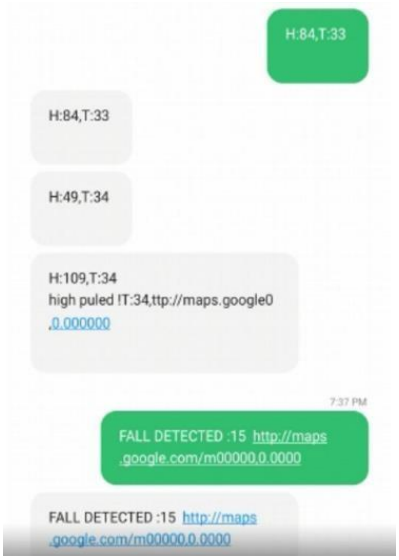

Figure 5. Case 1 result

Figure 6. Case 2 result

Figure 7 Case 3 result

Figure 8 Case 4 result

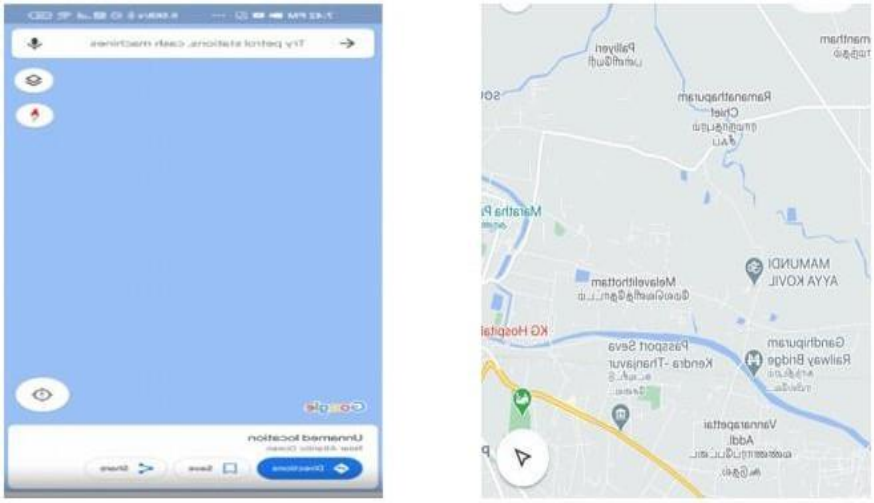

Figure 9. Case 5 result

9. Graphical output

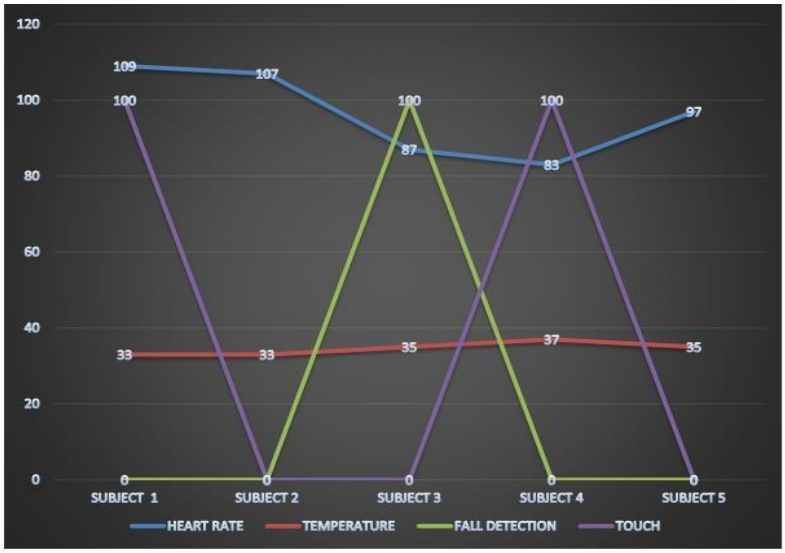

Figure 10. Test readings Graphical representation

The above Figure 10 representing graphical output of the test readings that are obtained from the subjects at different situations. Here the subjects are in X axis and their readings are in the Y-axis. This graph gives the clear-cut idea of subject's readings for which the alert message is given.

10. Conclusion and future work

In this context, for health care of patients, the proposed system is based on supported mobile health technology is made and it uses a smart glove to authorize the caretakers or physicians to line up as well

as examine the history of patient's physiological data during his or her absenteeism in the clinical centre or homes. These obtained data will help them to take care the elderly patients in their difficult times for their survival. Furthermore, this smart glove is very much useful for women's safety purposes to safeguard them from danger.

In the future work, design of a smart inside sole system will be proposed that will help in the data transfer directly to the hospitals nearby and also implement safety measures explicitly for sexual assault alongside these features.

The main challenge is to make the device capable to work for 24 hours to monitor, command and regulate various person scheme or activities with the help of live processing and data transmission, the motions during daily activities have to be monitored and detected by the healthcare suppliers and also to determine unlikely events or episode like a drop down for the elderly/older subject that may occur.

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