UDC 004

REMOTE MONITORING USING THE KERAS LIBRARY

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Abstract. This article discusses the use of modern technologies, including mobile applications and neural networks, for remote patient monitoring. Various applications of artificial intelligence in medicine are described, such as real-time monitoring, diagnostics, personalized treatment, and remote consultation. Particular attention is paid to the use of mobile device cameras in medical applications for video consultations, symptom recognition, disease monitoring, and patient response analysis. An example code for image classification using deep neural networks is provided. The final part of the article discusses the importance of using mobile health with neural networks for remote patient monitoring and predicting possible complications.

Keywords: mobile applications, medical monitoring, artificial intelligence, neural networks, remote diagnostics, video consultations, symptom recognition, personalized treatment, remote consultation, deep learning, image classification, patient health.

Modern technologies play an important role in improving the availability and quality of healthcare. One such approach is the use of mobile applications for remote monitoring of patients. This method allows not only to continuously monitor health parameters, but also to promptly respond to possible complications. We will consider the use of neural networks for data analysis and patient condition prediction.

Remote patient monitoring is a service provided by a medical institution using information technology. Monitoring of the immediate condition of the patient is provided using portable, mobile wearable medical devices, as well as modern telecommunication technologies such as video communication, audio communication, photos and chats, the collected data from these devices goes directly to the doctor. Remote patient monitoring can also be used to monitor a patient in the worst state of the disease, at work. When using remote patient monitoring, three types of remote health status are distinguished by the form of implementation: synchronous, asynchronous, remote.

Synchronous remote monitoring is a method of assessing a patient's condition in real time using remote monitoring or telecommunication technologies. It involves transmitting data about the patient's health to a doctor, which allows monitoring their well-being without the need for physical presence. This may be information about pulse, pressure, temperature and other indicators, which is sent to the doctor through specialized devices. One of the important elements of such monitoring is the possibility of video calls or audio consultations, where the patient can directly ask the doctor questions about their condition. Thus, patients can receive the necessary medical care without leaving home, which greatly simplifies the process of seeking a consultation and makes it more convenient and faster. With asynchronous remote monitoring, the patient independently measures his indicators, such as pressure and temperature, and sends them to the doctor via e-mail or chat using secure communication channels. This allows data to be transmitted not in real time, but at a time convenient for the patient, which makes the process more flexible.

Asynchronous monitoring is especially useful for patients with a high risk of relapse. Regular sending of information allows doctors to detect deviations in health status in time and respond promptly, transmitting data to medical institutions if necessary. This helps prevent the development of complications and provide timely assistance. Remote online monitoring is a form of dynamic control that allows the patient to be under constant supervision of doctors or medical personnel. Data on his health status is transmitted regularly, which makes it possible to track changes almost in real time.

Thanks to modern medical devices such as a pulse meter, glucometer, tonometer and cardiac monitor, this process has become possible without the need to visit the hospital. There are also specialized monitoring systems designed to control certain diseases. For example, monitors for tracking apnea, cardiac monitors, devices for patients with dementia and Parkinson's disease, breathing machines and fetal monitors.

The use of AI in mobile patient monitoring can be implemented in various ways: For example, in real-time monitoring: Mobile devices with built-in sensors such as accelerometer, gyroscope, and heart rate monitors can collect data on physical activity, heart rate, blood oxygen levels, and other health parameters.

Algorithms analyze this data in real time to detect abnormalities or warn of potential health problems [1]. Diagnosis and prognosis: AI processes data collected by mobile medical devices such as ECG monitors and medical apps to diagnose diseases or predict possible complications.

Personalized treatment approach: AI analyzes patient health data collected from mobile devices and offers personalized treatment and health management recommendations based on the patient's activity, sleep, and nutrition.

Remote consultation and support: Mobile apps use AI to provide real-time medical consultations or to support patients with chronic diseases.

These and other methods demonstrate how AI is being integrated into mobile health apps to improve patient health monitoring and provide them with more personalized and effective care. In mobile patient monitoring, "mobile" refers to the use of portable devices such as smartphones or tablets to collect and transmit health data. Cameras on mobile devices play an important role in various medical patient monitoring apps and technologies: Video consultation medical apps: The patient uses the camera of the mobile device to make a real-time video call to the doctor for consultation and diagnosis [2].

Medical applications for symptom recognition: The mobile device camera is used to capture the symptoms of a disease, which are then processed by computer vision algorithms. Medical applications for disease monitoring: Using the mobile device camera to measure heart rate or collect sleep data.

Medical applications for patient reaction recognition: The mobile device camera analyzes the patient's facial expressions and behavior to determine his emotional and psychological state [3]. Using mobile device cameras in medical applications can significantly improve the monitoring of mobile patients and improve the quality of medical care. We use deep neural networks trained on data collected from various sources to analyze and predict the patient's condition. For this, we load pre-trained models using the Keras and TensorFlow libraries [4].

Next, the images are prepared by converting them to the required format and size. Image normalization is also performed to ensure correct analysis.

The code shown in Fig. 1 is an example of image classification using a deep neural network on a pre-trained model. First, the model is loaded from a file and the list of class labels is loaded from a text file. The image is then prepared for analysis by resizing the image and normalizing the pixel values. The images are then fed to the model, and predictions are obtained in the form of probabilities of belonging to different classes. The final result is displayed as the category with the highest robability and the confidence level of the model corresponding to this prediction [5].

```
# Disable scientific notation for clarity
np.set_printoptions(suppress=True)

# Load the model
model = load_model("/content/keras_model.h5", compile=False)

# Load the labels
class_names = open("/content/labels.txt", "r").readlines()

# Create the array of the right shape to feed into the keras model
# The 'length' or number of images you can put into the array is
# determined by the first position in the shape tuple, in this case 1
data = np.ndarray(shape=(1, 224, 224, 3), dtype=np.float32)

# Replace this with the path to your image
image = Image.open("/content/WIN_20240324_22_33_46_Pro.jpg").convert("RGB")

# resizing the image to be at least 224x224 and then cropping from the center
size = (224, 224)
image = ImageOps.fit(image, size, Image.Resampling.LANCZOS)

# turn the image into a numpy array
image_array = np.asarray(image)

# Normalize the image
normalized_image_array = (image_array.astype(np.float32) / 127.5) - 1

# Load the image into the array
data[0] = normalized_image_array

# Predicts the model
prediction = model.predict(data)
index = np.argmax(prediction)
class_name = class_names[index]
confidence_score = prediction[0][index]

# Print prediction and confidence score
print("Class:", class_name[2:], end="")
print("Confidence Score:", confidence_score)
```

Figure 1 - Image classification

After image processing, the model predicts the patient's condition by generating probabilities of certain behaviors and movements that may indicate the patient's health status and the need for medical intervention [7]. The results obtained provide valuable information for real-time patient monitoring, warning of potential problems, and timely intervention by medical personnel.

Using mobile health to remotely monitor a patient's condition using neural networks opens up new perspectives in medical diagnostics and patient care. Accurate predictions based on data obtained from mobile devices allow for rapid response to changes in health status and prevention of potential complications

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