Research
Based
Curricula

Wearables in Healthcare

Key Stage 4 Information and Communication Technology

Model Answers

2019

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Resource One
Model Answers

Answers

1. A stroke is a serious life-threatening medical condition that occurs when the blood supply to part of the brain is cut off. Atrial Fibrillation (AF) is a common heartbeat disorder that changes blood flow dynamics and increases the likelihood of stroke.

2. Step 1 - collect heart rate data. Step 2 – visualise HR recordings, on a smartphone for example. Step 3 – use the Internet of Things to share and process data. Step 4 – use a Deep Learning system to classify the data as AF or normal. Step 5 – feedback the result to patient and medical practitioner.

3. Step 1: take twenty seconds of heart rate data. Step 2: calculate the heart rate by dividing the number of beats by 20. Step 3: Repeat Step 1 and 2 to obtain a record of heart rate over time. Step 4: Determine the range of the heart rate over time (maximum – minimum); if the range is larger than a certain value, then the patient may be experiencing AF.

Resource Two
Model Answers

Answers

1. In response to the lack of wireless heart rate monitors, the Polar company was set up in the 1970s, filing its first patent for a device. In 1982, the Polar launched its first wearable wireless heart rate monitor – the PE Tester 2000.
2. Benefits include:
    - Improved electrodes for more accurate monitoring
    - On-board memory to record heart rate for a whole session
    - Wireless updates
    - Easily replaceable batteries
    - Waterproof to 30 m, allowing for water sports
    - Improved strap and buckle, for comfort and secure attachment
3. Compared to the H7, the H10 can make two Bluetooth connections simultaneously, can update wirelessly, has in-built memory, a longer battery life and comes with the Polar Pro strap.
4. Implantable sensors: pro – unlike wearable sensors, these are below the surface of the skin so can't fall off or interfere with activities. Con: requires invasive surgery to install. Wrist sensors: pro – easy to wear. Con – may not provide accurate data. Chest strap sensors – should provide more accurate heart data than wrist sensor. Con – harder to wear than wrist sensor and may interfere with activities. Ambient sensors. Pro – doesn't need to be worn, not invasive, doesn't interfere with activities. Con – technology does not yet exist for accurate recording, and it will likely be very expensive.

Resource Three
Model Answers

Answers

1. Bluetooth is a wireless technology standard for exchanging data between fixed and mobile devices over short distances using short-wavelength UHF radio waves in the industrial, scientific and medical radio bands, from 2.400 to 2.485 GHz, and building personal area networks (PANs). It was originally conceived as a wireless alternative to RS-232 data cables.
2. Bluetooth Low Energy is aimed at novel applications in healthcare, fitness, beacons, security and home entertainment industries. Compared to Classic Bluetooth, BLE provides reduced power consumption and cost. BLE achieves this by transmitting data in small packets which requires less power when compared to normal Bluetooth packets. As a result, Bluetooth Smart devices could be operated for short term (months) or even long term (years) on tiny, coin-cell batteries.
3. Resting rate = about 60 bpm. Maximum = about 95 bpm. Range = about 35 bpm. Mean = about 70 bpm.
4. Assume an average of 70 bpm over the lifetime. Assume a lifetime of 80 years. How many minutes is that? 80 x 365.25 x 24 x 60 = 42076800 minutes. So number of beats = 42076800 x 70 = 2945376000. Almost 3 billion times.
5. -

Resource Four
Model Answers

Answers

1. The Internet of things (IoT) is the extension of Internet connectivity into physical devices and everyday objects
2. In a smart home, IoT sensors would make it possible to monitor and set temperature and light levels remotely, for example. In a smart city, IoT traffic lights would make it possible be possible to monitor and control traffic in real-time, for example, to help with congestion. In a smart hospital, wearable IoT sensors would make it possible to monitor and respond to patient vital data in real-time, for example.
3. An Internet of Medical Things would include IoT devices to monitor vitals like heart rate, blood pressure, oxygen levels and movement. This could all be done remotely and in real-time, allowing clinicians or artificial intelligence to constantly monitor and respond to patient needs.
4. Once data is in Thingspeak, we can analyse and visualize it, calculate new data, or interact with social media, web services, and other devices. The ThingTweet application links the Thingspeak account to a Twitter account. As such, things, sensors, devices and channels can be updated to Twitter or be updated through Twitter by using the Tweeter-Control application programme interface (API). For instance, we can make a device tweet us by giving alerts notification when the atrial fibrillation is detected.

Resource Five
Model Answers

Answers

1. These systems learn by considering examples. The system would be given pictures of cats labelled ‘cat’ and pictures of other things labelled ‘not cat’. The system generates identifying characteristics by using these examples e.g. that cats have four legs, fur, a tail, whiskers. Once trained, the system can then identify cats in non-labelled images.

2. DL is similar to human learning in that it relies on using examples to figure problems out, and relies on trial and error to make adjustments.

3. The challenge of using DL in autonomous vehicles is to make the system act more human-like. That is, be able to identify things like road signs under varying conditions (different lighting, different weather). The risks are that if the system cannot adapt to varying conditions, then the vehicle may pose a risk to its occupants and other vehicles on the road. For example, it might miss a sign informing the vehicle to slow down or stop.

4. In our system the DL system was trained using examples of heart rate records containing or not containing episodes of atrial fibrillation. The DL system learned what atrial fibrillation looked like in a hear record. The DL system was then integrated into our IoT platform and can determine whether atrial fibrillation is present with a high degree of accuracy.

5. -

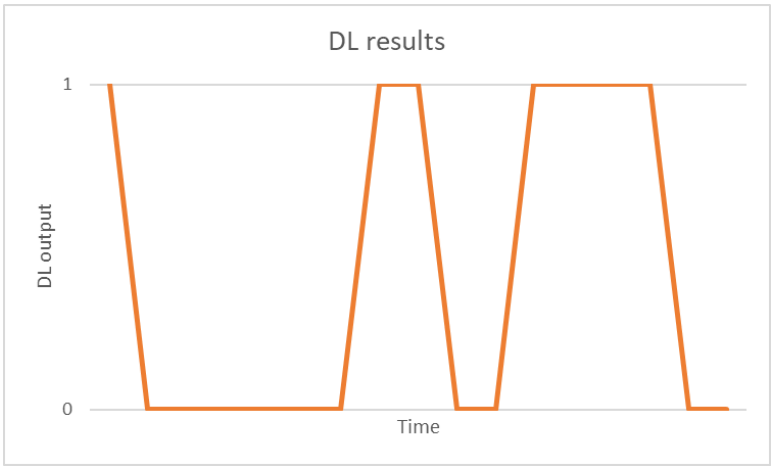
Resource Six
Model Answers

Answers

1. Remote, autonomous monitoring systems can reduce the pressure on overstretched medical services by allowing patients to be discharged to their home environment. This would free up beds and allow hospitals to allocate limited resources to emergency cases.

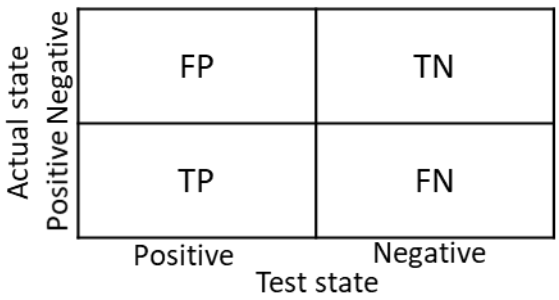
2. The DL results shows an episode of atrial fibrillation before the 14 November, but no atrial fibrillation thereafter.

3. Whenever the DL output is 1 in the graph below, there is atrial fibrillation.



4. If ThingTweet alerted the clinician as well, the clinician could call the patient by telephone. This might be useful, as some patients might not have access to internet technology.

1.



Resource Six
Model Answers

Answers

2. True positive and True negative results are correct. A False positive is incorrect and may lead to further testing and worry. A false negative is incorrect and dangerous because the disease is missed.

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