COURSEWORK 2

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1) IoT based Health Monitoring & Automated Predictive System to Confront COVID-19
Author/s: M.M.S. Choyon, M. Rahman, M.M. Kabir, & M.F. Mridha
Publication Year: 2020

IMPACT:

The paper proposes an IoT and machine learning (ML) based health monitoring system to combat COVID-19 more effectively. Since the pandemic overwhelmed healthcare systems, many patients couldn't get timely diagnosis or treatment. This system continuously tracks key health indicators like body temperature, heart rate, and oxygen levels using wearable sensors. By analyzing this data with ML, it can detect early COVID-19 symptoms, predict severity, and alert medical staff for urgent cases. This reduces delays in treatment, helps isolate high-risk patients, and minimizes physical contact between doctors and infected individuals, lowering transmission risks.

ADVANTAGES:

The system offers real-time health monitoring, allowing doctors to track patients remotely and intervene quickly if symptoms worsen. It reduces hospital visits, lowering exposure risks for both patients and healthcare workers. Machine learning improves accuracy in detecting COVID-19 patterns, helping distinguish mild cases from severe ones. The use of IoT wearables makes it scalable for mass monitoring in quarantine centers or homes. Additionally, it ensures continuous data collection, helping in long-term research on COVID-19 effects.

DISADVANTAGES:

A major challenge is the dependency on wearable sensors, which may not always be accurate or comfortable for long-term use. Data privacy is a concern since sensitive health information is transmitted over networks, making it vulnerable to breaches. The system requires stable internet connectivity, which may not be available in rural or underdeveloped areas. High implementation costs for IoT devices and ML infrastructure could limit accessibility. False alarms due to sensor errors or non-COVID-related health fluctuations might also occur.

DETAIL OF MODEL/ARCHITECTURE:

The system consists of three main layers:
1. Sensing Layer – Wearable devices (like smart bands or patches) collect vital signs (temperature, SpO2, heart rate).
2. Network Layer – Data is sent via Bluetooth/WiFi to a gateway (like a smartphone or hub), which forwards it to the cloud.

3. Cloud & AI Layer – ML algorithms analyze trends, detect anomalies, and classify COVID-19 risk levels. Doctors receive alerts via a dashboard, and emergency notifications are sent if critical conditions are detected.

Modeling

The system uses supervised machine learning models trained on historical COVID-19 patient data. Algorithms like Decision Trees or Neural Networks classify symptom severity based on input from sensors. For example, a sudden drop in oxygen levels combined with high fever may trigger a "high risk" alert. The models continuously improve as more patient data is collected, increasing prediction accuracy over time. A rule-based system ensures immediate alerts for life-threatening conditions, while predictive analytics helps in early intervention.

2) AI-Powered Honeypots for Enhanced IoT Botnet Detection
Author/s: V.A. Memos & K.E. Psannis
Publication Year: 2020

IMPACT:
IoT has advanced technology by connecting physical devices to the internet, but this also opens them to cyberattacks. Hackers can exploit security gaps to control these devices which is why integrating AI into honeypot systems improves botnet detection in IoT environments by using machine learning to analyze malicious behavior and identify threats early, minimizing potential damage. This approach allows for the early detection of threats, reducing the potential damage caused by botnet attacks.

ADVANTAGES:
One of the primary advantages of AI-powered honeypots is their dynamic adaptability. Unlike traditional static honeypots, these systems can simulate realistic network behaviors, making them more convincing to attackers and thereby collecting more accurate data on malicious activities. Additionally, the use of AI enables the system to evolve in response to new attack methods, ensuring continuous protection. Additionally, the deployment of these honeypots can be more cost-effective, as AI can automate many processes instead of manual intervention. This automation not only reduces operational costs but also allows for faster response times to potential threats.

DISADVANTAGES:
Despite their benefits, AI-powered honeypots also present certain challenges. One significant concern is the potential for these systems to exhibit predictable patterns, which skilled attackers might detect, thereby rendering honeypot ineffective. While the deployment can be cost-effective, maintaining the AI models requires substantial resources, including specialized hardware and skilled personnel, which can be costly. Thus, careful implementation and continuous monitoring are required to mitigate these risks.

DETAIL OF MODEL/ARCHITECTURE:

The architecture of the AI-powered honeypot system involves a hybrid approach that combines traditional honeypot techniques with advanced AI methodologies. Each honeypot is connected to a central cloud server for analyzing potential attacks. The system utilizes machine learning algorithms to assess the likelihood of botnet presence. Specifically, supervised logistic regression is employed to process input data and estimate the probability of a device being part of a botnet.

3) IoT Based AI and its Implementations in Industries
Author/s: Sherif El-Gendy
Publication Year: 2020

IMPACT:

The integration of IoT and AI has transformed industries by enabling smarter automation, predictive maintenance, and real-time decision-making. Known as **Industry 4.0**, this shift allows machines to communicate (M2M) and optimize processes without human intervention. Industries benefit from reduced costs, improved efficiency, and enhanced safety. For example, AI-powered IoT sensors can predict equipment failures before they happen, minimizing downtime. This technology also supports sustainability by optimizing energy use and reducing waste.

ADVANTAGES:

One of the biggest advantages of IoT-based AI is improved efficiency, as AI can quickly analyze data from sensors and automate repetitive tasks. Predictive maintenance, another key benefit, helps prevent costly machine breakdowns by detecting issues before they cause major problems. Real-time monitoring allows industries to track performance and make instant adjustments, while the system's scalability means more devices can be added as needed. Additionally, AI helps in decision-making by processing large amounts of data and suggesting the best actions.

DISADVANTAGES:

Despite these benefits, there are also disadvantages, including security risks from increased connectivity, high initial costs for setting up the system, and the complexity of integrating AI with existing machinery. Privacy concerns also arise due to the large-scale collection of data, and reliance on stable internet connectivity means network failures can disrupt operations.

DETAIL OF MODEL/ARCHITECTURE:

The architecture of IoT-based AI systems consists of four main layers working together. The first layer includes sensors and devices that collect data from machines and the environment. The second layer is the network, which transmits this data using technologies like Wi-Fi, 5G, or Bluetooth. The third layer is where AI processes and analyzes the data, identifying patterns and making predictions. Finally, the application layer uses this analyzed data to control machines, send alerts, or display insights on dashboards for human operators. The system operates in a continuous loop sensors gather data, networks transmit it, AI processes it, and actions are taken automatically or with human oversight. This seamless integration of IoT and AI is revolutionizing industries, making them faster, smarter, and more efficient. However, for wider adoption, challenges like security, cost, and system complexity must be addressed.

4) Artificial Intelligence of Things Wearable System for Cardiac Disease Detection
Author/s: Y. -J. Lin et al.
Publication Year: 2019

IMPACT:

This system has a cardiac risk mitigation that enables early detection of arrhythmias, reducing the risk of strokes and sudden cardiac deaths and has an AIoT Advancement in which it combines AI and IoT to create a continuous, intelligent health monitoring platform.

ADVANTAGES:

The advantages of this are it has high diagnostic accuracy, where the CNN-based model achieved 94.96% accuracy using real patient data. It also has Real-Time monitoring and alerts in which instantly labeling and warning capabilities through the app. Adding to it is an end-to-end integration and big data utilization where the cloud storage allows continuous improvement of AI through more training data.

DISADVANTAGES:

As for the disadvantages, this system's device dependency requires users to wear the ECG patch continuously, which may affect comfort or adherence. Another thing is that the connectivity requirements relies on Bluetooth and internet connectivity for real-time analysis and data upload. Privacy and data security is also a problem in storing ECG data in the cloud and introduces privacy risks unless adequately protected. And lastly, for the model imitations, the performance may degrade in non-ideal real-world conditions such as movement artifacts and noise.

DETAIL OF MODEL/ARCHITECTURE:

The system architecture's hardware have wearable ECG patch equipped with Analog front-end (AFE) circuit for signal acquisition and Bluetooth module for wireless transmission. There's also a mobile app, cloud database, and an AI platform that uses a Convolutional Neural Network (CNN) for classifying cardiac diseases, especially arrhythmias (including atrial fibrillation, bradycardia, and tachycardia).

5) Stress Detector System Using IoT and Artificial Intelligence
Author/s: A. Mustafa, M. Alahmed, A. Alhammadi, & B. Soudan
Publication Year: 2020

IMPACT:

It offers a non-invasive, real-time system for detecting stress, which has the potential for reducing the risk of stress-related illnesses such as heart disease. It is also for preventive healthcare which allows early intervention by notifying users and healthcare providers before stress leads to serious outcomes. Additionally, for mental health awareness, as this system promotes stress self-management and awareness through personalized feedback.

ADVANTAGES:

The advantages are it has a real-time monitoring which enables instant stress detection and feedback through mobile phones. Another thing is that it is cloud-based AI analysis which offloads computation to the cloud, allowing for more complex AI models without draining local resources. Addiotionally, it is a user-centric design and has high classification accuracy, as it provides personalized suggestions for stress relief and alerts medical professionals if needed, and it was reported to have 97.6% accuracy in binary classification for physiological data.

DISADVANTAGES:

The disadvantages of it however are it doesn't have privacy and security concerns, has reliance on mobile devices, is cloud dependent, and has limited classification.

DETAIL OF MODEL/ARCHITECTURE:

The system uses three key physiological sensors: Skin Conductance Sensor (also known as Galvanic Skin Response or EDA sensor), ECG Sensor for heart rate variability (HRV), and Skin Temperature Sensor. For its architecture, the data acquisition have sensors embedded in a wearable device that collect real-time physiological data. The data is transmitted to a cloud server via the user’s mobile phone. And the AI algorithms analyzes the data to determine stress levels. The UI or the User Interface has a mobile app that displays the stress state and suggests stress-relieving activities.

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DOCUMENTATION: