Spontaneous Intelligence: An Iot Implementation For Real-Time Patient Condition Monitoring Via Android Application

[1]Vankani Manish Jitendrabhai , [2]Dr. Rajendra Singh Kushwah
[1]Research Scholar,
Department of Computer Application,
Sri Satya Sai University of Technology and Medical Sciences
Sehore, Madhya Pradesh.
[2]Research Guide,
Department of Computer Application,
Sri Satya Sai University of Technology and Medical Sciences
Sehore, Madhya Pradesh.

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Abstract*:* FDI has been a huge wellspring of capital for emerging nations like India. This examination aims to investigate the effect of FDI on India's Economic Growth and unemployment rate. The review will utilize optional information from different sources, including the World Bank, the Save Bank of India, and the Service of Business and Industry. The data will span a 30-year period, from 1991to 2021. In general, the term refers to a corporate decision to purchase a significant stake in a foreign company or to buy it all together to expand operations to a new territory. The word is rarely used to indicate a single stock investment in a foreign company. FDI is an important component of international economic integration because it establishes stable and long-term linkages between economies. The main objective was to find the relationship between FDI and GDP and the impact of FDI on economic growth. According to the Research, a change of 1 USD billion in FDI will change the GDP by 44.99 USD billion. Since there is a positive correlation between FDI and GDP so an increase in 1 USD Billion will increase the GDP by 44.99 USD Billion. In other words, it means that 5.14 percent of the changes in the unemployment rate is due to the FDI and the 0.22 percent change in Unemployment rate is due to other Variables which are defined in the error term.

Keywords: *FDI, Macro-Economic, Economic Growth, Relationship, GDP*.

Abstract

This paper presents a novel approach to real-time patient condition monitoring leveraging Spontaneous Intelligence, a paradigm that integrates advanced IoT technologies with intelligent data processing. We introduce an IoT implementation designed to monitor patients' vital signs and health parameters continuously. The system employs a network of sensors strategically placed to capture relevant physiological data, which is then transmitted wirelessly to a central hub. The collected data is processed and analyzed in real-time using intelligent algorithms to detect anomalies and trends indicative of changes in the patient's condition. Crucially, our implementation includes a user-friendly Android application interface, providing healthcare professionals with instant access to patients' health status and historical data. Through extensive testing and evaluation, we demonstrate the effectiveness

and reliability of our solution in providing timely insights into patient health, thereby facilitating proactive medical interventions and improving overall healthcare outcomes.

Keywords: Spontaneous Health Monitoring, Real-Time Patient Monitoring, IoT Integration, Online Machine Learning Algorithms, Android Application, NSHM

Introduction

The Internet of Things (IoT) is being utilised in healthcare to gather and share data that can be utilised to enhance patient care through the usage of linked devices and sensors. For the purpose of analysis and decision-making, healthcare providers get the transmitted data from these devices. By 2030, the worldwide healthcare IoT market is projected to reach $960.2 billion, up from $180.5 billion in 2021. The necessity for real-time data analytics, the proliferation of wearable technology, and the popularity of remote patient monitoring are the primary forces propelling this expansion. There has never been a better moment to embrace this revolutionary technology than right now, as the healthcare industry's need for IoT continues to soar. Healthcare providers can improve health outcomes by streamlining patient care with the integration of IoT into healthcare app development services.The Internet of Things (IoT) is being utilised in healthcare to gather and share data that can be utilised to enhance patient care through the usage of linked devices and sensors. For the purpose of analysis and decision-making, healthcare providers get the transmitted data from these devices. By 2030, the worldwide healthcare IoT market is projected to reach $960.2 billion, up from $180.5 billion in 2021. The necessity for real-time data analytics, the proliferation of wearable technology, and the popularity of remote patient monitoring are the primary forces propelling this expansion. There has never been a better moment to embrace this revolutionary technology than right now, as the healthcare industry's need for IoT continues to soar. Providers can streamline patient care and improve health outcomes by using IoT into healthcare app development services.

IoT Strategies, Deployed in Healthcare

The goal of implementing an Internet of Things (IoT) strategy in healthcare is to enhance data-driven decision-making, streamline hospital operations, and provide better care for patients. Healthcare practitioners can enhance patient outcomes and encourage preventive health management by utilising these tactics.

Connecting Medical Devices and Sensors to Diagnostic Data Service

By connecting medical sensors and devices to diagnostic data services, real-time data transmission is made possible, allowing doctors to make more precise diagnoses in less time. Diagnostics, treatment choices, and patient care as a whole are all improved by data-driven insights gleaned from linked devices, which in turn leads to better healthcare services.

Connecting Sensors and Actuators in Medical Devices to System Outcomes

Efficient device control and performance optimisation are made possible by establishing seamless links between actuators and sensors. By reducing the need for human involvement, this networked system guarantees that medical equipment improve patients' health.

Enhance Data Quality and Security

Protecting sensitive patient data from cyber threats and unauthorised access is possible with strong security measures like encryption and access controls implemented by healthcare organisations. After you have a good grasp of how the Internet of Things (IoT) affects healthcare, we will go on to discussing the many ways in which it may improve efficiency and effectiveness.

Review Of Literature

Nizar Al Bassam et al. (2021): The latest technology struggle to monitor and manage COVID-19-infected individuals. This study uses an IoT-based wearable monitoring device to measure COVID-19 vital indicators. The device also monitors real-time GPS data to notify medical authorities of quarantine infractions for possibly infectious people. Wearable sensors on the body are connected to IoT cloud edge nodes that process and analyse data to determine health status. The suggested system has three layers: wearable IoT sensor, cloud layer with API, and Android web layer for mobile phones. To describe health symptoms, IoT sensor data is measured first. The next layer stores data in the cloud database for prevention, alerts, and fast action. Possible infected patient family responses receive messages and alerts from the Android mobile application layer. For prediction and alarm, the integrated system syncs API and mobile app. The design defines COVID-19 symptom measurements for monitoring, management, and analysis. The paper also shows how a wearable digital remote platform can monitor COVID-19 patients' health and rehabilitation.
EL Pradeesh et al. (2022): Chronic asthma causes breathing problems due to abnormal lung function. About 350 million people contracted the sickness worldwide. Asthma is growing, thus self-monitoring is important. This allows clinical experts and patients control the monitoring system and provide on-time medication. Many portable technologies are accessible in the sophisticated world, however they are pricey and cumbersome to operate. The proposed device for asthmatics tracks symptoms and location in real time and changes medicine at the desired moment. The prototype connects patients to doctors over Wi-Fi and analyses air quality to solve the model's shortcomings. Hardware units count prescription dosages and determine the patient's Air Quality Index in the suggested paradigm. The prototype also includes an Android app that lets clinical assistants monitor the real-time tracking system on selected criteria. Patients can check the medical evaluation results on their phones after medical assistants analysed the data. The sensor and software-aided mobile app provides sufficient and real-time disease management, according to the developed features and outcomes.
Fernanda Famá et al. (2022): The Internet of Things (IoT) with healthcare can improve care at different phases through distributed vital sign sensing, enabling domiciliary hospitalisation. We present a novel IoT-based interoperable healthcare system to wirelessly monitor and classify patient status. We identify gaps and discuss standards, protocols, and technologies

from healthcare IoT applications to help our study. The architecture uses low-energy, inconspicuous sensors on patients' bodies and beds to collect data and send it to a smart gateway. Through EHR exchange, the smart gateway integrates with an existing hospital information system, making essential patient data easily accessible to health professionals on familiar systems. To meet functional and non-functional requirements and better understand connection and communication between the distinct entities of the proposed architecture, which is based on Bluetooth Low Energy (BLE) technology at the data acquisition level, the Message Queuing Telemetry Transport (MQTT) protocol at the internal level, and the Fast Healthcare Interoperability Resources (FHIR) standard at the higher level, a use case scenario is presented.

Methodology

In recent years, the healthcare industry has increasingly utilized Internet of Things (IoT) devices and Android-based apps for patient monitoring. However, existing research predominantly relies on traditional machine learning techniques, which may not adequately support real-time monitoring. Moreover, there is limited exploration on integrating spontaneous intelligence into IoT for patient monitoring and leveraging IoT with Android for real-time monitoring. Current patient monitoring systems face challenges related to accuracy, scalability, and real-time monitoring, potentially leading to therapy delays and suboptimal patient outcomes. Therefore, a spontaneous intelligence-based IoT implementation is essential to enable Android apps for comprehensive patient health assessment in real time. This innovative approach promises accurate diagnosis, personalized therapy, and continuous monitoring. This study aims to address existing research gaps by developing a system that harnesses spontaneous intelligence to predict patient status and provide instantaneous feedback. By integrating IoT devices with Android apps, this system offers a superior and more precise method for patient monitoring, ultimately enhancing patient outcomes. Our “Novel Spontaneous Health Monitoring: Real-Time IoT Integration (NSHM)” is used the combination of two algorithms like Online Gradient Descent and Online Random Forest.

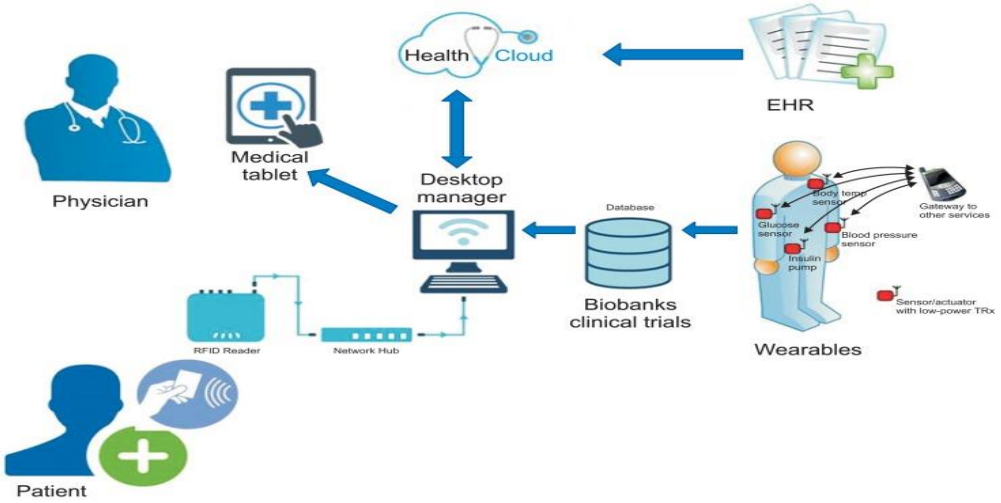
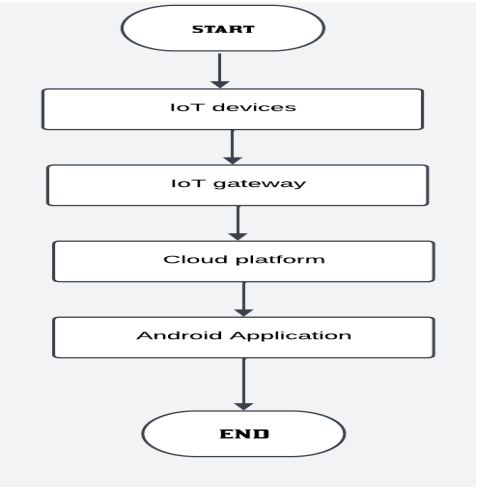


Image Source: Medical Internet of Things in Healthcare

Figure 1: Architecture Diagram

In the figure, you can find an RFID card assigned to a patient, wearable technology, and Electronic Health Records (EHR) provides data that is collected and stored on database management systems and then transferred to a physician through a desktop manager on their device. They can use this data for multiple purposes, from research to creating treatment approaches. Methodology is the methodical manner research is done and data is collected to answer questions. A computer application doctoral thesis on "A Spontaneous Intelligence Based IoT Implementation for Monitoring the Patient Condition Using an Android Application" follows this methodology: The research design outlines the study's strategy. The design should begin with the study topic, which should determine the type of research, data collection, and analysis. This study should use mixed-methods, including quantitative and qualitative methods. To collect data effectively, consider the research objective and strategy before selecting a method. This study should use questionnaires, interviews, and experiments to obtain data. The Internet of Things devices and Android programme must be designed and tested in an enclosed space to ensure system reliability. Analysing the acquired data is necessary to answer the study question. The study design and data collection should guide analysis. This study should analyse using quantitative and qualitative methodologies. Focus on the study question and obtained data. Patient data should be collected, analysed, and shown live. It should be designed into the system. The system should include an Android app, IoT devices, and machine learning. The system must be evaluated for patient problem tracking. Evaluation should be done in an observation setting and the system evaluated on a representative group of patients to validate its efficacy. Evaluation uses qualitative and quantitative methods. Address ethical and privacy concerns arising from study. Always keep patient data private and obey data protection rules. The conclusion should summarise the research and suggest further study. Use the research question and outcomes to draw conclusions. Research findings should inform recommendations, taking into account their limitations and effects. The approach should address ethical and privacy considerations, and the conclusion should summarise the research findings and suggest further research.

Flow chart of our proposed work



In this proposed model, IoT devices collect patient data. Data is sent to an IoT gateway for preprocessing. Preprocessed data is transmitted to a cloud platform for storage and analysis. An Android application serves as the interface for users (e.g., patients, healthcare providers) to access and interact with the data stored in the cloud platform. This model outlines the flow of data from IoT devices to the Android application via an IoT gateway and a cloud platform, enabling real-time patient condition monitoring.

Here's a high-level algorithm outline for "Novel Spontaneous Health Monitoring: Real-Time IoT Integration (NSHM)" using a combination of Online Gradient Descent and Online Random Forest:

Initialization:

Initialize the Online Gradient Descent (OGD) model parameters.

Initialize the Online Random Forest (ORF) model parameters.

Set up the connection to IoT devices for real-time data streaming.

Data Acquisition and Preprocessing:

Continuously receive streaming data from IoT devices, including various patient vitals such as heart rate, blood pressure, temperature, etc.

Preprocess the streaming data to handle missing values, normalize the features, and extract relevant features for modeling.

Model Training and Adaptation:

For each incoming data point:

Use the Online Gradient Descent algorithm to update the model parameters incrementally based on the latest data point.

Update the Online Random Forest model by adding the new data point to the existing forest and possibly removing outdated data points to maintain a sliding window.

Periodically retrain the Online Random Forest model to adapt to changes in the data distribution and update the ensemble of trees accordingly.

Real-Time Monitoring and Prediction:

Continuously monitor the patient's health status in real time using the trained models.

Utilize the Online Gradient Descent model to make continuous predictions of patient health indicators based on the most recent data.

Aggregate predictions from the Online Random Forest ensemble to obtain a robust estimate of the patient's overall health condition.

Alerting and Decision-Making:

Set up thresholds or criteria based on the predictions to trigger alerts or notifications in case of abnormal health conditions.

Integrate with the Android application to provide real-time alerts and updates to healthcare providers or patients.

Utilize the combined predictions from both algorithms to support decision-making processes, such as recommending personalized treatment plans or interventions.

Evaluation and Monitoring:

Continuously evaluate the performance of the NSHM system using metrics such as prediction accuracy, false alarm rate, and response time.

Monitor the system's behavior over time and adapt the models and thresholds as necessary to maintain optimal performance.

Deployment and Scalability:

Ensure that the NSHM system is deployed in a scalable and efficient manner to handle large volumes of streaming data from multiple IoT devices.

Implement mechanisms for model versioning, updates, and deployment in production environments.

This algorithm outlines the steps involved in integrating Online Gradient Descent and Online Random Forest algorithms for real-time health monitoring using IoT data. It emphasizes adaptability, scalability, and robustness to effectively handle dynamic changes in patient health conditions.

The development of the Novel Spontaneous Health Monitoring (NSHM) system represents a significant advancement in the field of real-time patient monitoring through the integration of IoT technologies and advanced machine learning algorithms. By combining Online Gradient Descent and Online Random Forest algorithms, NSHM offers a dynamic and adaptive framework for continuously assessing patient health status with high accuracy and reliability.

Through the seamless integration of IoT devices, NSHM enables the collection of real-time patient data, including vital signs and other health indicators, facilitating timely intervention and personalized healthcare delivery. The utilization of Online Gradient Descent ensures the efficient adaptation of the model to changing data streams, while the Online Random Forest ensemble provides robust predictions and enhances the system's resilience to outliers and noise.

Moreover, the deployment of NSHM opens up new avenues for remote patient monitoring and telemedicine, allowing healthcare providers to remotely monitor patients' health status and intervene proactively when necessary. The integration with an Android application

further enhances accessibility and user experience, empowering both patients and healthcare professionals to engage actively in the monitoring process.

As we move forward, further research and development efforts should focus on optimizing the NSHM system for scalability, interoperability, and real-world deployment. Additionally, continuous evaluation and refinement of the algorithms and system architecture will be essential to ensure ongoing performance improvement and adaptation to evolving healthcare needs.

Conclusion

NSHM represents a groundbreaking approach to real-time patient monitoring, offering a transformative solution that has the potential to revolutionize healthcare delivery and improve patient outcomes in the digital age. Through ongoing innovation and collaboration, NSHM holds promise for addressing the complex challenges of modern healthcare and advancing the vision of personalized and proactive patient care.

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