
IMAGE: A MAP OF THE STARS OF THE ORION CONSTELLATION

Print ISSN: 2514-863X Online ISSN: 2514-8648

# JournalPreview

London Journal of Research in Computer Science and Technology
Volume 23 | Issue 3 | Compilation 1.0

Great Britain Journals Press

WWW.JOURNALSPRESS.COM

# Journal Content
## In this Issue

Great Britain Journals Press

# Internet of Things and Machine Learning Implementation in the Healthcare Sector

*Dina Darwish*

*Ahram Canadian university*

## ABSTRACT

Modern health monitoring is crucial. Today's busy lifestyles lead to early health issues. Many issues occur from daily routines. Despite their ignorance of the risks, people enjoy many hobbies. Thus, identifying daily activities that affect health and predicting future diseases is crucial. However, electronic health data can forecast diseases like diabetes, TB, and others.

Machine learning is used to predict a person's overall health. A complete health examination includes sleep quality, food, physical activity, and other elements. Also, the internet of things (IoT) is crucial in monitoring health and giving information when abnormalities occur. This paper focuses on the importance of monitoring health, and the role of the internet of things and machine learning in accomplishing this. And, providing the usage percentages of IoT applications in the healthcare sector from different countries.

*Keywords:* internet of things, machine learning, monitoring health, applications, usage percentages.

*Classification:* LCC Code: RC488.5 .I57

*Language:* English

Great Britain Journals Press

*LJP Copyright ID: 975831*
*Print ISSN: 2514-863X*
*Online ISSN: 2514-8648*

London Journal of Research in Computer Science and Technology

Volume 23 | Issue 3 | Compilation 1.0

# Internet of Things and Machine Learning Implementation in the Healthcare Sector

Dina Darwish

## ABSTRACT

*Modern health monitoring is crucial. Today's busy lifestyles lead to early health issues. Many issues occur from daily routines. Despite their ignorance of the risks, people enjoy many hobbies. Thus, identifying daily activities that affect health and predicting future diseases is crucial. However, electronic health data can forecast diseases like diabetes, TB, and others.*

*Machine learning is used to predict a person's overall health. A complete health examination includes sleep quality, food, physical activity, and other elements. Also, the internet of things (IoT) is crucial in monitoring health and giving information when abnormalities occur. This paper focuses on the importance of monitoring health, and the role of the internet of things and machine learning in accomplishing this. And, providing the usage percentages of IoT applications in the healthcare sector from different countries.*

*Keywords:* internet of things, machine learning, monitoring health, applications, usage percentages.

*Author:* Ahram Canadian university, Egypt.

## I. INTRODUCTION

Digital Technology helps society in achieving global health prospects. Sustainable Development 2030 highlights ICT growth and its worldwide influence, since interconnectedness can accelerate human progress. Strategies and actions are needed to close the digital divide and create knowledge societies. Technology has improved government services, and made them more accessible to more people, especially in healthcare, because services and data that were unavailable previously, are now affordable. Ministers and delegation heads are involved in exploiting healthcare information to obtain sustainable growth, accelerate progress in the healthcare field, and help in reaching the health related sustainable development goals (SDGs).

The commercial sector and civic society play a crucial role, because the information and communication includes academic and technolo -gical communities. Developing countries urge the World Health Organization (WHO) to act in its field. The World Summit on the Information Society (WSIS) emphasizes ICTs at a global level.

Then, it is important to allocate enough resources and recognize information and communications roles in this case since technology opens new possibilities, at the same time, achieving the 17 sustainable development goals. Global health experts increasingly agree on the importance of strategic use of digital technologies and cutting-edge information systems. Concerted efforts are needed to include an extra billion people in universal access to critical services facilitated by ICT. WHO [1] asserted on digital interventions and using technology to solve problems and improve outcomes. The "health system" is the comprehensive network of organizations, and resources that deliver medical services and promote health. Digital health's 2020–2025 global plan emphasizes technology use.

Health emergencies are a priority to help one billion people, and health coverage protects an additional billion people. The Thirteenth General Program of Work, from 2019 to 2023, sets an organization's goals and priorities. IoT, virtual care, and remote technologies are being used in more fields, and AI, big data analytics, and blockchain technologies are being used in academic and professional fields. Data-sharing

platforms, wearables, and tools, and remote data capture and interchange using storage systems and technology are used to enable Healthcare information sharing. Medical diagnosis and data-driven treatment can enhance outcomes, and decision-making, digital therapies, clinical trials, and healthcare self-management are essential.

Professional support requires knowledge, skills, and competence to enhance evidence-based practices and person-centered care. Despite great achievements by some nations, many nations remain confronting development issues and still need institutional help to develop, then, national eHealth/digital health plans and initiatives are needed, and their action plan requires extra work.

This analysis examines resources and capabilities, and digital health strategy worldwide is needed for the goal of improving and supplementing existing and new efforts. Digital health promotes evidence-based practices to improve healthcare outcomes depending on disruptive technologies like AI and IoT and others. The WHO guideline covers "digital health interventions."

Health system strengthening is essential and health plans should include digital health. The major goal is to let people benefit ethically while maintaining safety, security, and reliability. Academic fields prioritize equity and sustainability. Development should follow principles. Academics value transparency, accessibility, scalability, replicability, and interoperability. Technology, law, and ethics all require privacy, security, and confidentiality.

These principles protect sensitive data. This paper focuses on the importance of individual health and the role of digital technologies like AI and IoT in enhancing healthcare. The rest of the paper is organized as follows section 2 includes importance of individual health, section 3 focuses on using machine learning in healthcare, then, section 4 focuses on IoT role and usage in the healthcare sector, then finally, conclusions and future scope are discussed.

## II. INDIVIDUAL HEALTH

A person's health is assessed by comparing it to others, also, parameters can estimate a person's health. Sleep, screen time, diseases and smoking affect one's health, and calories and exercise have an influence on the health. There are daily activities that affect our health, like watching TV, listening, playing sports, and walking. An individual's physical metrics include height, weight, age, gender and other characteristics, activities change more than these metrics. Consultants can offer broad health projections, after knowing the person's sleep quality and adequacy.

Sleep professionals at sleep centers can advise people on how much sleep they need. If people want to know their caloric needs, and how can they manage calorie intake to maintain, increase, or lose weight? How much exercise need they do to reach these goals? They need to go to medical practitioners, since they can advice them on calorie balance. Professionals analyze many criteria and measurements before making suggestions, also they follow particular norms and criteria in this case. For instance, a 20-year-old boy, 175 cm tall, 63 kg, and to maintain weight, low-activity people should consume 1,950 calories each day. But this technique ignores critical features like sleep and calorie status that requires separate expertise. Predicting these events without computations may be inaccurate. Professional counsel may cost low-middle and middle-class families. Thus, a model that predicts their health based on multiple parameters is needed.

Knowing one's health helps prevent future ailments. As mentioned, sleep patterns affect health beside smoking, sickness, and other factors. Healthcare data management emphasizes data handling efficiency. Patients create a lot of organized and unstructured data, besides diagnostics, doctor prescriptions, and wearable devices, that are now unstructured data that need to be collected and analyzed to be used in the benefit of a person's health. Data analysis can be accomplished through the use of machine

learning and collected from smart devices connected to the internet (IoT).

## III. AI IN HEALTHCARE

Healthcare focuses on data analysis and forecasting in healthcare domains. Disease prediction has a big impact on healthcare analytics. Predictive models help prevent preventable illness epidemics, improving quality of life. Several recent studies have proposed health prediction models. With many considerations. Sahoo, Mohapatra, and Wu proposed in a study [2]. The study established a cloud-based probabilistic data collecting system and a framework for forecasting an individual's future health state using their current health status. Hirshkowitz et al. [3] developed a sleep duration assessment and suggestion system using age based classification. Researchers [4] proposed a new approach for 21st-Century Health Status Estimation Using Machine Learning. The study introduced the Convolutional Neural Network for disease risk prediction. A study using unimodal illness risk prediction and CNN-based multimodal disease analysis found that risk prediction intrigues. Weng, and his colleagues [5] examined disease prediction methods using ANNs. The researchers evaluated and contrasted each method using statistics. Researchers [6] devised a technique to collect health data using a specific method, in which, deep learning architectures assessed questionnaire results. Tayeb et al. [7] employed K-Nearest Neighbors (KNN) to predict cardiac disease and chronic renal failure. The author [8] proposed using EMRs to predict strokes. The researchers compared Deep Neural Networks (DNNs) to gradients in Error Correction Mechanisms (EMCs). Researchers [9] suggested a cloud-based smart clothing system for sustainability and human well-being monitoring, also, technology implementation was also discussed. Regarding studied methods, Schmidt, Tittlbach, Bös, and Woll [10] examined numerous types. Over 18 years, the researchers found substantial links between fitness, health, and physical activity. In a recent university fitness center data analysis [11], user fitness activity data predicts fitness center occupancy, but the fitness activity data can be predictive. Health parameter quantification study is extensive. Additionally, The computation of health parameters using alternate parameters is well-documented. Harris-Benedict [12] uses physical measurements to calculate a person's BMR. This method estimates the calorie needs for optimal health.

Daily living activities affect health. Personalization can tailor health projections and recommendations, and this inspired the design of a daily life-based health prediction model. In the new Healthcare Era, the society healthcare is influenced by many factors, and affects in the finance, transportation , and entertainment. Big data and machine learning algorithms have transformed data analysis and insight extraction.

Integration has improved predictive analytics, pattern detection, and decision-making. In summary, modern society includes entertainment, business, and healthcare. Netflix knows which films people like and shows them. The timing, location, and item preferences of consumers are of interest for companies, like Amazon and Google. This enquiry concerns symptoms and conditions people are actively researching. Data can be used for intricate individual profiling, which can be valuable. Behavioral knowledge and targeting can help us predict and understand healthcare trends.

AI could improve several fields. Healthcare includes diagnostics and therapy. Already important AI algorithms are performing comparisons in medical image interpretation and other activities, humans outperform machines. Using AI, examining symptoms and EMR biomarkers, as well as, characterizing and prognosticating diseases with EMRs can be performed. Many countries have a shortage of doctors due to increased healthcare demand. Healthcare facilities are likewise coping with many issues.

### *3.1 New Technology and Patient Expectations*

The user bases service and outcome expectations on Amazon and Apple items [13]. The advances in wireless technology and cellphones have opened many doors. Health tracking apps and search portals have enabled on-demand healthcare services, enabling remote healthcare delivery 24/7

interactions. Cost-effective techniques are needed to meet the needs of underserved and under specialized regions. Minimizing unneeded clinic exposure reduces the danger of communicable diseases. Recently, healthcare AI has garnered interest. AI, a discipline of computer science, creates intelligent machines that can do human tasks. Traditional healthcare infrastructure may be inadequate.

Healthcare infrastructure needs to be identified as the system expands. It was designed to meet current needs [14]. Though understandable, these solutions' success in treating patients requires thorough independent assessment, besides safety and efficacy are crucial. Today, AI-enabled healthcare technologies are gaining importance. Next-generation healthcare technology tools can be implemented. It's widely believed that AI improves healthcare operations and processes, also, AI application implementation which rely on the system, could save costs in the healthcare sector. Cost reductions come from reduction of hospitalizations, doctor visits, and medical care treatments from reactive to proactive healthcare, Health management is prioritized over disease treatment. AI-based technologies will help with many chores, since monitoring and guidance keep people healthy. To improve patient care, diagnose faster, personalize treatment programs, and improve monitoring and evaluations, AI-based healthcare technologies are expected to increase rapidly. Technology has advanced in the past decade, also, AI and data science has advanced. Currently, different applications have been explored for decades. The current AI enthusiasm is unique. Optimized computational processing speed, data collection capacity and AI talented people are required to accelerate AI development. The use of tools and technology [15,16] in the AI field, will revolutionize artificial intelligence (AI) technology and its widespread use and effect on society. Specifically, deep learning (DL) has significantly impacted healthcare.

The aforementioned reason has had a major impact on current AI tool viewpoints and has driven several AI tool innovations. Given the present enthusiasm for using artificial intelligence (AI) in numerous disciplines, it is clear that these applications are highly anticipated. Deep learning helps find information. Correlations are too complex for earlier machine approaches. Unlike prior neural networks, which had 35 levels of depth, Deep learning neural networks often include more than ten layers, simulating millions of artificial neurons. Many corporations dominate this sector, like Watson and Deep Mind. Artificial intelligence (AI) technology outperforms humans in some tasks and activities.

This category includes chess, Go, and other games. Watson and Google's Healthcare applications use DeepMind. Diabetes research uses IBM Watson. Advanced cancer care, modeling, and drug discovery remain underdeveloped. DeepMind is being investigated for mobile medical assistants, imaging-based diagnostics, and patient deterioration prediction [17,18]. Data and computation-based technologies have grown exponentially. Cost-effective services enable exponential expansion. In life sciences and healthcare, mapping the human genome and digitizing medical data could increase like genetic sequencing. Electronic health records and other tools lower profiling costs. Exponential growth is expected to dominate in this area.

### *3.2 Healthcare AI Use*

AI tools are thought to enhance human talents. AI in healthcare supports doctors and other healthcare workers. AI can help healthcare practitioners with many tasks, from administrative operations to clinical documentation, patient outreach, and medical image analysis. Healthcare uses gadget automation and patient monitoring. Forbes reported in 2018 that healthcare is of the utmost importance. Administrative workflows, image analysis, and robotic surgery are mentioned, Virtual assistants, connectivity and clinical decision support are crucial [19]. AI in healthcare is becoming more common. This study covers machines, dosage error reduction, and cybersecurity [20]. A report of McKinsey in 2019 discussed cognitive connected areas. Technology has enabled healthcare innovations. Devices, customized medicine, and robotics-assisted surgery are examples. Electroceuticals are

well-studied in research [21]. Numerous applications exist throughout the healthcare value chain. Also, drug development and ambient assisted living (AAL) research have grown in popularity.

### 3.3 Precision Medicine

Precision medicine is known as personalized medicine, is a new medical strategy that tailors treatments and interventions to individual patients. Precision medicine can tailor healthcare to patients' disease features. Genomic variants and other medical considerations will be considered in a customized therapeutic approach. Precision medicine examines age, gender, geography, race, family history, immunological profile, and metabolism. Precision medicine uses individual biological traits rather than population-based trends. Throughout a patient's treatment, data collection is involved. Individuals provide genetic and physiological data. Precision medicine benefits healthcare. Healthcare costs may be reduced. Precision medicine can save healthcare expenses by avoiding needless operations, testing, and drugs. Precision medicine reduces harmful medication reactions. Precision medicine is expected to benefit from its novel approaches. This study examines patient outcomes and health service delivery and evaluation changes after healthcare interventions. Modern healthcare emphasizes digital health apps and "omics"-based diagnostics.

Machine learning methods are used with large datasets. Many precision medicine initiatives benefit the discipline as a whole. Academic research often uses genetic, demographic, and electronic data. Health records can be diagnosis and therapy selection. Digital health apps record and process data.

Patients also reported diet, mental well-being, and physical activity using wearable, smartphone, and other health monitoring data. In precision medicine, machine learning algorithms find patterns in data sets to improve prediction and outcomes. Healthcare AI research is growing. Omics-based testing uses population genetic data. Machine learning algorithms find relationships and predict patient treatment responses. Metabolite profiles can also reveal health and disease. These biomarkers provide a complete picture of an individual's physiological condition and can be used to determine disease risks, progression, and treatment efficacy. Protein expression patterns can help researchers understand disease mechanisms. The gut microbiome's makeup and diversity can illuminate microbial communities' function in health and disease. Metabolite profiles also reveal a person's metabolic processes. Metabolic profiling and machine learning can provide personalized treatment [22, 23].

### 3.4 Healthcare AI Implementation Barriers

In order to assess the potential fluctuations in the healthcare industry's integration of artificial intelligence (AI), specifically with regards to variables associated with technological adoption. What insights can be gleaned from previous healthcare information technology (IT) implementations?

The scholarly literature underscores the significance of integrating advancements in the implementation of artificial intelligence (AI) and other information technology within enterprises. The successful implementation of electronic medical records necessitated the utilization of inventive strategies for integrating software systems and introduced novel procedures for healthcare professionals, chemists, and other occupations within the healthcare industry. Consequently, the greater affordability of complementary innovation in larger corporations and metropolitan regions is anticipated to result in a higher prevalence of AI implementation within larger healthcare institutions and urban locales.

The application of artificial intelligence (AI) in the healthcare sector can be exemplified by the analysis of a substantial dataset consisting of 1,840,784 job advertisements originating from 4,556 hospitals. A total of 1,479 job listings from 126 hospitals were assessed by Burning Glass Technologies, with a specific focus on the requirement of artificial intelligence (AI) skills.

The job listings encompassed positions such as "Analytics Architect," "Bioinformatics Analyst," "Cardiac Sonographer," "Physician - Internal Medicine," and "Respiratory Therapist." The findings of the analysis revealed that a majority of AI-related job opportunities, specifically 60%, were categorized as clinical positions. Administrative roles accounted for 34% of the job opportunities, while research-focused positions constituted a smaller proportion of 6%.

The research identified a total of 1,479 job advertisements related to artificial intelligence. A significant discovery indicates a deficiency in healthcare skills related to artificial intelligence. Based on the findings of a previous study in the field of information technology, it has been observed that the 126 hospitals that are actively recruiting for artificial intelligence (AI) positions tend to exhibit a higher number of personnel and are predominantly situated in densely populated urban areas. It is anticipated that artificial intelligence (AI) has the potential to ameliorate the existing state of affairs in the healthcare sector. It is anticipated that the implementation of artificial intelligence will primarily commence within large-scale institutions and major urban centers, encompassing domains such as electronic medical records, computer systems, and the commercial internet.

Gaining insight into the factors that contribute to hospitals' reluctance to adopt artificial intelligence (AI) is imperative for comprehending the potential complementary advancements that could facilitate its implementation within healthcare settings. There are several factors that impede the widespread adoption of a proposal, including algorithmic limitations, restrictions on data access, legislative barriers, and misaligned incentives.

### *3.4.1 Legal and Administrative Hurdles*

Legal and administrative hurdles hinder industry and sector operations. Foundational regulatory constraints cause algorithmic and data issues. Three types of regulations matter. Privacy regulations initially complicate healthcare data collection and consolidation. Due to privacy concerns in the healthcare field, using actual health data to train AI models may be difficult, slowing progress compared to other industries. Novel medical technology requires lengthy and demanding regulatory approval. Innovation clearance takes years. Health care providers' fear of responsibility can also prevent them from adopting innovative technologies. Health care regulation is more conservative than in other businesses. This means that innovative regulatory frameworks are needed to integrate AI into healthcare. This approach will maximize AI's benefits while protecting patient rights and maintaining high-quality healthcare. Three regulatory hurdles could be modified to complement each other. These issues involve health care data ownership and use, AI medical device and software approval, and medical provider-AI developer liability.

### *3.4.2 Data Constraints*

Data quality affects AI algorithm performance. Thus, data scarcity is another barrier to adoption. Medical data gathering and access are difficult. Medical practitioners sometimes dislike data collecting because it disturbs their workflow and produces incomplete data. Data aggregation between hospitals or healthcare providers is difficult. Electronic Healthcare Record (EHR) systems used by government-certified providers serving hospitals and healthcare facilities are incompatible, resulting in localized data collection rather than an integrated approach to documenting a patient's medical history across multiple providers. Lack of large, high-quality datasets hinders AI system development.

### *3.4.3 Algorithm Limitations*

Neural network advancements have increased artificial intelligence's potential but decreased interpretability. Neural networks make AI algorithms "black boxes" that require a lot of work to understand. Thus, without proactive efforts to identify issues with neural network-generated algorithms, there is a risk that the AI will produce flawed solutions that are only discovered after deployment. This lack of transparency can undermine trust in AI and impede its adoption by

healthcare providers, especially since doctors and hospitals may be held responsible for decisions involving AI. Complementary innovation in trustworthy AI, such as using technology or methods to understand AI algorithms, is widely recognized. Many large-scale projects aim to develop and improve AI. Interpretable AI could reduce the black box problem and increase confidence. Healthcare practitioners may trust AI systems by understanding how AI makes suggestions. Individuals are working to standardize AI clinical trial techniques. These efforts should improve healthcare AI integration. Implementing such criteria will help healthcare practitioners identify how biases or knowledge gaps affected an AI system's suggestions.

## IV. IOT SITUATION IN HEALTHCARE

This section provides an overview of the global healthcare Internet of Things (IoT) industry. Medical devices can be categorized into fixed, wearable, implanted, and other classifications. The software and system components encompass various segments, such as application security, network security, data analytics, remote device management, and network bandwidth control. The market is divided into segments based on services, products, connectivity, and end users.

This section investigates industry trends, growth prospects, and regional forecasts spanning the period from 2022 to 2030. The global healthcare Internet of Things (IoT) market attained a valuation of USD 180.5 billion in the year 2021 [24]. According to projections, the estimated value of USD 960.2 billion is anticipated to be achieved by the year 2030, with a compound annual growth rate (CAGR) of 20.41%. Services accounted for 59% of the total revenue generated in the year 2021 [24].

In the year 2021, hospitals experienced a 35% increase in end-user income. In the year 2021, North America exhibited the highest proportion of revenue, accounting for 40.3%. The Asia Pacific region is projected to experience a growth rate of 18.50% during the period from 2022 to 2030. Table 1 [24] presents the projected forecast for the Internet of Things (IoT) in the healthcare sector until the year 2030.

*Table 1:* IoT Expected Forecast Till 2030 (from www.precedenceresearch.com)

| Year | IoT in Healthcare Market Size, 2021 to 2030 (USD Billion) |
|---|---|
| 2021 | 180.5 |
| 2022 | 217.34 |
| 2023 | 261.69 |
| 2024 | 315.09 |
| 2025 | 379.4 |
| 2026 | 456.82 |
| 2027 | 550.05 |
| 2028 | 662.3 |
| 2029 | 797.46 |
| 2030 | 960.2 |

Data gathering, analysis, monitoring, and research occur online. Sensors, software, and information processing systems dominate the healthcare IoT market. Due to expanding demand for medical devices in healthcare facilities and more patients seeking medical attention, the Internet of Things (IoT) in healthcare has grown significantly. Medical gadgets with improved efficiency and faster results have also been prioritized.

New technology and developments have increased digitalization in many locations, especially developing countries. The healthcare market has grown significantly since the governments integrated and promoted medical device development and provision. The Internet of Things (IoT) transmits data between machines,

smartphones, and smartwatches using enhanced wireless connectivity and embedded technologies. Due to advances in medical device software, sensors, and healthcare IoT research, the market rate increased during the projection period. Also, development factors are signaling chemicals that regulate cell development, proliferation, and differentiation. Medical device use in hospitals, especially with IoT technology, has boosted market growth. Chronic diseases like lung disease, COPD, hereditary problems, and others are causing more active patients. Governments integration of facilities into new innovative technologies is driving market growth.

Governments help from several nations to improve medical device accessibility in healthcare facilities. IoT-enabled medical devices include several tools and sensors to improve healthcare results. These devices include drug efficacy trackers, tools for transferring medical data, air quality sensors, biometric scanners for remote care, blood pressure monitors, glucose monitors, oxygen monitors, temperature monitors, advanced surgical equipment, connected contact lenses, sleep monitors, inhalers, and wearable devices. Devices use machine learning and AI. User-friendly, efficient, and effective gadgets have improved safety, security, privacy, and adherence to standards and professional abilities.

Covid-19 has slowed healthcare IoT market growth. Medical gadget use has increased hospital admissions due to viral infections. The COVID-19 epidemic has affected over 185 million people and killed many. Many governments have passed laws to reduce disease spread. A countrywide closure, transit halt, and curfews. The surge in Covid-19 positives has increased testing demand and healthcare IoT growth.

### *4.1 Product Information*

Internet of Things (IoT) applications in healthcare use innovative devices to improve electronic health records and health monitoring. Vital signs monitors include blood glucose, blood pressure, multipara meter, and heart rate monitors. Medical devices include imaging systems, respiratory devices, patient monitoring equipment, infusion pumps, hearing devices, anesthesia machines, ventilators, neurological devices, fetal monitoring devices, and implantable cardiac devices like pacemakers, cardiac monitors, cardioverter defibrillators, and others. Wireless connections in hospitals have greatly accelerated medical gadget development. This technology is widely used to monitor active patients, manage ailments, and other purposes, driving market growth.

Healthcare IoT applications are categorized by medical equipment type. This category includes fixed, implanted, wearable, and other modern medical devices in healthcare institutions. Wi-Fi, Bluetooth, and signee-enabled embedded systems enable uninterrupted work operations. Analytics, database, and network layers comprise the system and software. Microsoft Application Insights lets developers monitor and diagnose their apps' performance and usage. Telemedicine, store and forward telemedicine facilitated by software using wireless connections, medication management, interactive medication, patient monitoring, clinical operations, workflow management, clinical imaging, and fitness measurement can be used to segment healthcare applications in the IoT. Drug development and research have boosted the IoT healthcare market. In 2021, the percentage of healthcare IoT market share by region [ 24] is shown in table 2.

*Table 2:* IoT healthcare percentage revenue in 2021 by region

| Regions | Revenue share in 2021 (%) |
|---|---|
| North America | 40.30% |
| Asia Pacific | 20.60% |
| Europe | 25.70% |
| Latin America | 9% |
| MEA | 4.40% |

### 4.2 Market Leaders

IoT technology in healthcare has boosted the medical equipment business. Medical device development has advanced to protect patients through efficient and effective processes. Due to enhanced technologies and improved healthcare facilities, medical equipment prices have risen in recent years.

Chronic diseases, respiratory diseases, hereditary diseases, COPD, and other conditions have increased in prevalence. Thus, hospital admissions and medical device use have increased. Geriatric patients are increasing. Due to outmoded, error-prone medical instruments, IoT healthcare is growing. Patients now prioritize emerging technology. Due to rising patient numbers and advances in wireless networking, embedded systems, and medical equipment, healthcare facilities are using the Internet of Things (IoT) more. Wireless data transfer and software creation and upgrading are crucial for process continuity. Online transactions have increased data security worries, specifically about hacking and unauthorized disclosure of sensitive data. This obstructs market growth. Technology-driven medical device price increases pose a major barrier to healthcare business growth. Most people cannot afford medical gadget costs.

Business and economics require identifying crucial market opportunities. These market possibilities are growing areas. Self-medical devices like glucose monitors, blood pressure monitors, self-injecting devices, sleep monitors, stress monitors, and inhalers that connect to smart phones or watches are now available.

Several factors drove healthcare IoT market expansion. Doctor-to-patient ratios have fallen worldwide. Wireless networking makes user-to-user communication easy. Government measures like reimbursement have increased regulations. Technology and modern healthcare infrastructure have spurred IoT medical device research and development. Major industry players introducing innovative medical equipment boosts IoT market growth. Segmental insights involve analyzing and comprehending certain market segments. Market leaders are [24]:

- US-based medical technology business Medtronic
- US-based Hillrom-Welch Allyn
- US-based Stanley Healthcare
- Abbott Laboratories is a global pharmaceutical, diagnostic, and medical device corporation.
- US-based AgaMtrix.
- iHealth Lab, Inc.
- AliveCor,Inc
- BioTelemetry, Inc., a publicly traded firm, develops and markets medical devices to monitor and diagnose cardiac arrhythmias and other conditions.
- Japan-based Omron Healthcare, Inc.
- Siemens AG, a German multinational,
- Healthcare multinational Johnson & Johnson Services, Inc.
- US-based Boston Scientific Corporation is a medical technology leader.
- BIOTRONIK, a German firm.
- US-based Honeywell Life Care Solutions
- Koninklijke Philips N.V. (Netherlands)
- US-based GE Healthcare

From a geographical standpoint, it is anticipated that the Asia Pacific region will take the forefront in the advancement of healthcare Internet of Things (IoT) technology. The proliferation of advanced technologies and the increasing demand for goods and services have resulted in an upward trend in market rates. The government has facilitated the implementation of Internet of Things (IoT) in hospitals through the utilization of advanced infrastructure. The utilization of healthcare Internet of Things (IoT) has witnessed an increase in North America, Europe, Latin America, the Middle East, and Africa as well. The implementation of this initiative has significantly enhanced healthcare services in the aforementioned regions. In recent times, numerous disciplines have witnessed noteworthy advancements. In 2020, Abbott and Insulet unveiled a novel system for glucose monitoring and automated insulin delivery. In the year 2021, Hill Rom unveiled integrated solutions aimed at enhancing patient outcomes. In 2021, the SyncaR

AR technology and StealthStation S8 surgical navigation system were introduced by Surgical Theatre and Medtronic. Medical devices are utilized for the purposes of diagnosing, treating, and preventing various diseases.

Implantable medical devices are specifically engineered to be surgically inserted into the human body for the purpose of diagnosing, monitoring, or treating specific medical conditions. The term "Software and System" encompasses computer programs and hardware components that collaborate to accomplish predetermined objectives. This connection facilitates operational efficiency and enhances overall performance. Application security is a discipline that aims to safeguard software from potential threats and vulnerabilities. Data analytics involves the examination and interpretation of extensive datasets in order to derive meaningful insights and inform decision-making processes. The practice of remote device management encompasses the ability to exert control over devices from a distance. The tasks encompassed in this domain include monitoring, configuring, updating, and troubleshooting. The practice of architecture involves the design and implementation of system integration within a broader framework. The issue at hand pertains to application development, with a specific focus on support and maintenance.

Glucometers test blood glucose levels. Electrocardiograms (ECGs) and heart rate monitors are used in clinical settings to examine and monitor heart electrical activity and measure heart rate. Medical devices assess blood pressure against artery walls. Clinical settings use these gadgets. Multiparameter monitors measure and show numerous patient physiological parameters. Oximeters are breathing support devices that help people with breathing issues. Imaging systems capture, record, and reproduce images.

Implantable cardioverter-defibrillators (ICDs) monitor heart rhythms and are surgically installed. Implantable cardiac monitors, also known as implantable loop recorders, are medical devices surgically inserted to monitor and record heart electrical activity. Infusion pumps supply fluids like drugs or nutrition to patients. Fetal monitoring devices evaluate a developing fetus's health and physiological parameters during pregnancy. Neurological gadgets diagnose, monitor, and treat nervous system disorders. Embedded systems are computer systems that execute specific duties within a larger system or device. Finally, laboratory research is regulated, methodical investigation in a lab.

## V. CONCLUSIONS AND FUTURE SCOPE

This paper discusses the importance of monitoring the health of individuals, as this helps in maintaining a balanced lifestyle. Also, the importance of using AI in the healthcare sector, to help analyze patients' data, for detecting any health issues, and help in taking precautions before health deteriorates, and decreases costs at the same time in the healthcare sector. Also, precision medicine is a type of medicine that depends on AI in detecting health problems based on each individual's metrics. Besides, implementation of AI challenges in healthcare were discussed in this paper. The role of internet of things (IoT) in facilitating transmission of patients' data from specialized devices to analyze these data, and provides results of analysis to doctors. It is expected in the future for healthcare using IoT to increase annually due to the benefits and costs reduction it provides in healthcare.

## REFERENCES


1. World Health Organization. WHO guideline recommendations on digital interventions for health system strengthening: evidence and recommendations. Geneva. Available: https://apps.who.int/iris/handle/10665/311980,accessed 17 December 2019.
2. K. Sahoo, S. K. Mohapatra, & S.-L. Wu (2016). Analyzing healthcare big data with prediction for future health condition, IEEE Access, 4, 9786-9799.
3. Hirshkowitz M, Whiton K, Albert SM, Alessi C, Bruni O, DonCarlos L ... Hillard P J A. (2015). National Sleep Foundation's sleep time duration recommendations: methodology and results summary, Sleep Health, 1(1), 40-43.





London Journal of Research in Computer Science and Technology

4. Min Chen, YixueHao, Kai Hwang, Lu Wang, & Lin Wang. (2017). Disease Prediction by Machine Learning over Big Data from Healthcare Communities", IEEE Access, 5, 8869-8879.
5. C.-H. Weng, T. C.-K. Huang, & R.-P. Han. (2016). Disease prediction with different types of neural network classifiers. Telematics and Informatics, 33(2), 277–292.
6. Nie, M. Wang, L. Zhang, S. Yan, B. Zhang, & T. S. Chua. (2015). Disease inference from health-related questions via sparse deep learning, IEEE Transactions on Knowledge and Data Engineering, 27(8), 2107– 2119.
7. Tayeb S, MatinPirouz, Johann Sun, Kaylee Hall, Andrew Chang, Jessica Li, ... ShahramLatifi. (2017). Toward Predicting Medical Conditions Using kNearest Neighbors, IEEE International Conference on Big Data, 3897-3903.
8. Hung Chen-Ying, Chen Wei-Chen,Lai Po-Tsun, Lin Ching-Heng& Lee Chi-Chun. (2017) Comparing deep neural network and other machine learning algorithms for stroke prediction in a large-scale population based electronic medical claims database, 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 3110-3113.
9. Chen, Y. Ma, J. Song, C. Lai & B. Hu. (2016). Smart clothing: Connecting human with clouds and big data for sustainable health monitoring, ACM/SpringerMobile Networks and Applications Mobile, 21(5), 825- 845.
10. Schmidt S. C. E., Tittlbach S., Bös K., &Woll A. (2017). Different Types of Physical Activity and Fitness and Health in Adults: An 18-Year Longitudinal Study. BioMed Research International.
11. Yunshu Du, Assefaw H. Gebremedhin, & Matthew E. Taylor (2019). Analysis of university fitness center data uncovers interesting patterns, Enables prediction. IEEE transactions on knowledge and data engineering, 31(8), 1478 – 1490.
12. Harris JA & Benedict FG. (1918). A Biometric Study of Human Basal Metabolism. Proceedings of the National Academy of Sciences of the United States of America, 4(12), 370–373.
13. Kirch DG, Petelle K. Addressing the physician shortage: the peril of ignoring demography. JAMA 2017;317(19):1947-8.
14. Combi C, Pozzani G, Pozzi G. Telemedicine for developing countries. Appl Clin Inform 2016;07(04):1025-50.
15. Bresnick J. Artificial intelligence in healthcare market to see 40% CAGR surge; 2017.
16. Lee K-F. AI superpowers: China, Silicon Valley, and the new world order. 1st ed. Houghton Mifflin Harcourt; 2019.
17. King D, DeepMind's health team joins Google Health.
18. Hoyt RE, Snider D, Thompson C, Mantravadi S. IBM Watson Analytics: automating visualization, descriptive, and predictive statistics. JMIR Public Health Surveill 2016;2(2):e157.
19. Marr B. How is AI used in healthcare—5 powerful real-world examples that show the latest advances. Forbes; 2018.
20. Kalis B, Collier M, Fu R. 10 promising AI applications in health care. Harvard Business Review; 2018.
21. Singhal S, Carlton S. The era of exponential improvement in healthcare? McKinsey Co Rev.; 2019.
22. Konieczny L, Roterman I. Personalized precision medicine. Bio-Algorithms MedSyst 2019; 15.
23. Love-Koh J, et al. The future of precision medicine: potential impacts for health technology assessment. Pharmacoeconomics 2018;36(12):1439-51.
24. Precedence research, Available: https://www.precedenceresearch.com/internet-of-things-in-healthcare-market, accessed 2023.

*This page is intentionally left blank*

# Enhancing Energy Efficiency and Convenience with an Automated Room Light Control System

*Izang, A.A., Ajayi, O.F., Kolade, Z.A., Takon, E.W. & Oluka, B*
*Babcock University*

## ABSTRACT

This paper presents the implementation of a system that controls light automatically and it is energy efficient as it only switches on the lights when required and switches them off when not needed, reducing energy consumption. Furthermore, from past study, it was noticed that most physically challenged people and most aged people do not even have the strength to switch on and off the lights as a result of the inability to manually operate the system.

For this research the ESP-32 microcontroller which is the heart of the system was used, it is programmed to receive signals from the PIR sensor and switch the lights on when it detects movement in the room. The system is also designed to switch off the lights automatically when no movement is detected for a predefined time period. The light control of the system is actualized when an individual enters and remains off after leaving. The designed system is achieved using infrared light sensor and combination of array counters. The implemented system can be commercialized to be used in public places like malls or libraries to restrict the flow of people.

*Keywords:* ESP-32 microcontroller, sensor, room light controller system, ESP-NOW, energy efficiency, smart home, energy conservation, wireless communication.

*Classification:* LCC Code: TK5105.8857

*Language:* English

Great Britain Journals Press

*LJP Copyright ID: 975832*
*Print ISSN: 2514-863X*
*Online ISSN: 2514-8648*

London Journal of Research in Computer Science and Technology

Volume 23 | Issue 3 | Compilation 1.0

# Enhancing Energy Efficiency and Convenience with an Automated Room Light Control System

Izang, A.A.[α], Ajayi, O.F.[σ], Kolade, Z.A.[ρ], Takon, E.W.[Ↄ] & Oluka, B[¥]

*Author α:* Department of Information Technology, School of Computing and Engineering Sciences, Babcock University, Ilishan-Remo, Ogun State, Nigeria.

σ ρ Ↄ ¥: Department of Computer Science, School of Computing and Engineering Sciences, Babcock University, Ilishan-Remo, Ogun State, Nigeria.

## ABSTRACT

*This paper presents the implementation of a system that controls light automatically and it is energy efficient as it only switches on the lights when required and switches them off when not needed, reducing energy consumption.*

*Furthermore, from past study, it was noticed that most physically challenged people and most aged people do not even have the strength to switch on and off the lights as a result of the inability to manually operate the system.*

*For this research the ESP-32 microcontroller which is the heart of the system was used, it is programmed to receive signals from the PIR sensor and switch the lights on when it detects movement in the room. The system is also designed to switch off the lights automatically when no movement is detected for a predefined time period. The light control of the system is actualized when an individual enters and remains off after leaving. The designed system is achieved using infrared light sensor and combination of array counters. The implemented system can be commercialized to be used in public places like malls or libraries to restrict the flow of people.*

*Keywords:* ESP-32 microcontroller, sensor, room light controller system, ESP-NOW, energy efficiency, smart home, energy conservation, wireless communication.

## I. INTRODUCTION

Conserving electricity is important in this digital world, frequently humans have forgotten to turn off appliances around them thereby not conserving electricity. Due to this, creating an economic stimulus for their budgetary development has proven to be extremely difficult.

To overcome this there is a need to manage the lighting around us (room, halls, conference room etc.), automated systems are an efficient way to reduce energy use today. The design, development, and implementation of a micro controller-based automatic room light controller with a bidirectional counter are presented in this project. When it comes to product development, it is important to step back, assess the current situation, and conceive a sane and logical solution to the issue at hand. It is necessary to provide background information regarding the conventional method of carrying out a task.

Within our institution Babcock University, this project can be used in various rooms like seminar hall, conference hall, classrooms to count the accurate number of people in that room. This project can also be done in our homes because many times we come out of our bedroom, and we forget to turn off the room light. It can also be used in cinemas, malls etc. This automation helps in reducing cost in that no human power is required to control the system.

This system is designed to control the lighting system of the room by turning on the lights automatically whenever there are one or more

persons in the room. To display the people in the room, this system is also linked to a bidirectional visitor counter. The manner this system operates is as follows: Whenever anyone enters the room, the visitor counter is increased by one, and once someone leaves, the visitor counter is decreased by one.

Also, since the government or any institution can easily control the population in each location, this project can help to address the issue that insecurity has become to our nation. This project aims to automatically turn on or off the lights in a room by detecting the human movement hence, the research investigates an automated room light to reduce the stemming difficulty faced by multiple institutions, businesses, and governmental organizations in order to control these and the adoption of automated control in this situation would make it easier for those with disabilities and illness to operate these devices.

## II. LITERATURE REVIEW

Prior to this study, other studies have been developed to control how lights are operated. Below are the various studies and their purpose

The power usage in public places like Library, Hotels, and Domestics takes the highest percentage of the energy consumed in the world (Bai & Ku, 2008). Currently, the area of technologies focuses on; automation, energy consumption and cost optimization (Sudhakar, Anil, Ashok, & Bhaskar, 2013). Automation in the public places guarantees efficiency as well as increase in the lifespan of electrical components (Tadimeti & Pulipati, 2013).

Gazis et al. (2022) proposed monitoring and tracking visitors within a building. The authors used python, protocols, communication and sensors. Specific location operation might be the negative part of the design.

Owing to the rapid increase in population, it is also important to know the number of people in the public places by counting the inflow and outflow, this will enable the organization or administrators to satisfy the visitors, feasibility studies and future expansion (Dey *et al.*, 2016).

Human beings, especially old and disabled find it difficult to put-off light when it is not required, this results into energy wastage and increase in the cost of electricity (Ranjit, Ibrahim, Salim, & Wong, 2009). As a result of the increase in cost of electrical energy and shortcomings in our power generation, it becomes necessary to make good use of the available electrical energy (Priya & Vijayan, 2017). In (Monder, Chen, & Tomoaki, 2022), the author presented an array sensor and low-resolution infrared sensor designed to identify the location of indoor, outdoor peoples were not discussed in the paper. Therefore, energy conservation has become a priority for efficient utilization of electrical energy (Wazed, Nafis, Islam, & Sayem, 2010). Knowing the exact number of people at a particular time can be used to analyze the progress an organization is making and also guide it in policy and decision making (Ashkanani, Roza, & Naghavipour, 2015). (Manoj, & Thingom, (2022) designed and implemented Visitor counter using FPGA and Bluetooth, though the goal was achieved, but the design worked in one direction only. Infrared ray sensor was used to design visitor counters with automatic light control but absolute count would not be determined by the design.

*Automatic room light controller using IR sensor:* According to (T Jangfa in the year 2021) came up with a device that can automatically control the lighting system of a room and capability of taking count of number of people in a room on its own has been long overdue. Fire outbreaks that occur in various homes originate when the occupant is either sleeping or not even at home at all. In big environments such as petrochemical industries, whenever there is a fire outbreak, it turns out to be so fierce that people run away for the sake of their lives.

*Automatic room light controller using Arduino and pir sensor:* According to (Vrushabh Kunturwar, in the year 2020.) This review is basically talking about how the room will automatically turn on upon detecting a human motion and stay turned on until the person has left or there is no motion initially. When there is no human movement, the PIR sensor doesn't detect any person and its OUT pin stays LOW.

*Room light controller with visitor counter:* According (Thitesh Raminao in the year 2018) today's world, there is a continuous need for automatic appliances automatic room light controller with visitor counter is a reliable circuit that takes over the task of controlling the room lights as well us counting number of persons/ visitors in the room very accurately." Main concept behind this project is to measure and display the number of persons entering in any room like seminar hall, conference room. And when the number of persons inside the room is zero, the power supply inside the room will be turned off. This will help to save electricity. LCD display placed outside the room displays the number of persons inside the room.

*A bidirectional automatic room light controller using visitor counter:* According to (EP Ogherohwo, in the year 2018). A bidirectional automatic room light controller using visitor counter and 8051 microcontroller is a reliable circuit that takes over the task of controlling the room light as well as counting the number of persons visiting the room very accurately. When somebody enters the room the counter is incremented by one and the light in the room will be switched ON whenever anyone leaves the room then the counter is decremented by one and so on. The light will only be switched OFF when all the persons in the room goes out.

## III. THE DESIGN AND IMPLEMENTATION OF THE SYSTEM

With the help of this research, a smart home solution, people especially physically handicapped people will have an easy and effective way to regulate a room's lighting settings since they won't need to manually turn on or off the light; instead, the light will do so on its own.

The device automatically detects changes in temperature and motion and adjusts the lighting conditions as necessary using a combination of sophisticated sensors and a microcontroller.

An AC-DC adapter or batteries can be used to power the Automated Room Light Controller in order to provide the system with the necessary voltage and current. A boost converter would have to be installed to enhance the DC power supply and provide the components with a steady 5V supply, protecting the individual components from harm.

The ESP-32 Microcontroller is the heart of the system. It provides a map of all the hardware that is embedded in this microcontroller. A host device will enable the Wi-Fi module to connect to the internet, allowing the Wi-fi module to inform the microcontroller that is connected. There are a variety of ways to set up an ESP-NOW network. Within the same network, ESP32 and ESP8266 devices can coexist. *Initiators and Responders:*

1. *Initiator:* This device initiates the transmission. It will require the MAC address of the receiving devices.
2. *Responder:* This device receives the transmission.

Using widely used asynchronous serial communication interfaces, such as RS232, RS422, and RS485, the Universal Asynchronous Receiver/Transmitter (UART) handles communication (i.e., time constraints and data framing). A UART offers a widely used and affordable way to implement full- or half-duplex data exchange across various devices. Each of the three UART controllers (also known as ports) on the ESP32 chip uses the same set of registers, making programming easier and allowing for greater flexibility. Each UART controller is independently configurable with parameters such as baud rate, data bit length, bit ordering, number of stop bits, parity bit etc. All the controllers are compatible with UART-enabled devices from various manufacturers and can also support Infrared Data Association protocols (IrDA)

At the entrance, the motion sensor is used to identify guests. When someone enters the room, the motion sensor alerts the ESP-32. The temperature sensor is used to determine the ambient temperature of the space. The ESP-32 can alter the lighting in the room using this information. The light can be turned on and off using the motion sensor.

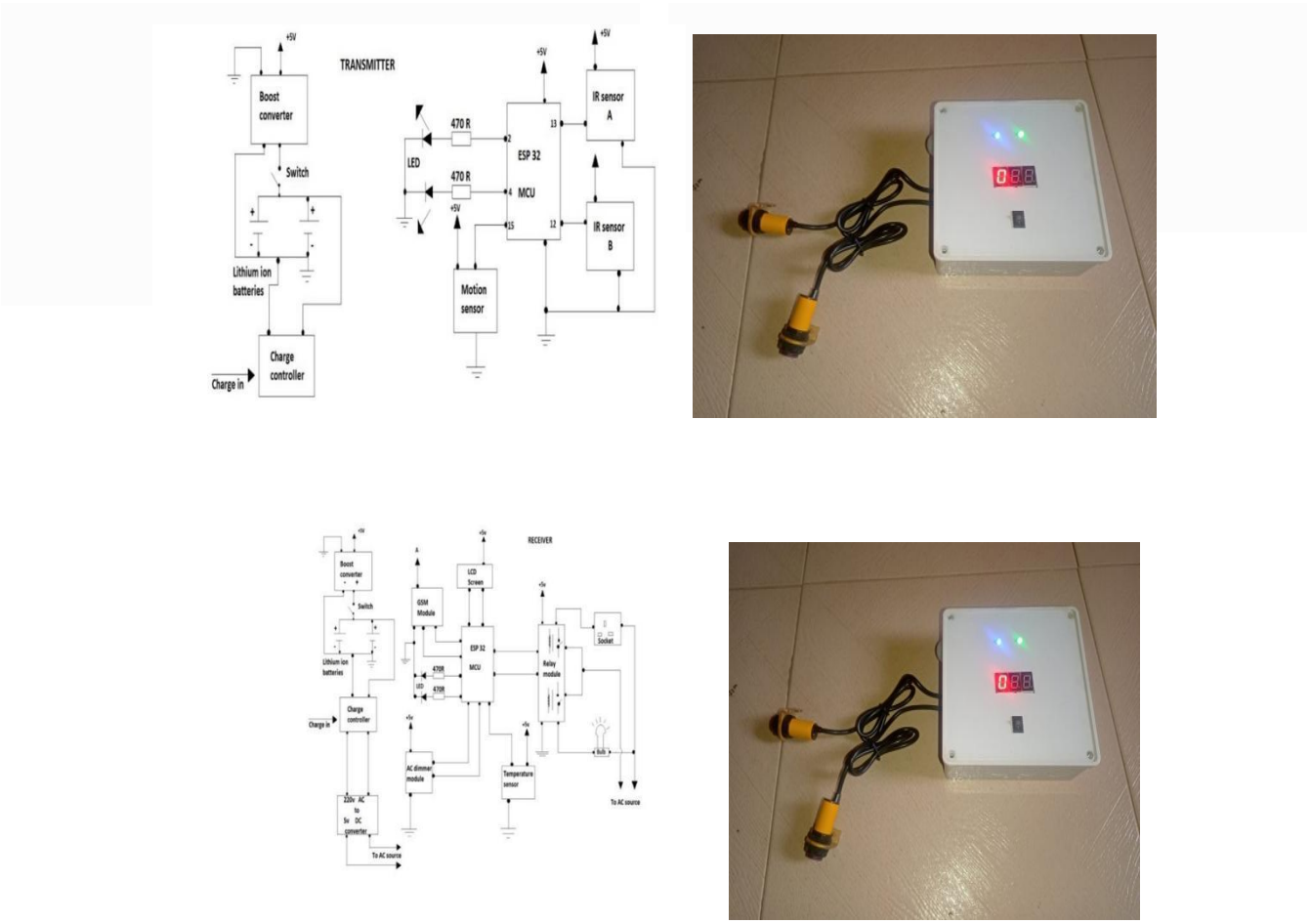


*Figure 1:* Schematic Diagram

The diagram above depicts how the device is carefully mounted using two boards, one for the transmitter and one for the receiver. An infrared sensor is used to count the number of visitors; the first infrared sensor starts the timer, and the second infrared sensor stops it. The first board, which is the transmitter, is carefully positioned on one perboard. We have the temperature in addition to the two lithium-ion batteries next to the perfboard. On top of the PVC shell, there is a motion sensor that can be used to identify people, and there is a seven-segment display that can count the number of persons that have been spotted.

There are two lights on top of it that you can see when you enter. The green light comes on when someone opens the door, while the blue light flashes when it is on. The second board, which is the receiver, is neatly installed on one perfboard along with the rest of the system's parts, four lithium-ion batteries, an AC-DC converter, a boost converter for charging the batteries, a relay module, an ESP-32 microcontroller, a GSM module, and an AC dimmer.

## IV. HOW THE SYSTEM WORKS

You must turn on the system in order to use this device, at which point the ESP-32 microcontroller initializes and begins to run the firmware. Then, to determine the ambient conditions in the room, the ESP-32 periodically checks the temperature and motion sensor data. The ESP-32 adjusts the brightness of the lights using the AC dimmer and relay module based on input from the temperature and motion sensor. To conserve energy and create a comfortable environment, the lights automatically dim if the temperature rises too much. If no one is present, the lights will be turned off.

## V. CONCLUSION AND RECOMMENDATION

This work presents the design and implementation of automatic light control with bidirectional counting sensors. The design goal is to minimize the cost of electrical energy. The circuits were designed and constructed using various electronics components.

Children, adults, and physically handicapped individuals can all benefit from the Automatic Room Light Controller System since it offers a hands-free lighting control experience. This project required a lot of time in the planning, designing, testing, and execution phases. All things considered, the automatic room light controller system offers a dependable, effective, and adaptable lighting solution for regulating the lighting conditions in a space. The system has the ability to lower energy use, boost comfort, and enhance a room's overall lighting experience.

This project is hereby recommended for use in homes, classrooms, workplaces, or any other enclosed space with the conviction that it simplifies life and lowers energy usage.

It is highly advised for use in living spaces, educational institutions, and meeting spaces. Also, it allows homeowners to experience a luxurious lifestyle that is stress-free for everyone because they do not have to worry about manually turning on and off their lights.

## REFERENCES


1. Administrator. (2023, February 25). *Automatic Room Lights using Arduino and PIR Sensor*. Electronics Hub. https://www.electronicshub.org/automatic-room-lights-using-arduino-pir-sensor/#:~:text=of%20the%20Project.
2. *Automatic room light and fan controller with bidirectional visito..* (n.d.). Www.electronicwings.com. https://www.electronicwings.com/users/abhilasha/projects/27/automatic-room-light-and-fan-controller-with-bidirectional-visitor-counter.
3. *Automatic Room Light Controller*. (n.d.). Hackster.io. Retrieved March 22, 2023, from https://www.hackster.io/ashumhr12/automatic-room-light-controller-7f61d5.
4. *Automatic Room light Controller with Visitor Counter*. (2013, June 10). Www.projectsof8051.com. https://www.projectsof8051.com/ automatic-room-light-controller-with-visitor-counter/#:~:text=Automatic%20Room%20Light%20controller%20section.
5. *Automatic Room Lights using Arduino and PIR Sensor*. (2018, January 25). Electronics Hub. https://www.electronicshub.org/automatic-room-lights-using-arduino-pir-sensor/.
6. EP Ogherohwo. (2018, May 22). *Automatic Room Light Controller with Bidirectional Visitor Counter» ElectroDuino*. ElectroDuino. https://www.electroduino.com/automatic-room-light-controller-with-bidirectional-visitor-counter/.
7. Greene, R., Anwar, S., & Favier, P. (2019). Microcontroller Based Automatic Room Light Controller and Visitor Counter: Design and Construction. *Journal of Multidisciplinary Engineering Science and Technology (JMEST)*, *6*, 2458–9403. https://www.jmest.org/wp-content/uploads/JMESTN42353243.pdf
8. Guarav Waradkar. (2020, April 21). *Automatic Room Light Controller Circuit and Applications*. ElProCus - Electronic Projects for Engineering Students. https://www.elprocus.com/know-about-working-of-automatic-room-light-controller-and-applications/.
9. Odiang', M., & a. (n.d.). PROPOSAL ON AUTOMATIC ROOM LIGHT AND FAN CONTROL SYSTEMS. *Www.academia.edu*. https://www.academia.edu/7334897/PROPOSAL_ON_AUTOMATIC_ROOM_LIGHT_AND_FAN_CONTROL_SYSTEMS.
10. Singh, G. (n.d.). *Automatic Room Lighting*. Engineers Garage. Retrieved March 22, 2023, from https://www.engineersgarage.com/automatic-room-lighting/.
11. Sinha, S., 172, Sinha, A., Singh, A., Singh, D., Singh, P., Maurya, A., & Singh, M. (2017). Automatic Room Light Controller with Visitor Counter. *International Journal on Emerging Technologies (Special Issue NCETST-2017)*, *8*(1), 172–175. https://www.researchtrend.net/ijet/pdf/44-S-837.pdf
12. *The Internet of Things with ESP32*. (2016). Esp32.net. http://esp32.net/

*This page is intentionally left blank*

# Driver Drowsiness and Alcohol Detection System using Arduino

*M R Archana Jenis , Anitha K, Jayalakshmi J & Binuja B.*

## ABSTRACT

Drowsiness in driving causes the major road accidents. Now a day's drowsiness due to drunken driving is increasing. If driver is found to be drowsiness in eyes more than 5 secs, then the eye blink sensor senses the blink rate. If the eyes are found to be closed, then the speed of the car slows down. In our proposed system, along with drowsiness, alcohol detection is also detected by using alcohol MQ3 sensor. If alcohol is detected in driver's breathe, then the car slows down. These sensors are interfaced with Arduino UNO.LED glows in case of alcohol detection and buzzer rings in case of drowsiness detection and speed of the car varies on detection of both cases.

*Keywords:* arduino UNO, eyeblink sensor, MQ3 sensor, L29.

*Classification:* LCC Code: TK7882.E2

*Language:* English

Great Britain Journals Press

*LJP Copyright ID: 975833*
*Print ISSN: 2514-863X*
*Online ISSN: 2514-8648*

London Journal of Research in Computer Science and Technology

Volume 23 | Issue 3 | Compilation 1.0

# Driver Drowsiness and Alcohol Detection System using Arduino

M R Archana Jenis[α], Anitha K[σ], Jayalakshmi J[ρ] & Binuja B.[ω]

## ABSTRACT

*Drowsiness in driving causes the major road accidents. Now a day's drowsiness due to drunken driving is increasing. If driver is found to be drowsiness in eyes more than 5 secs, then the eye blink sensor senses the blink rate. If the eyes are found to be closed, then the speed of the car slows down. In our proposed system, along with drowsiness,alcohol detection is also detected by using alcohol MQ3 sensor. If alcohol is detected in driver's breathe, then the car slows down. These sensors are interfaced with Arduino UNO.LED glows in case of alcohol detection and buzzer rings in case of drowsiness detection and speed of the car varies on detection of both cases.*

*Keywords:* arduino UNO, eyeblink sensor, MQ3 sensor, L29.

*Author* α ρ ω: Department of Computer Science and Engineering. Assistant Professor, St. Joseph's College of Engineering, OMR, Chennai.
σ: Assistant Professor, CSI College of Engineering, Ketti,

## I. INTRODUCTION

Drowsy driving is a major problem. No one knows the exact moment when sleep comes over their body. This makes the driver less able to pay attention to thrroad. It affects the driver's ability to make good decision. Each near nearly 1,00,000 traffic crashes can be attributed to drowsy driving, including more than 1,500 death and over 70,000 injuries, according to the

- Unsensational Highway Traffic Safety Administration. Another major factor of accidents are due to consumption of alcohol.
- The number of road accidents caused by drunken drivers was1,643 in 2018.Hence in order the reduce the accidents due to drowsiness and alcohol consumption can be reduced by using the eye blink sensor and alcohol sensor respectively.
- Hence when they are detected the speed of the car slows down and stop which avoids the rash driving .
- Accidents due to driver drowsiness can be prevented using eye blink sensors. The driver is supposed to wear the eye blink sensor frame

The eye-blink sensor works by illuminating the eye and eyelid area with infrared light, then monitoring the changes in the reflected light using a phototransistor and differentiator circuit. The exact functionality depends greatly on the positioning and aiming of the emitter and detector with respect to the eye. The sensor is connected with Arduino UNO.

Any amount of alcohol in your bloodstream can impact your driving ability. The effects of alcohol abuse vary greatly, putting you at risk for causing an accident or highway injury. Safe driving requires the ability to concentrate, make good judgements and quickly react to situations.

However, alcohol affects these skills, putting yourself and others in danger. The consumption of alcohol can be detected by using MQ3 sensor.MQ3 sensor detects the consumption of alcohol from the breath of the person. This helps in avoiding accidents caused by consumption of alcohol.

## II. LITERATURE SURVEY

In recent years, the drowsiness of the driver is detected by using image processing techniques. If the drivers eyes closed for certain period of time, the driver is said to be drowsy.As a result we get information related to driver's condition and the speed of the car is reduced. Rate of death due to road accidents is increasing day by day. Driver drowsiness is one of the common reasons for most of vehicle accidents.

A drowsy driving detection and avoidance system. They utilized an image processing technique to detect the eye blink of the driver. If the drivers eyes remain closed a certain period of time, the driver is said to be drowsy. As a result we get immediate information related to the driver's condition and speed of the vehicle is reduced which reduces the chances of road accidents. In the training phase, the system uses the input image of driver from real time camera and input image undergoes several image processing steps and required feature is extracted from an image.

Features are trained and stored in knowledge base. In the testing phase same above said procedures are followed. The result of testing and is compared with coefficients stored in knowledge base using image classifier (SVM) and checked weather driver eye is opened or not.

IoT based hardware, which is advanced product related to driver safety on the roads using combination of mobile computing and digital image processing and controller. They will detect driver drowsiness and gives warning in form of alarm. And traffic collision information system will continuously monitor the distance from vehicle which is done by the ultrasonic sensor. If the ultrasonic sensor detects the obstacle then it will accordingly warns the driver.If somehow collision occurs it will detect collision using impact sensor and provide emergency help service for driver. The alcohol sends a value of alcohol contained in the drivers breathe in case of consumption and indicates the values in LCD display and sends message to the registered phone number.In case of high level consumption of alcohol, it stops the ignition of the motor of the car. The scanning of driver's eyes continuously using the Eye Scanner, so that whenever the car driver closes his eyes for a longer period (2 seconds or more), the scanner generates or activates the alarm and the alarm starts ringing loudly. This will wake up the driver and make him conscious for driving ahead The alarm system will be included as an application in the car music system and the driver will be given the choice of switching on/off the functionality. If the driver switches off the safety feature the IRIS/Eye Scanner will stop working. But if the safety feature is switched on by the Driver the IRIS Scanner will continuously scan the driver eyes while the driver is driving the car and check whether the driver is attentive or not. In addition to analyzing the situation of threat due to Drowsy driving, this alert system post alarming the driver will fetch the nearest refreshment halt direct him to destination with exact distance and expected time to reach and will also announce to driver through the medium of navigation system/music system speakers of the car.

This way we can create complete solution for safety device to alert drowsy drivers, hence saving many precious human lives. Fatal Road accidents can be easily avoided by understanding the psychological condition of drivers. Majority of road accidents occur during night driving due to the state of drowsiness. This project provides an eye blink monitoring system that alerts the driver during the state of drowsiness. A normal eye blink rate has no effect on the output of the system. Here we use one gate way Raspberry pi, in that gateway webcam is connected, with the help of webcam when the driver is going to close his eyes more than 5secs it will click the picture of driver and send to web application.

In web application one admin will be there he is monitoring and send the message that will be converted into speech is initiated to wake the driver. To detect driver drowsiness and gives warning in form of alarm and traffic collision information system will continuously monitor the distance from vehicle which is done by the ultrasonic sensor and provides warning to the driver and also in case of any collison occurs, it provides emergency help service for driver. For Health Monitoring of driver, making wearable device which will give the heart beat and body temperature of the driver, so before boarding to vehicle administrator should know the status of subject. Genuine following of driver will likewise track with versatile GPS.

## III. DESIGN REQUIREMENTS

### 3.1 Arduino Uno

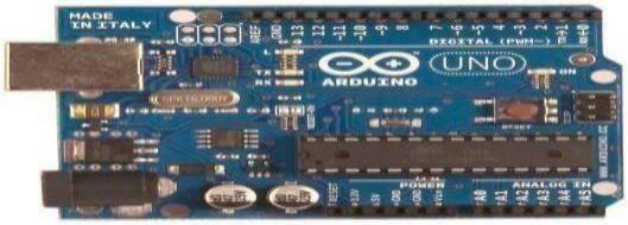


*Fig. 1:* Arduino UNO

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers. The microcontroller kits are used for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL). General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by all. changes in the reflected light using a phototransistor and differentiator circuit. The exact functionality depends greatly on the positioning and aiming of the emitter and detector with respect to the eye.

Arduino came with a common flat form Integrated Development Environment. The Arduino UNO is a microcontroller board based on the ATmega328. It has 14 digital Input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The Arduino UNO is a microcontroller board based on the ATmega328.

It has 14 digital input/output pins of which 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It is connected to a computer with a USB cable or power it with a AC-to- DC adapter or battery to get started.

### 3.2 Mq3 Sensor

MQ-3 alcohol sensor can detect the presence of alcohol at concentrations from 0.05mg/l to 10 mg/l.Used for detecting alcohol concentration on your breathe.

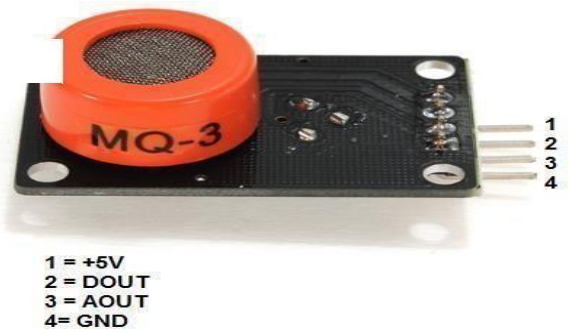


*Fig. 2:* MQ-3 Sensor

### 3.3 Eyeblink Sensor

The eye-blink sensor works by illuminating the eye and eyelid area with infrared light, then monitoring the

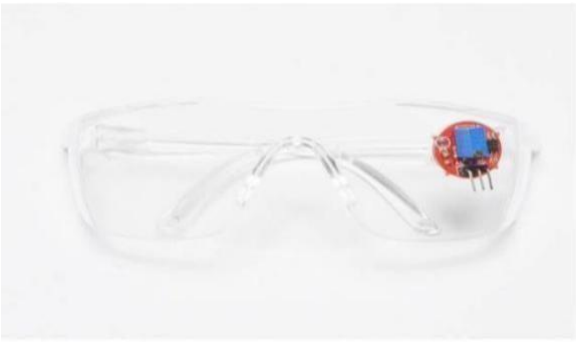

*Fig. 3:* Eyeblink Sensor

### 3.4 DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. DC motors were the first form of motor widely used, as they could be powered from existing direct- current lighting power distribution systems.

A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed

motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

*Fig. 4:* Dc motor

### *3.5 L298H Bridge*

An H bridge is an electronic circuit that switches the polarity of a voltage applied to a load. These circuits are often used in robotics and other applications to allow DC motors to run forwards or backwards.

Most DC-to-AC converters (power inverters), most AC/AC converters, the DC-to-DC push–pull converter, most motor controllers, and many other kinds of power electronics use H bridges. In particular, a bipolar stepper motor is almost invariably driven by a motor controller containing two H bridges.

*Fig. 5:* L298H Bridge

## VI. System Design

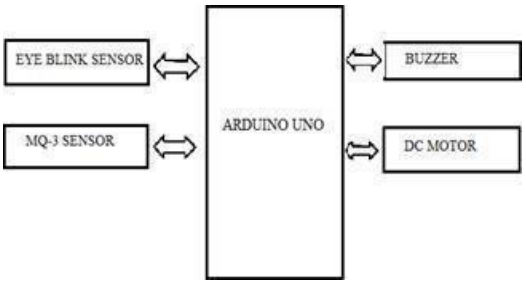


*Fig. 6:* Block Diagram of Proposed System

## V. PROPOSED SYSTEM

In our proposed system, drowsiness of the driver is detected by using eye blink sensor. The eye blink rate is continuously being monitored by using Arduino. If the eye is closed for more than 5 seconds then the driver is found to be drowsy.

Hence the buzzer starts buzzing and also the speed of the car slows down(here indicated by a dc motor). Also, alcohol is detected by using Mq3 sensor. The sensor is interfaced with Arduino. LED glows when alcohol is detected and the speed of DC motor varies according to the content of the alcohol present in the driver's breathe.

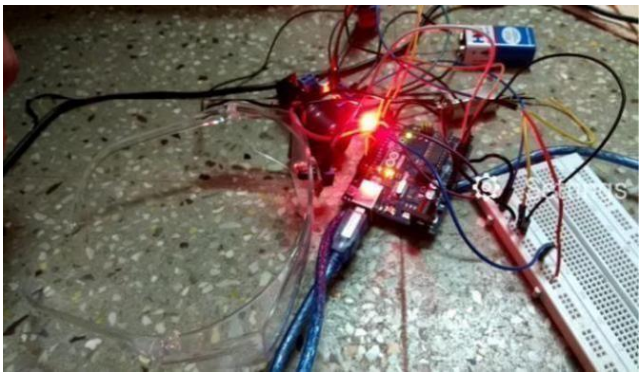

*Fig. 7:* Working of Proposed System

## IV. CONCLUSION AND FUTURE SCOPE

The driver drowsiness and alcohol detection system is used to detect the drowsiness of the driver and also detects the alcohol consumption of driver.If there is drowsiness or consumption then the motor of the car gets slowed down and the buzzer sounds until the eyes gets opened.The values of alcohol and the blink rate will be displayed in the serial monitor of the Arduino IDE. This proposed system helps in finding drowsiness and alcohol detection using Arduino.

This helps in avoiding many accidents. Further we extend this project by using webcam to detect the drowsiness of the driver.

## REFERENCES


1. Elzohairy Y (2008) Fatal and injury fatigue-related crashes on ontario's roads: a 5-year review. In: Working together to understand driver fatigue: report on symposium proceedings, february 2008.
2. Dingus TA, Jahns SK, Horowitz AD, Knipling R (1998) Human factors design issues for crash avoidance systems. In: Barfield W, Dingus TA (eds) Human factors in intelligent transportation systems. Lawrence Associates, Mahwah, pp 55–93.
3. Idrees, H., Warner, N., and Shah, M. (2014). Tracking In Dense Crowds Using Prominence And Neighborhood Motion Concurrence. Image And Vision Computing, 32(1):14–26. Yamamomo K, Higuchi, S Development of a drowsiness warning system. J, SocAutomotEng Jap 46:127–133.
4. Ueno H., Kanda, M. and Tsukino, M. "Development of Drowsiness Detection System", IEEE Vehicle Navigation and Information Systems Conference Proceedings, (2015), ppA1-3,15-20.
5. Sean Enright, Electronics Engineering Student, 506- 650-3611, May 26-2017, Alcohol Gas Detector "Breathalyzer".

*This page is intentionally left blank*

# The Importance of Website Usability in Digital Marketing: A Review

*Heemakshi Sharma*

## ABSTRACT

The effectiveness of any digital marketing strategy is strongly dependent on the user experience of the website being promoted. A website that is difficult to browse, confusing or slow to load the content can result in a poor user experience and, as a result there is a loss in leads or consumers. A website that is easy to use, well-organized and optimised for mobile devices, on the other hand can help improve user engagement, raise conversion rates and ultimately boost the success of digital marketing initiatives. This paper shows the significance of website usability in digital marketing and explores the impact of website usability on user experience and how it can affect the key performance indicators such as bounce rates, session duration and conversion rates. By emphasising the importance of website usability in digital marketing, this paper intends to give actionable insights for business looking to improve the user's website's user experience and maximise the digital marketing campaigns.

Understanding the impact of website usability on the performance of digital marketing efforts allows organisations to make informed decisions regarding website design and functionality to create good user experience that increases engagement and conversion.

*Keywords:* digital marketing, website design, website usability, mobile optimisation (responsiveness), search functionality (SEO).

*Classification:* LCC Code: QA76.76.W56

*Language:* English

Great Britain Journals Press

*LJP Copyright ID: 975834*
*Print ISSN: 2514-863X*
*Online ISSN: 2514-8648*

London Journal of Research in Computer Science and Technology

Volume 23 | Issue 3 | Compilation 1.0

# The Importance of Website Usability in Digital Marketing: A Review

Heemakshi Sharma

## ABSTRACT

*The effectiveness of any digital marketing strategy is strongly dependent on the user experience of the website being promoted. A website that is difficult to browse, confusing or slow to load the content can result in a poor user experience and, as a result there is a loss in leads or consumers. A website that is easy to use, well-organized and optimised for mobile devices, on the other hand can help improve user engagement, raise conversion rates and ultimately boost the success of digital marketing initiatives. This paper shows the significance of website usability in digital marketing and explores the impact of website usability on user experience and how it can affect the key performance indicators such as bounce rates, session duration and conversion rates. By emphasising the importance of website usability in digital marketing, this paper intends to give actionable insights for business looking to improve the user's website's user experience and maximise the digital marketing campaigns.*

*Understanding the impact of website usability on the performance of digital marketing efforts allows organisations to make informed decisions regarding website design and functionality to create good user experience that increases engagement and conversion.*

*Keywords:* digital marketing, website design, website usability, mobile optimisation (responsiveness), search functionality (SEO).

## I. INTRODUCTION

The creation of websites for the internet or a private network is referred to as web development. Web development projects can range from simple static plain text sites to complicated web apps like e-commerce development and social network services. Web engineering, web design, website development, client liaison, client-side/server-side scripting, web server and network security settings and e-commerce development are all part of this process of website development.

Website development often focuses on the non-design components of website creation, such as writing, markup and coding. CMSs (content management systems) can be used to make modifications to material easier and more accessible. Web development teams in larger organisations may contain numerous workers who use standard approaches such as Agile methodology. In contrast, smaller businesses may only need to hire one full-time or contracted developer or they might combine job roles such as having a single person handle both graphic design and data systems maintenance[1].

Web development can be a collaborative effort amongst departments, and there are three sorts of web developer specializations: front-end developer, back-end developer and a full-stack developer. Front-end developers work on the behaviour and graphics that appear in the user's browser while back-end developers work on the servers. Full-stack developers are the ones that cover both the front-end and back-end developer's part.

Personal networking and marketing have also been influenced by web development. Websites and no longer merely instruments for work or commerce, they are now platforms for communication and social networking. Social media such as Facebook and twitter provide people with a platform to communicate and a more personal and interactive manner to engage the public.

London Journal of Research in Computer Science and Technology

The notation of the worldwide web is inextricably tied with the Hypertext Markup Language (Html). Html is used to define web page components such as sections, paragraphs, headers, tables, lists and interactive forms. This term is employed to depict the arrangement or format of webpages. Html also enables for the incorporation of external resources such as photos, videos and other things into a webpage.

Modern web development practices emphasize structure and style separation, with HTML defining structure and CSS (Cascading Style Sheets) defining style. JavaScript is another language that is widely used in conjunction with HTML to provide interactivity and dynamism to web pages the emergence of web 2.2 necessitates the evolution of web languages in order to formalise already recognised best practices in online development. We examine the significant innovations in new web standards and protocols.

In this paper the emphasis is mostly on the new HTML version, its components and extensions and new CSS syntax possibilities. Also new JavaScript APIs that enable whole new ways of web development like browser-based databases, Geolocation and full duplex communication between a browser and a server have been used over here.

## II. CONVENTIONAL TECHNOLOGIES IN WEB DEVELOPMENT

It is usual practice to categorise web technologies based on whether they are used on the client - side or server-side of online applications. Understanding the main categories of web technologies is critical for individuals who want to work in web development. As a result, below is the list of web development technologies organised by usage category:[2]

- Browsers
- HTML and CSS
- Programming Languages
- Frameworks
- Web servers
- Databases
- Protocols

### *2.1 Frontend Design Strategies*

#### *2.1.1 HTML (Hypertext Markup Language)*

HTML or hypertext markup language is a computer language designed to make it easier to develop web pages that can be visited by anyone with Internet connection. It is a simple language to learn, and most individuals can understand the fundamentals in a single setting under the direction the organization responsible for establishing and maintaining the language. The language is regularly updated and enhanced to suit the expectations of the increasing Internet audience. Hypertext is used to build hyperlinks, which allows the user to navigate the web. HTML tags are used to mark up the text within them, marking it as a specific kind (for example italicised). HTML is classified as a markup language because it uses code words and syntax similar to markup languages.

HTML is made up of short codes that the website designer types into a text file, which is then saved as an HTML file and accessed by web browser such as Google Chrome, Mozilla Firefox or Internet Explorer. The browser scans the file and converts the text into an image. A simple text editor or a complex graphical editor can be used to build HTML pages. The language is written in the form of HTML elements, which are tags contained in a angular brackets such as HTML, within the text of a webpage.HTML tags are often used in pairs, with the first tag serving as the start tag and the second tag serving as the end tag (also known as the opening tag and closing tag). Text, tags and other elements can be added by web designers.

Web browser scan HTML documents and employ tags to interpret the content of the page and display it visually and vocally. HTML components are the basic building blocks of all web pages and web browsers may also use CSS to specify the appearance and layout of text and other content.

#### *2.1.2 CSS (Cascading Style Sheets)*

CSS is the language used to specify the appearance in formatting of a page produced in a markup language, the most common of which

being HTML. Its primary objective is to isolate documents information from its presentation features including layouts, fonts and colours. The split allows for More control over display qualities, enhances accessibility, former simplifies, formatting uniformity across numerous pages and lower structural content complexity. CSS may also be used to apply different styles depending on the rendering technology such as on screen of Braille based devices or different screen sizes. CSS is classified into 3 types: inline, internal or embedded and external. CSS benefits include time savings through the reuse of style sheets, quicker website loading times easier maintenance through global updates, the potential to build superior styles compared to HTML, interoperability with many platforms and adherence to worldwide web standards.

#### 2.1.3 JavaScript

JavaScript is a computer language that developers all over the globe used to produce dynamic and interactive online content. It is a lightweight, interpreted language that together with HTML and CSS is a key component of the world wide web. JavaScript scripts are embedded in or included from html text as a client - side programming language and execute directly in the user's browser. One of the JavaScript's key advantages is its speed, since it can be executed directly within the client - side browser without the need for network calls to a backend server. It is also an easy language to learn and use and it is extensively used and popular. JavaScript also has high compatibility with other languages making it ideal for a wide range of applications including the creation of rich interfaces.

It also decreases the strain on website servers because it is client - side. However, because the code operates on the user's computer, it may occasionally be abused for nefarious reasons, which is why some users disable it. Furthermore, JavaScript is sometimes interpreted differently by different browsers, making cross browser programming challenging to build.

### 2.2 Backend Design Strategies

#### 2.2.1 PHP (Hypertext Preprocessor)

PHP is a popular server -side programming language for web development. It was initially intended for the creation of dynamic web pages, but it is now mostly used for server-side scripting, command line scripting and the development of desktop programs. PHP is an open source, free to use programming languages which has grown to the one of the most popular for web development. It is often used with web content management system (CMS) like WordPress and Joomla as well as popular frameworks such as Symphony. PHP is compatible with wide range of web servers including Apache and can interface with databases such as MySQL, Oracle. PHP files are normally stored with .PHP suffix.

Typically, dynamic content is generated on the server before being delivered to the client's web browser allowing for dynamic content development based on users input or database queries.

#### 2.2.2 Java

Java is a general-purpose object-oriented programming language with the large number of implementation requirements. It is an object-oriented programming language with as minimal implementation dependencies as feasible. It is commonly used to create a wide range of applications functional on desktops, mobiles and online. It was created in the mid-1990s by James Gosling and his colleagues at Sun Microsystems and is now owned by Oracle Corporation. Java is well known for its "write once run anywhere" principle with states that Java code may be written on one platform and run on any other platform that supports java virtual machine (JVM). The JVM is an essential component of java since it allows java applications to run on any platform. Java is also well known for its powerful memory management, security features and extensive API library making it a popular choice for developing robust and scalable applications.

## III. GRAPHICAL USER INTERFACE (GUI) TECHNOLOGIES

### 3.1 Conversational Artificial Intelligence

#### 3.1.1 Digital Assistants

"SIRI" if the most well-known iPhone application, while "Google Voice assistant" is the most well - known Android software application and Alexa is the most well-known Amazon product. These programs, all have one thing in Common: they are speech - based assistants that respond to voice instructions. Voice based assistants have become the featured alternative for completing monotonous course as speech to text technologies and gadget processing capacity have advanced.

When a result, when individuals began utilising voice assistants to search the Internet there has been a rise in speech - based searches. This has had an influence on the usual method of looking for the text in the browser search engine, which in turn has an impact on the search results provided by search engines. The content individuals obtained changes as search engine processing involves.

This modification has an impact on the digital marketing tactics used by the websites to generate traffic and promote their business and increase the productivity. Many people feel that the rise of voice - based search will benefit digital marketing.

#### 3.1.2 Impact of Voice Assistants on Marketing

*Let us take a look at how speech technology is being used in marketing:*

- A new firm has already gained a footing in the voice industry by providing customers with interesting, interactive experiences (Business2 Community)
- According to Capgemini, 24% of Internet users would rather contact with a firm via personal assistant then through its website.
- According to bright edge, just 3.1% of marketers included voice search into their content marketing strategy in 2017.
- According to Digi day 43% of companies have already invested in speech technology for marketing purposes.

*The potential for voice technology in marketing look to be quite bright! Companies are utilising digital assistants for internal functions:*

Salesforce, a cloud software giant has entered the digital assistant discussion with the launch of Einstein voice, an expansion of its Einstein AI platform. Sales managers may use this technology to handle cloud services and narrate notes without touching the screen or inputting anything.

Einstein voice may also be combined with comparable technology to send team pipeline updates, calendar appointments and other essential priorities to the team in a more effective manner. Einstein voice bots, another fascinating offering enabling clients to create their own voice activated assistant and branded, engaging the end user on any smart speaker[4].

#### 3.1.3 Incorporating Voice-Activated Technology into Marketing Can be Challenging

Including speech technology in the user's marketing approach needs significant thought and planning. The user should consider if the user's target audience is likely to interact with the user's brand using speech technology and whether the user's content can provide value through this platform. Before investing into technology, user should evaluate the odds of success[8]. If user is still unclear about any of these considerations it could be preferable to wait and see how other companies are utilising voice technology before making a decision. Investigating how user's rivals use voice technologies might also give useful information[7].

### 3.2 Google Maps Marketing

Integrating Google Maps into user's website can provide the user's business with increased visibility and accessibility to potential customers who use the service to find local businesses for it allows customers to easily find directions, location information and learn about the services the business provides. Google Maps integration can improve user experience by helping visitors find information quickly and easily, especially for mobile users. It can also provide valuable data on customer behaviour, engagement levels and store

visits, allowing businesses to make informed marketing decisions. In today's world, integrating Google Maps into the user's website is essential for business that wants to remain competitive and succeed in their respective industries.

Google Maps has the potential to direct more traffic to the user's website which is a desirable outcome for any business. Moreover, it can amplify the impact of customer reviews, functioning as a digital form of word-of-mouth marketing that can reach a wider audience. Optimising Google Maps for voice search can be a wise move as it enables potential customers to find the business easily by simply asking Google instead of typing in a search query[11].

Creating a Google business profile can significantly improve user's local search engine rankings, increase lead generation and attract potential customers. With this profile user's business will be visible on all Google products and services including search, maps and YouTube. By optimising the profile with photos detailed descriptions of the products, services, customer reviews, contact details and operating hours user can showcase their unique offerings and stand out from their competitors. Moreover, tracking metrics such as impressions, clicks and views can help them better understand their online presence and make informed decisions to improve their marketing strategy and product offerings.

### *3.3 Conversational Marketing with Chatbots*

Many business owners are apprehensive about utilising chatbots to improve their operations. It might be uncomfortable to rely on robots to complete duties that were previously performed by humans; chatbots on the other hand are not intended to replace humans rather they are intended to simplify the human work. User can revolutionise their company's digital marketing techniques by adopting chatbots. These AI solutions are designed to respond to incoming communications in real time former giving standard or customised answers and even responding to new information through machine learning. They can be sent via a variety of sources including websites, SMS and social media platforms such as Twitter and Facebook. Although chatbots have only recently acquired mainstream appeal their uses are fast developing. Chatbots may help user's sell things by engaging visitors and generating sales[3].

*If the user is still unsure about incorporating them into their marketing strategy, here are some tips to consider when adding them into their marketing approach:*

- Communicate with website visitors in a conversational tone to address frequently requested questions.
- Qualify leads by asking questions in the chatbot to establish a customer's position in the sales funnel.
- Organise the team to manage its marketing program through continual communication by utilising chatbots.
- Conduct research using chatbots which can give important information about the target population.
- Personalise the user experience by asking a series of questions or using already collected data from the past encounters[5].

## IV. ADAPTIVE WEB DESIGN

### *4.1 Adoption of Device-Independent Web Design*

The shift from desktop computers to mobile devices like smartphones and ablets has been a growing trend and with the introduction of more devices this trend is likely to continue. This means that web developers need to make sure that their websites are adaptable to different devices and not just limited to one. Additionally, since many of these devices rely on wireless connections, website performance is crucial to provide users with the seamless experience.

Responsive web design is a technique that allows web developers to design and develop web pages that can adjust to different devices using flexible grid layouts, images, media and media queries. By incorporating performance techniques along with responsive web design, websites can improve their loading speed and overall user experience. These factors together can have a significant impact on website's success.

### 4.2 Upsides of Responsive Web Design

Responsive web design has numerous benefits. One of the main advantages is that it is content - focused and allows web pages to be independent of any device. This approach is cost effective and easier to maintain in the long run, providing a better and more consistent user experience.

Compared to fixed web pages, responsive web designs use single URL and the same HTML, making it simpler to change the content. Sharing the web pages URL on social networks is also more user friendly since the link takes users to the right version of the page, regardless of the device they use. Responsive web design maintains flexibility and enhances the user experience, insuring consistency across different devices.

With increasing number of devices and platforms for web browsing, adopting responsive web design can attract more loyal customers, improve the company's market share. Additionally, Google recommends using responsive web design as a best practice for the industry.

### 4.3 Constraints of Responsive Web Design

Responsive web design comes with some limitations that should be taken into account. One of the main disadvantages is that creating a responsive website requires more time and resources, making it up to 10 to 20% more expensive than a regular website. In addition, older web browsers in mobile devices may not support the latest HTML and CSS techniques used in responsive design, which may cause compatibility issues. Another issue is that responsive design can make it harder to place advertisements on the web page, which can be a problem for websites relying mostly on advertising revenue.

However, despite these limitations, the benefits of responsive web design still make it a valuable investment for most organisations. Responsive design provides improved results in long term savings and the minimalistic design can enhance the user experience by making the website more accessible on call devices. While there are some unsolvable problems with the responsive design such as responsive images there have been attempts to find solutions and establish web standards through organizations. Overall, responsive web design is necessary adaptation for the modern web and its benefits outweigh the challenges[12].

## V. SEO AND ONLINE CUSTOMER BEHAVIOUR

### 5.1 Effects of Voice Search on SEO Strategies

Some industry insiders believe that the advent of voice - based search may spell the end of SEO as we know it. The influence of voice - based search and digital marketing in strategies is apparent weather favourable on negative. One reason for its shift in approaches is that the voice in tech searches is fundamentally different.

Conversational languages used in voice searches is essential. Because conversational language is the foundation of voice – based, search material must be more natural sounding and answer inquiries quickly and accurately in order to rank for highly snippets[9]. It is critical to provide useful and authoritative content that Google picks to achieve this coveted place. Simply repeating terms without context is no longer sufficient. If the content is well created, it may be used to market a company[6].

### 5.2 Leveraging Google Maps to enhance Local SEO

If user wants to increase their local SEO, Google Maps could be a game changer Google Maps may help them enhance their exposure in search engine results by offering accurate information about the user's business such as its location, contact information and directions. User can improve their local SEO and bring more visitors to the business by using Google Maps. They can help the user increase their visibility in search engine results by integrating maps into their website and optimising their listings to attract more customers. Using these tactics, user can boost their local SEO and drive more traffic to the business. Integration of Google Maps into the website can benefit SEO by providing higher quality localised content and detailed directions which can lead to increased organic traffic.

Optimising Google Maps listing helps improve local SEO leading to a better search ranking for the website and optimised Google Maps listing can create a strong social media presence for foster relationships with potential customers[10].

## VI. CONCLUSION

In conclusion, website usability plays a crucial role in digital marketing. A website that is easy to use, navigable, and provides a good user experience is more likely to attract and retain visitors. This can lead to increased engagement, improved conversion rates, and ultimately, higher revenue for businesses. Additionally, usability can also contribute to search engine optimization (SEO) efforts, as search engines like Google prioritize websites that are user-friendly and provide a positive experience for their users.

Therefore, businesses should prioritize usability when designing and optimizing their websites to ensure they provide the best possible experience for their users and to achieve their marketing goals[13].

*Future Scope*

Looking to the future, the importance of website usability in digital marketing is likely to continue to grow. With the increasing use of mobile devices and the shift towards voice search, businesses will need to focus even more on creating websites that are optimized for these platforms. In the future, it will be important for businesses to ensure that their websites are optimized for all devices and provide a user experience that is consistent and smooth across different platforms.

Additionally, advances in technology such as virtual and augmented reality may also impact website usability in the future. Websites that incorporate these technologies will need to ensure they are intuitive and easy to use to provide a positive user experience.

Finally, as the digital landscape continues to evolve, businesses will need to stay up-to-date with the latest trends and technologies to remain competitive. This will require ongoing testing and optimization of website usability to ensure it continues to meet the needs and expectations of users.

Overall, the future scope for the importance of website usability in digital marketing is vast, and businesses that prioritize usability will be better positioned to succeed in the digital world.

## REFRENCES


1. Pratiksha D Dutonde, Shivani S Mamidwar, Monali Sunil Korvate, Sumangala Bafna, Prof. Dhiraj D Shirbhate– "Website Development Technologies: A Review" Department of Computer Engineering, Government College of Engineering Yavatmal, Maharashtra, India, Dr. Babasaheb Ambedkar Technological University Lonere, India, International Journal for Research in Applied Science and Engineering Technology (IJRASET).
2. Grega Jakus 1, Matija Jekovec 2, Saso Tomazic 3, J. Sodnik 4(January 2010)–"New Technologies for web Development", 1,3,4 University of Ljubljana, 5 DHH SpA.
3. Claire Kearney-Volpe, Amy Hurst (2021)– "Accessible Web Development".
4. Muffadal Katheria, Mamta Brahmbhatt (November 2019)- "A Critical Review of Voice Based Searches and Its Impact on Digital Marketing", B.K. School of Professional and Management Studies, Gujarat University.
5. David Carpenter (November 06, 2019) – "Could your Digital Marketing Strategy Use a Chatbot?".
6. Onuoha Chibuike 1, Nwokonkwo Obi 2 (September, 2022)– "Implementation of a web based chatbot Assited Services for results information system", 1 The University of Aizu , 2 Federal University of Technology Owerri.
7. Valerie K. Jones (Winter 2018)–Voice Activated Change: Marketing in the Ages of Artificial Intelligence and Virtual Assistants, University of Nebraska – Lincoln.
8. Bayan Abu Shawar 1, Eric Atwell 2 (July 2007) – "Chatbots: are they useful?"1 Al Ain University, 2 University of Leeds.
9. Asavari Sharma (November 15, 2022) – "How Voice Technology will Influence Marketing in the Future?" SEO.
10. Creative Elements – "Using Google Maps to Improve local SEO".

11. Jeannie Hill (December 30, 2017) – "Google Maps Marketing to promote your Business".
12. Erik Mod´e (June 27, 2014) – "Responsive Web Design and Optimizing Loading Times on Mobile Devices for Enhanced Web Presence", Uppsala University Department of Informatics and Media Information Systems Master thesis.
13. George S. Spais (April 15, 2010) – "Search Engine Optimization (SEO) as a dynamic online promotion technique: The implications of activity theory for promotion managers".