Robotics using Artificial Intelligence in Healthcare

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***Abstract*— Intelligent robots or Robotics using AI is a fast-growing and rapidly developing technology that can solve complex problems and perform complex tasks. Artificial intelligence in robots makes them intelligent, allowing them to work in unstructured environments.**

Use of AI in robots has enabled them to work in an environment where humans cannot go. They can perform task without human intervention. This led to rapid industrialization, growth in healthcare and agriculture sector. Machine learning, natural language processing, and computer vision are among the technologies used in robotics. They use these technologies to comprehend their surroundings, converse with others, identify items, and detect people.

In this paper we will dig into the architecture of AI Powered Robots and various applications of Robotics using AI in Healthcare Industry. We will also discuss the potential advantages of using AI in robots and its drawbacks.

***Keywords*— Artificial intelligence, Robotics, Healthcare, Automation.**

I. Introduction

Robotics using Artificial Intelligence, better known as intelligent robotics, is a fasted evolving field that merge the power of artificial intelligence and robotics to create an intelligent machine that can perform following tasks like sense, reason, and act in the real world. Artificial intelligence is used to enable robots to detect their surroundings, make judgements, and behave independently, without the need for human interaction. This has the potential to alter a wide range of industries, including manufacturing, logistics, healthcare, and agriculture.

In healthcare, robots can help with tasks such as patient monitoring, performing surgery and drug administration, allowing medical staff to focus on more complex tasks.

However, there are also concerns about the employment, privacy and security implications of robotics using artificial intelligence. As robots become more capable of performing complex tasks, they have the potential to replace human workers in some industries. There are also concerns about the use of robots for surveillance and possible damage from autonomous weapons. Despite these difficulties, artificial intelligence-based robotics has the potential to revolutionize a variety of elements of our lives, including the way we work, travel, and take care of the elderly and sick.

One of the key advantages of robotics powered by AI is its capacity to boost production and efficiency across a variety of industries. In manufacturing, for example, robots can perform tasks such as welding, painting and assembly faster and more accurately than humans. In logistics, robots can be used to move goods through warehouses and distribution centers, reducing the need for human labor. As the area progresses, we should expect to see more advanced and capable robots in the next years.

Overall, Automation is becoming more advanced and effective because to the incorporation of AI into robots, and there is unending room for improvement in the future. It is thrilling to be active in the field of AI and Robotics integration.

II. LITERATURE REVIEW

The role of humanoid robots and AI-based solutions in the hospitality and tourist industries is the main topic of this research study. Murphy et al(2019) .'s study examined the humanistic characteristics of robots and found 11 attributes essential for successful robotic services. Future research in this area was also highlighted in the report. Another research by Zlatanov and Popesku (2019) looked at several robot kinds and their significance in the tourist and hospitality industry, including customer service travel bots and Facebook chatbots. Imad (2019) suggested that the hotel sector deploy an AI-powered digital operations manager to improve user experiences and productivity in resource and revenue management. The objective of these studies is to provide a summary of current studies in the hospitality and tourism industries on the use of humanoid robots and AI-based solutions. This study of the literature will look at how medical robots may help both patients and medical staff. According to Shi et al[2019]. one such example is the use of exoskeleton robots which are found to be fruitful for the paralyzed individual to regain their ability to walk again. Another example of smart robot technology is Smart prostheses; they have sensors attached which are AI controlled that make them more precise and responsive than real body parts, and there is an option to cover them in bionic skin and connect them to the user's muscles. Robots, like the Hybrid Assistive Limb (HAL) exoskeleton, can be employed to perform surgeries and rehabilitation. The purpose of this literature study is to provide an overview of the application of Convolutional Neural Networks (CNN) through the use of robotic platforms in agricultural activities. Since the development of deep learning (DL), CNN has been implemented for various real-life applications, producing significant improvements for image identification and classification tasks. Similarly, CNN architectures had been implemented in agricultural operations through robots. Previous review articles have focused on DL in agriculture, summarizing all major agricultural tasks, such as the comprehensive review presented by Kamilaris and Prenafeta-Boldú (2018). In contrast, this review article specifically examines the application of deep learning methods, particularly CNN, for major agricultural operations performed through robotic platforms. By analysing the findings of previous studies, this review objective to provide a better understanding of the benefits and limitations of using deep learning approaches in agricultural operations through robotic platforms. AI-powered robots are being used by banks to improve the functioning and security of their ATMs. Some ATMs, for instance, are outfitted with face recognition technology to authenticate clients' identities and prevent fraud. Some ATMs include robotic arms that can disburse cash and count banknotes more precisely. Many banking activities, such as account opening and loan processing, are being automated using robotics and artificial intelligence (AI). This reduces human mistakes, improves productivity, and enhances the user experience. AI-powered robots are utilized in military and national security. They are utilized for surveillance and reconnaissance as they are installed with sensors and cameras to monitor and provide real-time data to the military operators on the ground. EOD robots are used by the military and law enforcement to find and destroy explosive devices. Artificial intelligence and machine learning algorithms are added to these robots to help them recognize and neutralize explosive devices more safely and effectively.

III. GENERAL ARCHITECTURE

- **Environment:** In AI-powered robotics, the environment refers to the physical space in which the robot operates. This includes any items, surfaces, or barriers that are within the robot's sensory range and may impact its behaviour or movement. The sensors such as camera, lidar etc. collect data and utilise it to create a representation of the physical environment so that they can work effectively.

- **Data Collection:** Sensors are the most important component of the robots because they are the data collectors. For robots to respond to something they require data, so we can say that Robotic perception heavily relies on data collected from the sensors mounted on the robots. When data comes from multiple sensors it must be effectively integrated and processed so that Machine Learning techniques can be deployed with the help of received data. The depiction and mapping of environment using sensory data is one of the most important parts of the robotic perception. This data helps to study the environment and provide the robots the ability to move and carry out the tasks.

- **Environment Representation:** Occupancy grid mapping because of its efficiency, probabilistic foundation, and simple implementation, it has been widely employed as a viable technique for environment representation in mobile robots and driverless automobiles. 2D representations are the most commonly used representations but now days scientists are shifting their focus towards 2.5D and 3D. This shift towards higher dimensions representation allows robots to work and make decisions in more complex environment which was not possible in 2D representation. Nowadays 3D sensor technology more affordable and reliable which makes 3D environment more accessible. Software tools such as ROS and PCL have contributed significantly in 3D representation. Octomaps by Hornung et al. [] is a well-developed method which have contributed in growing use of 3D-like environment representations.

- **AI/ML implementations**: After localizing the environment the robot proceeds with the assigned task for its execution. In a regular setup robot looks for the region of interest (ROI) and familiarizes itself with the current environment and build a 3D map. This 3D map helps them to avoid any potential obstacle and locate the target object. AI and ML techniques have been applied in robotics in many ways. Supervised learning is one of the most common Machine learning techniques used to train models to detect specific object or feature in the environment. A Model can be trained to identify different types of object such as people car or furniture from the images captured from the camera installed on the robot. Unsupervised and Reinforcement learning are also some Machine Learning techniques used to train models which latter can be used with the robots.

- **Execution of Task**: After implementing the AI/ML techniques for robotics perception the robot utilizes the information retrieved from its sensors to perform a specified task. If Machine Learning model is trained to recognize and find something in the environment then robot uses this information to navigate to the object by planning an obstacle free and short route to reach it and then perform action like grasping the object and moving it to the new location as instructed.

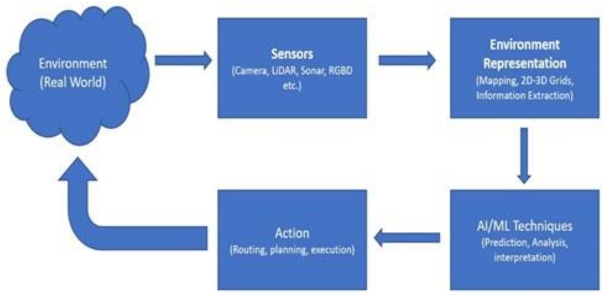


Fig.1 Block Representation of architecture

Figure.1 depicts the general architecture of AI in use in daily life. This diagram illustrates how these five components are interdependent. Artificial intelligence has the potential to significantly improve workplace efficiencies.

IV. AI IN HEALTH CARE

- **Surgical Robots:** Surgical Robots are the advanced robots that can perform precise and minimal invasive surgeries. Surgical cuts are smaller resulting in less pain and quick recovery. They reduce the risk of complications during surgeries. With the help machine learning algorithms, these robots can also adjust to changes in a patient's physiology and offer physicians with real-time feedback.

- **Medical Imaging:** A brand-new, cutting-edge technology called medical imaging has the potential to completely change how diseases are treated. Medical pictures such as X-rays, MRIs, and CT scans may be analysed by AI-powered robots to deliver accurate and rapid diagnosis. Radiology, Pathology and Clinical trials are some of the major areas where AI powered robots are used for medical imaging.

- **Rehabilitation using Robotics:** It is an advanced technology that helps patients with fast recovery from injuries and disabilities. Robots using Machine Learning algorithms can develop personalised rehabilitation programs for the patients. They also provide real-time feedback on how the patient is performing during his or her sessions.

- **Patient Monitoring:** AI and robotics-based patient monitoring is a modern technology that has the capacity to transform healthcare by providing precise and continuous monitoring of patients' vital signs and other health parameters. It also provides remote monitoring of patients i.e., patients who needs home care or they are located at remote locations. The new growing technology and machinery enables healthcare professionals to work efficiently and accurately.

III. PATIENT MONITORING IN HEALTH CARE

S. No	Patient Name	Healthcare Test	Test Data
1	Riya Singh	Sugar test	120
2	Shruti Srivastava	Thyroid Test	4.5
3	Aman Singh	Hemoglobin test	12

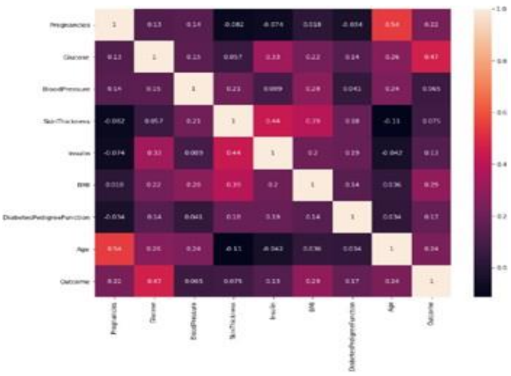


Fig.2 showing diagram for insulin vs sugar

Fig.2 displays the impact of insulin and sugar on the bodily cell. Insulin reduces the body's blood sugar levels by helping cells absorb glucose and provides glucagon when blood sugar levels are unusually low. The body's blood sugar levels increase as a result of glucagon telling the liver to release glucose that has been stored there.

V. PROPOSED METHOD

We are proposing the new method for monitoring health of patients using Artificial Intelligence. The majority of AI technology in healthcare that employs machine learning and precision medicine applications necessitates the utilization of medical imaging and clinical data for training, with the end result knowing. This is referred to as supervised learning. There are various types of artificial intelligence techniques, out of which we are using supervised learning techniques.

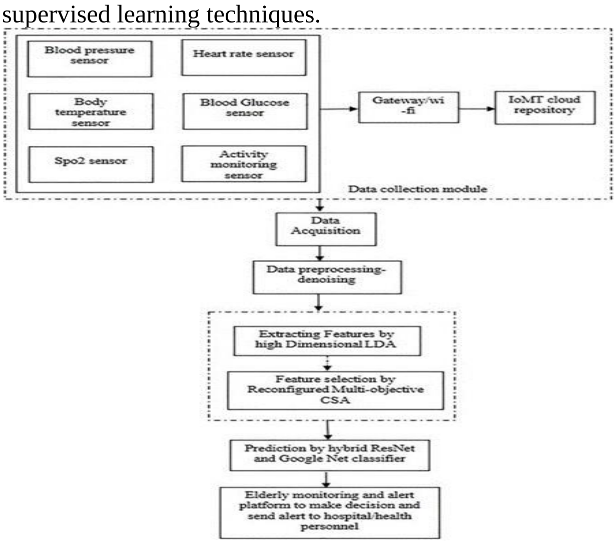


Fig.3 artificial intelligence technique for patient health monitoring.

Figure 3 is step by step method for Patients Health Monitoring System using Artificial Intelligence. We are using the logistic regression for Artificial Intelligence techniques.

The algorithm used in this paper are as follows-

```
from sklearn.linear_model import LogisticRegression reg =
LogisticRegression() reg.fit(x_train,y_train)
y_pred=reg.predict(x_test)
from sklearn.metrics import
accuracy_score,classification_report,confusion_matrix from
sklearn.metrics import r2_score
from sklearn.metrics import mean_squared_error
print("Classification Report
is:\n",classification_report(y_test,y_pred)) print("Confusion
Matrix:\n",confusion_matrix(y_test,y_pred))
print("Training Score:\n",reg.score(x_train,y_train)*100)
print("Mean Squared
Error:\n",mean_squared_error(y_test,y_pred))
print("R2 score is:\n",r2_score(y_test,y_pred))
```

DATA COLLECTION & MODEL VALIDATION

Data is used from Kamilaris et. al.[7].

diabetes (1)

Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
6	148	72	35	0	33.6	0.627	50	1
1	85	66	29	0	26.6	0.351	31	0
8	183	64	0	0	23.3	0.672	32	1
1	89	66	23	94	28.1	0.167	21	0
0	137	40	35	168	43.1	2.288	33	1

We have developed python program for above algorithm and implemented our proposed model for above dataset. We have got the results which encourage health monitoring system of the patients. Results are shown below-

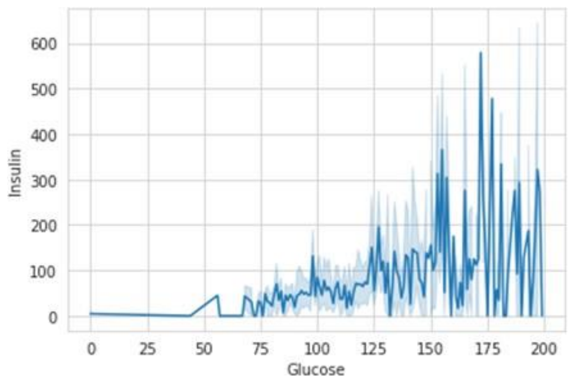


Fig.4- showing accuracy report outcome

In figure 4, it demonstrates that insulin decreases blood sugar levels by helping cells absorb glucose and provides glucose to cells for energy. When blood sugar levels are abnormally low, the pancreas releases glucagon. The body's blood sugar levels increase as a result of glucagon telling the liver to release glucose that has been stored there. This graph shows appropriate data analysis output.

Classification Report is:

Precision re-call f1-Score Support

0.92 0.88 107

0.62 0.68 47

0.82 154

0.77 0.78 154

0.82 0.82 154

0 0.84 1 0.76

Accuracy

Macro avg 0.80

Weighted avg 0.82

Confusion Matrix:

[[98 9]

[18 29]]

Training Score:

77.19869706840392

Mean squared error:

0.17532467532467533

R2 score is:

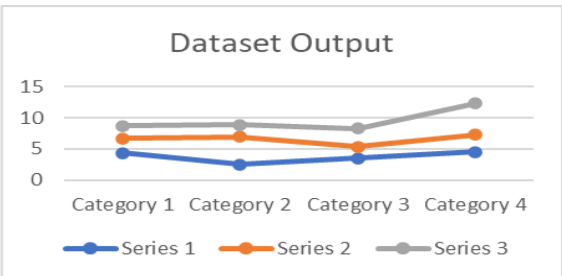
0.1731954662954862

S.no	AI techniques	Accuracy report
1-	Logistic Regression	82.46%

Table 2: Accuracy value for logistic regression Techniques

Predictive analytics and categorization frequently employ this kind of statistical model. Based on a collection of independent variables, logistic regression calculates the likelihood of an event occurring, such as voting or not voting.

So, we get a accuracy score of 82.46 % using Logistic Regression



Blue	Sugar test
Orange	blood haemoglobin level
Gray	thyroid test

Table 3- With the help of this dataset output we can determine the level of sugar, hemoglobin and thyroid level in patients report.

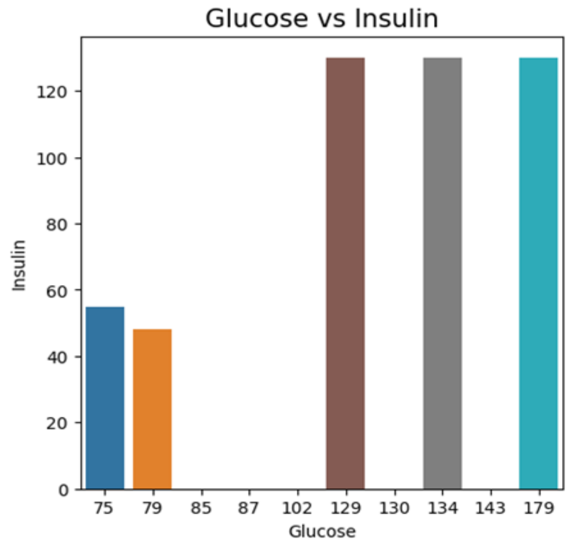


Fig 5- showing histogram for glucose vs insulin

Fig.5, shows the appropriate level of glucose and insulin in patient health data. The food you eat is converted into blood sugar by your body. When blood sugar enters your bloodstream, the pancreas responds by releasing insulin. Insulin enables the entry of blood sugar into cells so that it can be used for metabolism.

VI. CONCLUSION

In conclusion, the idea and integration of artificial intelligence into robotics has brought up a world of possibilities in many industries. From healthcare to manufacturing, robots with AI have the potential to increase efficiency and productivity, end up improving outcomes and reducing costs.

Moreover, the application of intelligent robots can enhance safety in a variety of sectors. Robots can be utilized, for instance, to carry out jobs that would be unsafe for people to conduct in risky areas like oil rigs or mines. This not only safeguards human lives but also boosts production and efficiency by decreasing downtime and lowering the possibility of accidents. We may anticipate seeing many more uses for intelligent robotics in industries where safety is of utmost importance as technology develops. Further, with these advancements come with some concerns about the impact on employment, privacy and security, which must be carefully considered and addressed.

With these challenges, the future of intelligent robotics is full of promise and potential. We may expect to see even more capable and advanced robots in the upcoming years as the sector continues to develop, which will bring about even more benefits. By continuing to develop this technology, we can transform the way we work, live and interact with the world around us. It is an exciting time to be involved in the field of AI and robotics integration, and the possibilities are truly endless.

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