Survey on: Applications of Smart Wearable Technology in Health Insurance

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Abstract. Humanity is considered as the most intelligent species on the earth and are health reactive. Today, due to increase in sluggish behavior there is reduction in physical activity and that leads to health problems. To overcome this cause, wearable technology helps human being to get updates about physical health behavior e.g. heart rate, blood pressure, steps count, BMI, calories and many more. Wearables available in market helps to measure all kind of metrics related to health. The aim of this research is to study and analyze the research to check whether wearable technologies with augmented smart AI solutions help to predict health status and its outcome. Leveraging Artificial Intelligence (AI) and wearable technology could help health insurance to cover the risks associated with the uncertainties in the health, increased life span and high cost of treatments. In this study, we first discuss the works where wearable technology and AI can create value in the field of healthcare and importantly discuss the use case of leveraging the insurance domain with a smart health-monitoring service for the customers. Although, there are inhibitions in implementing a smart and fitness monitoring system in health-insurance sector like privacy concerns and hesitations towards sharing the data, health-insurance sector can look at this use-case as an incentivization to the fitness conscious clients.

1. Introduction

Wearable devices are influencing nowadays in medical health and health insurance industry through digital platform by continuously monitoring health attributes. As people are more concerned towards maintaining their health, healthcare practitioners, insurers are willing to adopt wearables for better health of people [5]. In market, many wearables are available which can track health related parameters such as heart rate, blood pressure, calories, step count, physical activity, etc. and is gaining popularity in the market for monitoring fitness. The wearable technology has been used for health insurance company for gaining profit as well as maintaining person’s lifestyle healthier. Also, helps people in getting benefit from company such as discounts, vouchers, reduction in claim payment, etc. Hence, the data collected from wearable device helps medical company and insurance company to predict disease outcome [13].

Nowadays, technology such as Artificial Intelligence (AI) is increasing and has shown its effectiveness in the field of healthcare and health insurance industry for several application i.e. Pricing, Prevention, Prediction, Personalization applying on historical data. Generally, these are the use cases of AI which Insurance company are utilizing [22]. In some situations, when a person gets very exhausted, he/she may not be able to see symptoms of any diseases on the spot or sometimes it happens they may neglect about diseases occurring in their routine activities. To this problem, to alert people many researchers have come up with idea of predicting health and diseases risk with the static data available from hospital. But predicting huge amount of data may cost time, for this a model should be created which helps in predicting health risk [16].
Many AI technologies such as, Machine Learning, Deep Learning, Natural Language Processing, etc. are useful in making models. On applying data i.e. structured or unstructured to model, we can predict different things which can health firms in identifying future risk [25]. In this section, we will see some use cases of using wearables in healthcare and health insurance industry, which are mentioned below:

- Health Data Acquisition: Use of wearables to collect the vitals of individuals, helps in improving claim cost prediction.
- Incentivization: It will help making people lifestyle healthier and get rewards from wellness program.
- Health monitor: People gets alert message or notification from wearable to know about their health status.
- Health predictions: Several predictions can be made regarding health problems, customer retention and churn rate and fraud detection.
- Improved competitive position: Helps insurance company in strengthening their competitive position in the market.

In this paper, we would see what research has been done in health sector and health insurance using wearables in Section 2. Then, in Section 3 we will discuss and analyze what are the key findings after examining the literature. And lastly, we conclude this paper how wearables are useful for prediction purpose in Section 4.

2. Related Work

2.1 Application of Wearables in Life Style Monitoring

Patel MS et.al., gives idea for the wearable technology and devices which delivers benefits to human health behaviour, habits and well-being by using digital applications that are being used by many large technology companies. It focuses on the usage of the wearable device how it makes easy for human to adopt new technologies. Also, to adopt the new change in human behaviour and their habits these devices has to work on design strategies to make it effective for an individual. Hence, to connect with human behaviours through these wearable devices encouraging individual and feedback should be considered [1].

June Quah, gives idea about wearable is a medium through which we can monitor human health. There are several wearables available in the market but the main category of wearables in market lies to smart watches and fitness tracker. These wearables can collect human data such as physical activity in the form of step count, activity minutes, calories gain and burned, distance walked, etc. Also, many wearables nowadays can capture heart rate and sleep patterns. They have evaluated the effectiveness of human physical activity which are measured by wearable sensors helps in finding the mortality risk of a person. This was implemented on the dataset of U.S. population collected from clinical research studies. The main aim of this research is to find the relationship between person’s health and lifestyle behavior that is, physical activity, sleep patterns, calories gain and burned, etc. [2].

Asthana S et.al., surveys nowadays, in market numerous wearable devices are available that shows many attributes somewhat similar to each other which helps in monitoring and measuring an individual health attribute. However, due to ample devices available it becomes difficult for a person which wearable he/she should purchase for their health risk monitoring. For this, in this paper they have prepare a model which recommend an individual which is beneficial for them. This model works as they first gather all data such as diseases, the person is at risk of; his/her attributes, age, gender, state; and medical history, smoking, any fracture in past, etc. Then these diseases are combined to the attributes we collected in order to monitor or predict diseases, this was done via textual analytics model [3].

Paul G et.al., focuses on the privacy issues related to wearable health devices. The services provided by these devices are marketed by providers to end users and all are ready to buy these devices which help in monitoring health of an individual. But, regarding the usage of these devices questions arises of user privacy. So, it investigates and compares the privacy policies of four services (Fitbit,
Jawbone, Nike+, BASIS). On comparing privacy features offered by each service, privacy score was calculated out of which Nike+ provides higher privacy than other services [4]. Dunn J et al., depicts the wearable technology has a broad range of application in the field of medicine and medical health system. As wearable is revolutionizing medical healthcare system; devices are used for general health management system to improve care of an individual when he/she is in hospital or outside the hospital. When a person is outside of the hospital wearable devices combined with sensors helps in monitoring and tracking condition related to heart, metabolic, gastrointestinal disorders, sleep, neurology, movement disorders, mental health, environmental exposures and many more. Several studies conducted shows using wearables in medical system helps person not to only monitors their activities but also helps in reducing hospital visits, hospital readmission rates, improving an individual health and costly medical events. Wearables can also inform person about any ongoing symptoms such as any side effects. Thus, wearable data and sensors helps in collecting information and transferring fast to hospital or any medical service in case of an emergency [5].

Jin CY., summarizes how AI technologies are applied on wearable devices and various types of application are inspired by it. It shows different types of wearable gadgets available in market, which collects data and helps in model training and its application. They have categorized different types of wearable device such as Smart phones, watches, wristbands, Smart glasses, clothes and socks, shoes, earphones. In addition to that, these gadgets can collect various data such as Sport data, Physiological data, Environmental data and Communication data. For processing these collected data from wearables different models have been proposed which are effective to use that are Machine Learning, Convolutional Neural Network, Long Short-term Memory and Ensemble Learning. Also, it notes different application where machine learning and wearables can be used. Still there are some implication which need further exploration [6].

Wright R et al., surveys the wearable devices and technology are merged into clothes and accessories that are worn easily on the human body. These devices can be any of these: glasses, jewelry, headbands, and watches. These devices have great influence in the fields of healthcare, medical and body fitness. In the field of healthcare, several devices are developed such as Fitbit, wrist bands, and clip-ons which can help to track steps, activity, calorie burnt, distance and other physical activity. Many healthcare firms have developed smart glasses in the form of eyewear includes video glasses/goggles which is used for gaming, watching television or movies. Medical community has planned to use these Google glasses to look up on patient records which was based on application. Where physician can wear these glasses and before entering to patient room, he can scan the QR code through glass and find out the details of patient. But using this application it provides only limited information, does not allow to add/modify information with any gestures or voice commands. Along with that battery only last about two which was insufficient for shifts in the department [7].

2.2 Wearables-Artificial Intelligence (AI) in Health Sector

In this paper, Yu KH et al., describes Artificial Intelligence which is also said as machine intelligence has application in various fields such as Education, Healthcare, Business, Autonomous vehicles and many more. AI in Healthcare has played a vital role in medical diagnosis which takes information, process it and gives result to user. These analyses of data are done by applying AI technology that include machine learning technique for deep learning, structured data and natural language processing (NLP) for an unstructured data. Generally, AI in healthcare helps to analyze the relationship between the prevention/treatment techniques and patient outcomes. Several medical institutions and companies are developing AI algorithms and predictive analysis for their betterment in improving business operations. Using AI in healthcare gives accurate results and better prediction in patient’s treatment. Future scope is to develop Brain Computer Interaction that help people who are facing difficulty in moving, speaking and spinal cord injury [8].

Bayro-Kaiser E et al., surveys as number of wearable devices are growing high in market of U.S but there are some consequences to know if population of U.S are willing to adopt the wearable technology for health insurance wellness program and the incentives through which they may adopt it. For this, they have conducted a survey on U.S residents who were willing to accept wearables and was conducted in six different use cases where it was mandatory to access wearable device and give all the metrics
gathered within an insurance company. Those six use cases were, promoting health, early detecting of health diseases, predicting health risks, finding certain diseases disorder which may happen in coming future, adherence tracking activity, personalizing products and services and automated traditional process i.e. underwriting. On the basis of economic, privacy and technical circumstances, it says that two out of the three U.S population were willing to adopt wearable device for personal benefits related to health prevention and promotion [9]. Angelides MC et.al., shows how wearables can help an individual to improve their health lifestyle by bringing change in their daily routine and habit which may lead to a healthier lifestyle. They have developed a mobile app that supports data analytics and machine learning approach to help with inference of wearable data and recommending an individual’s personal lifestyle improve. They have shown a workflow where configuration and goal are set up in smart watch then with the goal set watch tracks an individual’s activity, those data are synchronized via Bluetooth, the raw data are analyzed and generates recommendation and forwards for visualizing the change or any improvement in habit or routine and then decision is taken and again after finding any change, goal is synchronized and whole cycle is repeated. Here, the analyses are merged with machine learning techniques to visualize patterns and correlation between activity such as sleeping and exercising which was very low. Thus, wearables require many sensors to monitor personal fitness during in case of any emergency. This would have high impact in health sector, insurance industry for better health and fitness [10].

Prabhu et.al., describes prediction of health risk at an early stage using machine learning technique. Many people in America have more chronic diseases and many of them have spent fee for the treatment of chronic diseases. This crisis has intended towards preventative measures where the major and primary concern is recognizing and taking actions at the early stage possible. These can be done on a person’s lifestyle, habits and medical records. They have proposed a Collaborative Assessment and Recommendation which depends on person medical history. For this they have built a new algorithm using Convolutional Neural Network which is based on Multimodal Diseases Risk Prediction using both types of data: structured and unstructured. This model was implemented on dataset available from the hospital. Compared their work with existing work, they have focused on both types of data in data analytics. With these, the prediction accuracy of their proposed algorithm was faster. Hence, this performs better at predicting future diseases risk using machine learning algorithm [11].

Shinde SA et.al., gives idea on machine learning techniques and its applications how they are used in predicting health risk and health care system. The main purpose of this papers is categorized in four folds. They are about providing guidelines for the researchers who want to explore in machine learning field, providing survey on machine learning, its application in predicting health risk and showing further direction to be implemented in coming future into health prediction system. Also, it shows machine learning methods in predicting health risk is gaining popularity in research area as well as for the future direction [12].

Burnham JP et.al., reviews and analyzes the literature to check whether using wearables we can determine health outcomes or not. For this, they researched various studies that using wearable technology for predicting health outcome. Also, it involves human studies where wearable technology tracks human health parameter and modelled that data for a prediction of mortality, readmission and emergency department visits. They study resulted out of eight, six studies developed a model for readmission and two studies modelled for mortality. But each of studies, have captured data from a wearable device that were predictive. Hence, wearable technology has high influence in predicting clinical outcomes, but still there is more to find in health care system for future aspects [13].

Repaka AN et.al., focuses on predicting heart diseases using data mining technique by examining and collecting data which can be useful in finding patterns for making business related decisions. They have used Naïve Bayesian classification technique to predict heart related diseases. They have collected data from various sources which includes patient particulars such as person’s span, blood pressure, sex, cholesterol, blood sugar, etc. Based on collected attributes it acts as an input for the Naïve Bayesian classification method. It is based on application platform where user has to login into its web portal and provides data and data are then transfer by Advanced Encryption Standard which are secured. Then the output is produced. The output reveals that the proposed system works systematically and effectively assists in predicting risk related to heart diseases[14].

Ambekar S et.al., surveys in healthcare data plays an important role. It has large amount of data to handle which can be used for health diseases prediction and patient care. Due to some missing data
values, accuracy of the model decreases. To overcome the problem of missing values, they have performed method of data cleaning and transforms incomplete data into complete data. For this, they have applied data mining technique called Naïve Bayes classification and KNN algorithm applied on the dataset. To predict risk, they have used structured data and method CNN based unimodal risk of disease prediction algorithm. Overall, the accuracy of CNN-UDRP method have high accuracy in predicting risk [15]. Amin P et.al., describes nowadays identifying diseases and diagnosis the diseases are the forefront of machine learning in healthcare. Today, there is increase in urbanization and decrease in physical activity which leads to health problems. To overcome this issue, wearables are available in the market which helps in monitoring physical data and notifying user about their health condition. But not all wearables are accurate in measuring metrics and predicting health risk. For that, they have proposed a machine learning model that captures data collected from wearable device and process it and helps in prediction whether there is risk of cardiovascular diseases. Method such as Logistic Regression gives good accuracy in predicting health risk [16].

Massaro A et.al., surveys on a proposed work which states decision support system based on AI algorithm and the wearable device helps in predicting health report. The data captured by wearables are stored on Big Data and processed by Support Vector Machine algorithm that able to predict health status. Another algorithm, Long Short-Term Memory was applied on the dataset, that proves the function of physiological data prediction. Hence, data mining techniques applied in healthcare industry can increase prediction analytics which offers advantages [17].

Salamon J et.al., have experimented sentiment analysis and heart rate analysis through four different data sources. At first, they measured heart rate through wearable device that is Fitbit Charge HR and collect data regarding their heart rate, stress, excitement, tiredness, as well as all physical activity, BMI, blood pressure, etc. Also, they measured heart rate by the Basis Peak and the ECG and collect data. Then, they compared both ECG heart rate data and HR heart rate data, where the precision of HR heart rate data was good enough than ECG heart rate data. Secondly, for sentiment analysis they conducted a survey where people have to expressed their sentiments in tweets by writing short texts and Twitter as a medium was used as a social recording medium and the result was evaluated using positive and negative hashtags. These data were merged together to find the mutual dependency of human activity: physical and emotional [18].

The literature discussed the potential of AI leveraged wearable devices in health data acquisition, processing and prediction for effective health monitoring.

2.3 Wearables-Artificial Intelligence (AI) in Health Insurance Sector

Rao et.al., surveys wearable devices that are been used by insurance companies which helps in increasing their business profits, sales opportunities and reduce cost of customer retention and acquisition. For this, Big data and Wearables in Life Insurance offers them to face today’s challenge to more targeted approach to attract customer and retaining them. Many companies have adopted wearable technology to attract customer to use this device which captures customers personal data such as all types of physical activities, blood pressure, BMI, heart rate, etc. Through these they set target for customer to achieve in given period which helps customer in maintaining their health lifestyle and getting better life and also helps customers to get benefits from insurance company. Also, Big Data helps insurance companies to identify new opportunities in business and helps in expanding relationship with customer for greater profitability [19].

Ravi Malhotra et.al., depicts data plays an important role in an insurance industry. The data are collected from various places such as wearable device connected with sensors, social media activity, voice analysis and many more. Many insurance companies are examining how they can take advantage of these data and merge it to Artificial Intelligence (AI) and Machine Learning (ML) to solve business challenges in an insurance industry which includes underwriting, claim handling, fraud detection, prevention, pricing, sales and customer experience. Also, they are finding ways how to explore ways to use predictive modelling and machine learning to enhance customer satisfaction, increase business efficiency and operations. It states graphically, trend of global AI market for coming years where it predicts in coming future market will overtake Artificial Intelligence (AI) technology. Also, adopting this technology some of the challenges may face by insurers related to data in an insurance company about security which should be solved [20].
Daniel Thyssen et al., surveys how wearables are helpful and used in an insurance sector using predictive analysis. It shows how business can be processed better using Predictive modelling, Handwritten Recognition, Text Analytics and Data Capture. These can be done with the help of new technology such as wearables device, Internet of Things (IoT), Blockchain, Cognitive Technology and many more. Using Predictive modelling, it can help insurance company for claim processing, dynamic pricing, better underwriting and reserving decision. These predictive modelling can be done with the help of wearable devices which are integrated with sensors that collects data from human body and provides several benefits such as managing diseases at early stage, reducing claim in an insurance company by achieving goal set by an insurer, better rehabilitation, etc. [21].

Samad Masood et al., shows nowadays, Artificial Intelligence (AI) is changing Insurance company and the way it engages customers. From many years, AI technique has been useful in detecting fraud but now insurers are adopting these technologies for better uses such as to speed up their operational efficiency. To improve operational efficiency and customer experiences insurers are merging Internet of Things with AI. Many companies started adopting AI that helps in claiming insurance on an ad hoc basis. Other than that, there are several uses of AI in Insurance Sector such as for Prediction, Pricing, Processing, Personalization and for Prevention techniques. For these, several companies are using wearable gadgets providing customer to achieve some physical activity by setting goal and based on results, it helps customer by offering different claims, discounts, wellness benefits with insurance. Hence, still this was challenging as data plays an important role, insurance company need to develop a data strategy for securing data [22].

Joanne Buckle et al., focus on the electronic device that is wearable devices how it is implemented and what are the practical use cases of wearables in the private medical insurance in the market. It also shows how insurers are willing to use these wearables devices for their own benefit for business growth and profit. These wearables devices help in capturing different metrics of an individual health data. In their research, they have conducted a survey in market to understand customers view points and their interaction levels with wearable device. From this, insurer may determine the premiums of customer. Also, with the help of wearables medical insurance company may get to know about health risk assessment as a part of scoring which metrics had better predictive value for the outcome. Using wearables in medical insurance company, helps customer to develop better health and based on that they may be awarded by insurance company on completing some set target. Some of the insurance company are currently using wearable technology such as Aditya Birla Health, Aetna, Oscar United Healthcare and many more and thus providing some benefits to customers in the form of rewards, discounts, vouchers and recommendations. Also, it shows about what types of device available and what do they track and fitness activity. And, though wearables may attract customers to purchase and that helps in increasing their physical activity levels, but some key metrics are not yet captured by wearables for their health risk assessment scores [23].

Chris Falkous et al., depicts how wearables are used in Life insurance company. There are several applications of using wearable gadgets such as tracking physical activity, improving underwriting capabilities, some value-added services for customer, also for insurance protection and main concern is to improve user health and well-being. Insurers using wearable devices need to know about the metrics and data collected from wearables in order to effectively quantify the impact on human health. Also, insurer can understand the relationship between metrics from devices and mortality rate. It helps insurer to communicate effectively and respond to evolving market [24]. Kumar N et al., presents the use case of Artificial Intelligence in an Insurance Company to overcome issues for better customer satisfaction. For that, Insurance company built a conceptual model which calculates the relationship between use cases and AI. To verify the model, an empirical quantitative research which is Proof of Concept (POC) was used which shows uses for Insurance Sector to overcome customer troubles. Also shows various Insurance companies who have adopted AI technology in field of Insurance Company providing various benefits to customer to have a positive influence on business growth, customer satisfaction, minimizing frauds and profits in the insurance industry [25].

Balasubramanian R et al., surveys how insurance companies will adopt AI technology in the future for their benefit. Where insurance company will need to understand some factors, which will be varied and how AI amend its claims, underwriting, distribution and pricing. Technology using CNN and other deep learning algorithms generally used for image, text and unstructured text processing is used for variety of applications. Using AI technology change from distribution to underwriting and pricing to
claim will be automated. Also, for secure payment transfer blockchain technology will help to provide authority and authentication. The underwriting process will be automated is shrink to minute seconds supported by combining machine learning and deep learning models. Claims for business firm and personal lines will also be automated by reducing claim processing times into few minutes. In future, insurance worker will need to adopt these new technologies, must be creative and willing to work with mix of semiautomated and machine supported task that evolves [26]. Riikinen M et.al., purpose is to find how chatbot in insurance support customers value creation. For developing chatbot, AI technology uses customer data for providing services in insurance sector. Chatbot designed provide interaction to customer influencing them with additional service. Here, they have built conceptual framework which plays 4 different roles: Info desk, Intelligent, Butler and Life Coach, these 4 are the chatbots that shows how customer value creation are supported. For future, chatbot can be created providing additional opportunities to customers for future research [27].

Burri RD et.al., gives idea about data are the key element in Insurance sector and how it converts machine learning methodology to insurance sector. Nowadays, insurance company are more interested in predicting future which has less financial loss for the company, optimize marketing strategy, to enhance company’s income and to improve its business. The main purpose of this paper was to predict claim and helps insurance company to charge customer its premium that to be paid. They presented several machine learning algorithms such as Random Forest, Logistic Model Tree, Naïve Bayes, Multilayer Perceptron and J48 and compared each techniques performance using various metrics. On evaluating results of above-mentioned techniques, Random Forest algorithm outperforms having maximum accuracy [28].

Su J et.al., surveys, these days, the health insurance industry is facing difficulties and competition in market. One of the main concerns is customer retention which is an important factor for business growth development. In this, they have addressed the problems faced by health insurance company in maintaining right customers and for that they have developed a retention predictive model which shows scores of customer retention who are likely to retain within the company. In that model, they have also mentioned some factors that were affecting retention. In creating model, they have applied machine learning techniques such as supervised learning K-Means clustering and Hierarchical clustering. Through these they demonstrate the customer retention scores in an insurance company [29].

Guelman L et.al., focuses on customer who are more likely to retain within an insurance company. Many approaches are done to predict customer churn who are likely to switch another company. But this paper, concentrates on right customers who reacts positively to the company’s persuasion. For that they have proposed an approach using method called Random Forest which was successful to predict customer retention. Also, developed algorithm of Random Forest for uplift problem. For processing a model, data set was taken from a Canadian insurer. Based on data set availability, they divided retention rates by groups that is Retained policies, Canceled policies and Retention rate. For modelling, input variables were taken as Policy, Driver and Vehicle characteristics. Using Random Forest algorithm, we can easily assume the change that a customer shift to different company when he/she approaches to company for renewal. These can help insurers also to change in their marketing skills towards customer churn [30].

Sabbeh SF., surveys, by comparing machine learning techniques for predicting scores of customer retention. As nowadays, customers are more indulged in getting Quality of service rather than quantity services. Also, organization needs to develop Customer Relationship Management system to find new customers and maintain the relationship with them and get bigger rate of customer retention for more profit gain by business. For the work to be done easily, Customer Relationship Management uses machine learning approach to build model which helps in predicting behavior and personal data of customer. This will help in predicting rates of customer retention and customer churn. Several machine learning models such as Discriminant Analysis, Decision Trees, KNN, SVM, Logistic Regression, ensemble-based machine learning algorithms were used. Overall, ensemble-based machine learning techniques outperforms all achieving higher accuracy than other methods [31].

Rawte V et.al., presents, number of frauds are increasing day by day in an insurance company which cause issues to health insurance field. To minimize these frauds, data mining techniques were applied to data available with insurance company. Before detecting fraud, it needs some preliminary data of health care system, some of fraud cases that happened in past. Here, using Data Mining technique they
have divided these learning into two parts that is supervised and unsupervised learning to find fraud claims. Well both these methods have two sides: pros and cons but by combining pros of both method they have created a hybrid model for analyzing fraud claims in an insurance company. They have classified original claim and duplicate claim by clustering using Support Vector Machine algorithm (SVM). These SVM technique is used that provide scalability and usability required by data mining system [32]. Roy R et al., surveys Insurance fraud that are happening nowadays in an insurance company. Many companies are facing this issue when person or entity makes false claim insurance to get compensation and benefits which are not owned by them. To overcome this challenge, this paper proposes a traditional approach for detecting fraud. It is based on heuristics development which indicates fraud but still there were some implication. Here, they have detected fraud in an auto or vehicle insurance company. They used machine learning techniques to indicate fraud. They have compared the accuracy of traditional method and machine learning method, where accuracy, precision and recall scores of machine learning technique was much higher than traditional algorithm [33].

Rayan N., presents how Insurance Company are experiencing fraud claim and processing. So, to analyze and detect fraudulent claims in Health Insurance sector the concepts of data mining and machine learning approach have been applied to identify it. Previously many techniques were applied to identify fraud but there was some implication with old method such as evaluating large database manually, new healthcare fraud was continuously increasing and requires regular update. To overcome these challenge, new approach was introduced for fraud detection system that is, advanced data mining, machine learning and statistical modeling method. Several factors were taken in consideration such as types of fraud happening in health insurance and healthcare data. They developed a workflow for analyzing and detecting fraud using supervised learning and unsupervised learning technique. This new approach was quite useful than old method [34].

Boodhun N et al., surveys, in present times, companies perform underwriting method to make decision on application and to price the policies claimed by customer. Likely, there is increase in huge amount of data and it should perform underwriting method accordingly which causes some risk in assessment. So, with the help of increase in technology and data analytics, the process of underwriting method can be automated and the risk of assessing an application can be reduced. To do this, they have proposed a method using supervised learning where it helps in predicting risk. For this, machine learning algorithm namely, Random Forest, Multiple Linear Regression, REPTree and Artificial Neural Network were implemented. These methods were experimented on a dataset for predicting risk level. Among all these, Multiple Linear Regression outperforms showing higher accuracy [35].

2.3.1 Use cases of Artificial Intelligence (AI) in Health Insurance field.

The above presented literature helps us summarize the role of wearable technologies and AI in insurance domain with the help of the representation in figure 1 and figure 2.
2.4 Wearable-Artificial Intelligence (AI) in diseases prediction

We now discuss the works in the specific use case of AI and wearable in insurance. The chosen use case of disease prediction contributes as:
• Health Data Acquisition: Use of wearables to collect the vitals of individuals, helps in improving claim cost prediction.
• Incentivization: It will help making people lifestyle healthier and get rewards from wellness program.
• Health monitor: People gets alert message or notification from wearable to know about their health status.
• Health predictions: Several predictions can be made regarding health problems, customer retention and churn rate and fraud detection.
• Improved competitive position: Helps insurance company in strengthening their competitive position in the market.

2.4.1 Analysing: key findings and limitation of work done in insurance field.

Table 1. Key Findings and Limitation of work in the analysis

| Author Name         | Year | Key Finding                                                                 | Problems                                                                                           |
|---------------------|------|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Alessandro Massaro  | 2020 | Used AI algorithm- SVM and LSTM to predict health status on the data collected from wearable device | Still the goal of finding match between measured and predicted values need to be done               |
| Poojitha Amin       | 2019 | Using FitBit data as a wearable applied machine learning algorithm to predict heart- cardiovascular diseases | Data obtained has lower percentage of disease. It only predicted heart disease                        |
| Anjan Nikhil Repaka | 2019 | Proposed approach was Application Based and applied Data mining technique- Naïve Bayes classification to predict heart disease | As it is application base, in overall process only patient can notice whether he/she has heart disease or not |
| PRABHU. T           | 2019 | Concern was to recognize disease risk at an early stage using machine learning algorithm- CNN UDRP | Here, data was collected from Medical dataset in huge amount                                        |
| Jin chun yu         | 2019 | Summarize use of AI technology for wearable devices, its types, applications, what data are collected and models used | Problems were wearables don’t give accurate measurement and due to that it effect in prediction     |
3. Discussion

3.1 Application of using wearables and AI in Healthcare and Insurance sector

In this section, we addressed how Wearables helps medical health and health insurance industry by providing solution to human health behavior. Also, we see using AI and wearables in healthcare and insurance industry has several use cases and application which helps in monitoring different attributes. AI technology merged with wearables provides solution for:

- **Prediction** - It helps insurance industry to offer a new way to predict real time events for their business benefit such as detecting fraud, customer retention and churn as well as also alert user for their health-related problems such as early health risk.
- **Customer Experience** – It helps insurance firms to know about customer learning using chatbot, providing best offers and customer value added services for better progress in company.
- **Pricing** – Price of Insurance policy may be reduced to an insure if they are properly motivated and convinced to used wearables otherwise, they have to pay as per the policy price.
- **Prevention** – Insurance company may get benefit to prevent human health fitness and illness from tracking physical activity and their daily payouts. Also, it bundles life insurance policies with change in human behavior and to reward customers with some benefits.
- **Processing** – Using AI in insurance sector helps insurer for faster claim processing, image processing as well as document processing. It will help in minimizing time and to underwriting policy.

Some benefits and application of using wearables:

- More than just tracking, helps doctors to monitor the patient remotely.
- Using wearable helps fitness loving people to get better healthier lifestyle by getting alert notification for health status.
- Also, incentivizes patients with reduction of paying claim cost.
- Helps insurance firms to improve business competency by providing wearables to its customer and maintain its position in the market.
- People can get benefit of getting rewards, discounts, coupons for wellness program using wearables.

The paper shows an exhaustive survey of different use case of AI and Wearable technology in insurance domain like claim processing, fraud detection, customer retention, customer churn as well as for predicting human health risk or diseases prediction using different datasets. AI techniques implemented were Convolution Neural Network, Support Vector Machine, Random Forest, Logistic Regression and many more. On analyzing and findings, we found work done in the field of healthcare for predicting health risk on dataset collected from different sources and least from wearables. The literature study shows the results were limited by the data set availability, choice of correct methods, and lesser accuracy in predicting health risk. Moreover, hesitation to share the health meter and activity tracker data are inhibitions towards the adoption. A better incentivization policy can be effective solution to the adoption of a service.

4. Conclusion

In this paper, we analyze how smart wearables with AI techniques find their applications in the field of healthcare and specifically health insurance. It helps healthcare system to get status about person’s health, his exercise patterns and predict early diseases for better health in future. It demonstrates, how insurance company get benefit from wearable device to transform their relationship with customer for their growing business and profit. Our literature work opens the door for researchers, insurance domain
experts, healthcare practitioners to find how the data collected from the end users can create value to the customers, insurance companies by creating a health-aware ecosystem. This will be however challenged with privacy concerns which have to be addressed. To discuss the far-reaching effects, it can also help in making the claims less fraudulent and help in quick and justified claim settlement.

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