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Data Collection for Classification in IOT and Heart Disease Detection

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ABSTRACT
Health predictions are a key technology-focused field. The software plays an important role in reliably and at a good rate predicting diseases. This work focuses on the study of methods that are used for purposes of prediction. The disease detection parameters are obtained through the use of sensors and maintained in the form of datasets. The Internet of Things(IoT) is used mainly to collect user data. For evaluation, techniques like Euclidean distance, K nearest neighbour, and ARIMA are considered. This work also highlights relative strengths and weaknesses. Data reliability may be at risk as the sensor may not function during the collection process. Various algorithms also possess fault tolerant capabilities.

KEYWORDS
Health Prediction, Internet of Things(IoT), K NearestNeighbour, Euclidean Distance, ARIMA, Fault Tolerant.

Introduction

There is lot of advancement in technology, thus it plays an important role in monitoring health.Issues related to health occur due to late infection detection. Nevertheless, technology helps to predict diseases in the early stages and thus prevent disease.(Mohammed et al. 2014)proposes Internet of Things generatessome applications on android for health care. (Dimitrov 2016) The Internet of Things(IoT) is commonly used to gather information from users about different parameters are applied.(Rao and Kumar 2012)KNN,(Abawajy et al. 2015)Random Forest,(Sinwar and Kaushik 2014). The reliability of the data shown depends on the sensors. Sensors can generate inaccurate data when malfunction occurs. Fault tolerance in such conditions is therefore essential. This paper describes the IOT applications for collecting data, the techniques recycled to practisedata generated by sensors and then the different proficiencies of fault tolerance is utilized to identify sensor data.All information that is generated by sensors is gathered in the form of datasets and maximum information is generated in the form of attributes, increasing the size of the dataset. After that this data is evaluated for reliability and forecasting the future. The demonstration associated with analysis process is listed as under.

(Chung 2014; Maksimovic, Vujovic, and Perisic 2015)IoT(Internet of Things) provide pervasive framework used to predict health status of persons. Variety of application domains that is associated with IoT including health care. Social and economic aspects are considered through IoT and hence are efficient for prediction purpose. In order to use IoT, state of the art network architecture is required. It is a vital component of IoT in health care. Backbone of IoT is supported through network architecture.It facilitates transmission and reception of health data. The network architecture is critical causing easy access platform for attributes collection. Effective network architecture causes social and economic benefits and also causes predictions which are accurate in nature. IoT network architecture along with issues tackled are given as under:

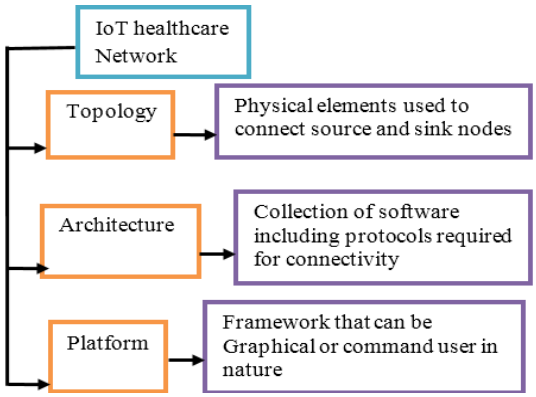

Fig. 1. Network Architecture for IoT Health care system

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(Chung 2014; Maksimovic et al. 2015)Topology specifies physical equipments arrangement in IoT network. Topologies provide seamless health care environment achieved through distinct placement of elements in network. Sensors used in the environment are of distinct type hence formed grid is heterogeneous in nature. Grid consisting of different types of sensors collects key signs and sensor data like temperature, high blood pressure, electrocardiograms and oxygen levels forming topology associated with IoT network.Figure 2 describes how grid is used for collection of enormous vital signs and convert heterogeneous grids into hybrid computing grids. The architecture of computing grid is as shown below:

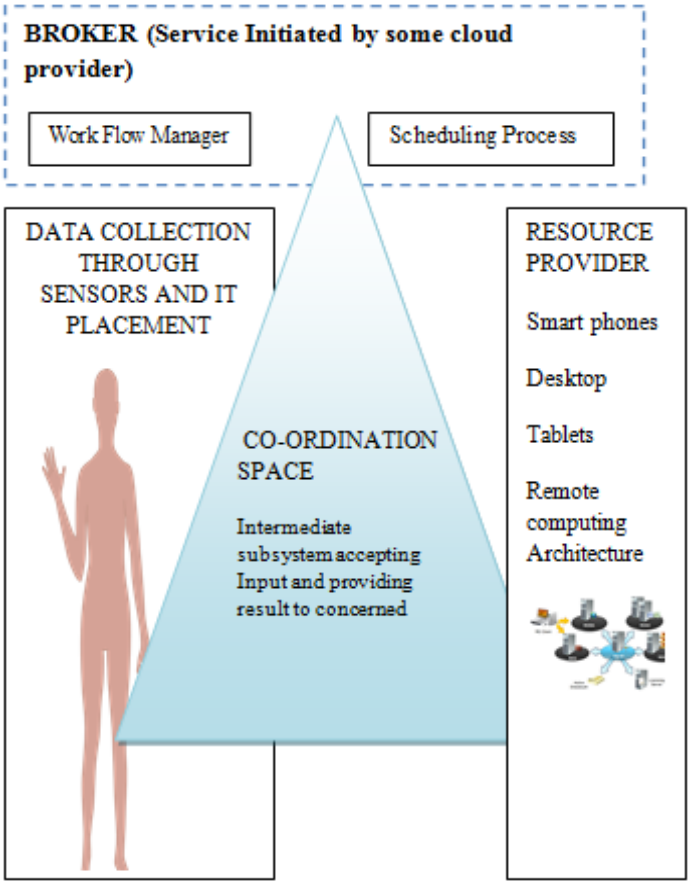

Fig. 2. IoT based ubiquitous Healthcare solution

(Christian Vecchiola, Xingchen Chu, Michael Mattess 2011; Wikipedia 2013)Platform is provided using cloud and is accessed by machines beyond their actual capacity. Platform can only be accessed by the use of set of protocols. Common protocol implemented and used in IoT architecture.

(Salman and Jain 2013)The physical and data link layer are used in collaboration. It receives data and converts it into bits and bytes. Error detection and correction mechanism is absent in this case. The collected data is organized into frames. Adaptation layer is used to make the data transferred from source to destination by converting the format of data of source into format understood by destination. The frames after words are transferred towards the destination using network layer. Internet protocol is followed in this transferred process. Data transmission towards the destination takes place by the use of transport layer. Transport Layer uses two protocols named

- Transmission Control Protocol
- User Datagram Protocol

TCP is transmission control protocol and is online in nature. It means it is necessary to establish connection at both the ends. Connection is reliable in nature. UDP on the other hand is user datagram protocol. It is offline in nature.Connection is unreliable in nature. IPV6 protocol is used in this case.Application layer is a collection of

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protocols required to transfer the data from source to destination. Set of protocols are defined within application layer. These protocols include HTTP, COAP and SSL.Hyper text transfer protocol is used in order to transfer the data over the internet enabled networks. COAP and SSL establish norms for transmission.

(D. C. Fundamentals n.d.;N. Fundamentals n.d.)The activities after successful connection establishment are to transmit the data.This transmission process involves three way handshaking protocols. Sender transfer the data towards destination and destination originates acknowledgement. After receiving the acknowledgement, next data transmission in terms of packets begun.Overall process of transmission is known as handshaking. There is an almost daunting selection of connectivity options for electronics engineers and application developers working on Internet of Things (IoT) devices and systems.

(Anon n.d.)There are many well-known connectivity systems, such as WiFi, Bluetooth, ZigBee and 2G/3G/4 G cellular, but there are also a number of new emerging networking solutions, such as Thread as an alternative to home automation applications and Whitespace TV technologies being introduced in major cities for IoT-based applications in larger areas.Data requirements, range, security and power requirements, and battery life are some factors that depend on the application.These are some of the major technologies of communication available to developers.

(Mohammed et al. 2014; Rohokale, Prasad, and Prasad 2011; Tarouco et al. 2012)Applications of IoT in health care are of prime importance. Services are provided through the support of IoT and are consumed by consumer using application support environment provided by protocol suite supported by IoT. Allocation areas are interactively shown as under:

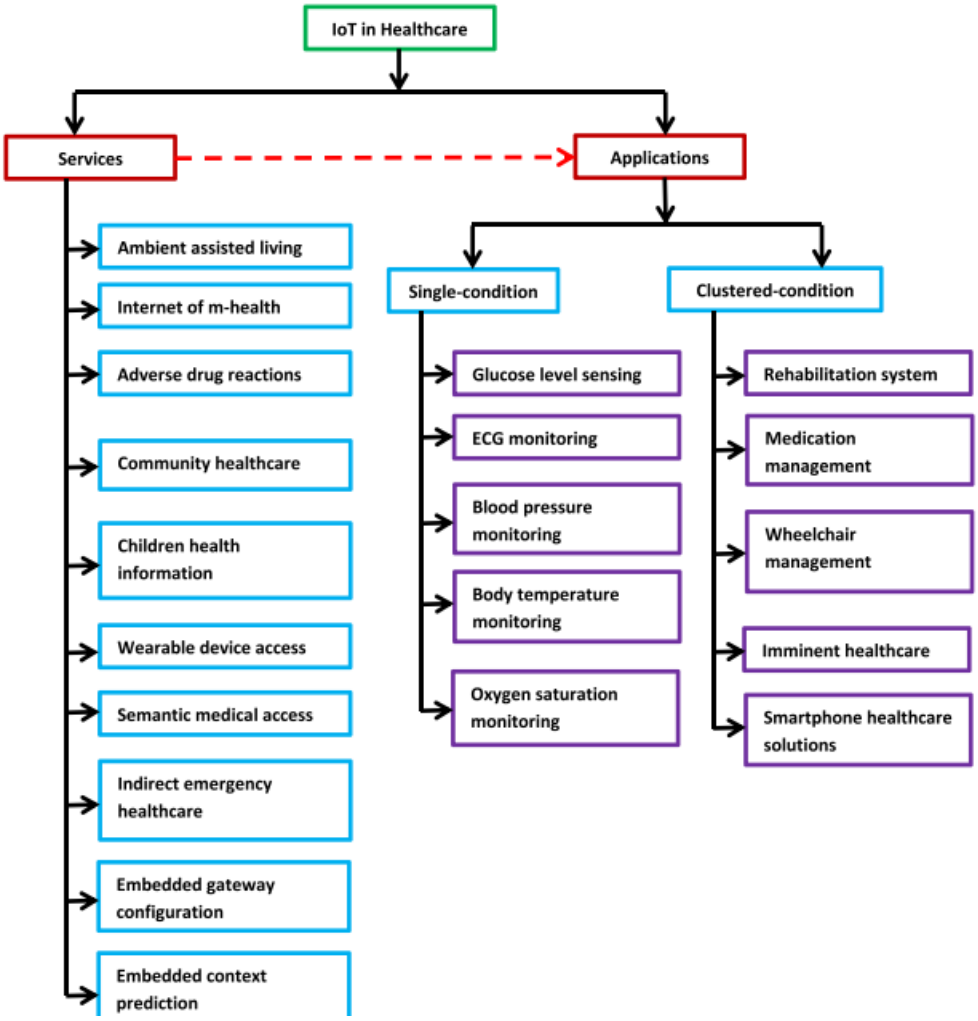

Fig. 3. IoT in health care environment

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Health care environment can involve single condition or clustered environment. Single condition indicates disease detection on the basis of single parameter list. The clustered condition indicates disease detection on the basis multiple parameters. To detect the disease number of techniques is devised. These techniques are prediction accuracy is listed through the following examples.

This literature present work for analyzing IoT, Algorithms and Fault tolerance. The work:

1. Describe applications of IoT and its usage in data collection relevant to health care.
2. Describe Algorithms used for health predictions.
3. Describes fault tolerant capabilities possessed by different algorithms.

Parameter Fetching Mechanism

The evaluation of Internet of Things greatly facilitates the diagnosis process of patients. (Anon n.d.)suggests monitoring of records associated with patients is becoming possible with the utilization of IoT. In order to accomplish this task, (Abdelwahab et al. 2015)(Xu et al. 2014)small IP based wireless sensor (Proximity sensors) is attached with the patient body. (Guo et al. 2016)proposes sensor based sensing application that helps in monitoring the psychological parameter like heart rate and blood pressure remotely and frequently. The record so obtained can be stored over the cloud so thatpatient record can be retrieved as and when required. The proposed work studies the applications of the IoT in the field of health care along with management policies used to enhance security of records stored within cloud.

Collection of Parameters through IoT

The parameters collection is integral part of health care. Collection of parameters is accomplished through sensors and organized in the form of tabular structure. (Li et al. n.d.; Vaishali and Kalaivani n.d.)as more and more data is collected Big Data is formed, it is organized to form dataset. The process of collecting parameters includes the sensors implanted on different parts of the body. The sensor produces information that are stored in the memory as person performs distinct activities. Overall organization of internet of things in parameters collection is organizedas follows:

Table 1. Parameter Collection settings

PARAMETER COLLECTION "PLACEMENT OF SENSORS" ALONG WITH ITS TYPE		
Parameters	**Description**	**Utilization Example**
Human Body	Devices attached inside or outside human body	Devices used to maintain well being of humans. Applications include disease management, increased productivity etc.
Home based environment	Homes and Building where people live in	Sensors used in security systems
Business Store	Places where customers engage in transactions	Stores, Banks, maul etc. involving large number of people.
Offices	Place where intellectuals interact with each other for business	Management of energy and security enhancement services in buildings
Organization like factories, industries etc.	Mostly used in production	Places where repetitive work is done like in hospitals, inventory systems.
Sites where actual work is done	User specific customer environment	Oil Mining and construction environment
Cars and other moving vehicles	System which work inside moving vehicles	Vehicles including cars, jeeps etc. used to monitor consumption of fuel.
Urban Environment	Cities	Smart Cities
Miscellaneous	Between Urban and rural area	Including rail tracks, roads etc. used to detect blockage if any

Collection of parameters collected through the above listed source form dataset. For detection of disease related to

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Activities, dataset from UCI website can be drawn. Parameters collected for disease detection is obtained by placing sensor over or inside the body. Next section describes techniques used to predict diseases through data obtained through sensors.

Techniques used for Prediction of Heart Disease

For Predicting health situations and monitoring various techniques are to be used that are described as given below:

K Nearest Neighborhood

(Jabbar, Deekshatulu, and Chandra 2013)(Enriko, Suryanegara, and Gunawan 1843)Use the KNN method to accurately detect and predict heart disease by simplifying parameters. By using grouping functions, the elements with homogeneous properties were grouped together and these elements are classified by the nearest neighbourhood algorithm. Threshold values comparison to the values produced by the grouping function is to be done to determine the problem.Problems are expressed in the type of variance.The process is described by taking two distinct points 'X' and 'Y'. Let distance(X,Y) is the distance between points X and Y then

a. $distance(X,Y) = 0\ and\ distance(X,Y)\ >= 0\ iff\ X = Y$
b. $distance(X,Y) = distance(Y,X)$
c. $distance(X,Z) \leq distance(X,Z) + distance(Z,Y)$

Property 3 is also referred to as transitive dependency. Range if the prediction is almost zero, then error will be reported. Metric error measurement is used to determine the approach's accuracy.Accuracy is given as:

$$Accuracy = 1 - Err\_rate$$

whereErr_rate is given as

$$\text{Err\_rate} = \frac{|X - X_a|}{X_a}$$

KNN is used in many different environments, such as classification, interpolation, problem solving, teaching and learning, etc. KNN's performance depends on the value of k. Precision is low and additional work is needed to improve precision.

Euclidean Distance

(Veytsman et al. 2014)The easiest method to forecast and class is Euclidean distance where the distance was used to measure the deviations. Distance can be interpreted in distinct ways.Let $[x_1, x_2, - - --, x_n]$is the distance of points in terms of x coordinate and $[y_1, y_2, - - --, y_n]$is the distance in terms of y coordinate. The Euclidean distance is defined as

$$Euclidean_{distance}\ = \sum (x_i - y_i)^2$$

Where I describe the range of values between 1 and n. All vector components are taken equally and in this case no correlation is evaluated. It is possible to normalize the result of Euclidean distance equation. This can be achieved as

$$M_i = (x_i)^2$$

Where all the vectors in the dataset are taken over by default. The scaled distance is calculated using the formula below

$$D^2 = \sum \frac{(x_i - y_i)^2}{M_i}$$

The scaled distance is modified so that between the specified range is the result obtained. To evaluate errors, the

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metric is used.

(Bui et al. 2016; Chen et al. 2014; El-Hattab 2016)Mean root square error method should be used to detect errors and accuracy. The level of accuracy and error are inversely proportional to one another.

$$RMS = \sqrt{(x - x_a)^2}$$

Using this formula, Root Mean square error is evaluated. Lower the RMS value to predict more accurately. The advantage of this approach is that the rate of convergence is better, but the disadvantage is that it can work on limited values. Non-negative values are permitted and the result is always between 0 and 1.

ARIMA

(Jose and Sadashivappa 2014)(Pan et al. 2016; Permanasari, A.E. Hidayah, I.Bustoni 2013) For accurate prediction of disease detection the Auto regressive moving average model is used. By using mathematical model the modification in time series are to be done in ARIMA.This model is based on adjustment of observed values. The goal is toachieve variations in the observed value and quality from the near-zero model. This model will accurately predict the difference between the sequence of paperwork and non-paperwork. This diagram depicts the flow:

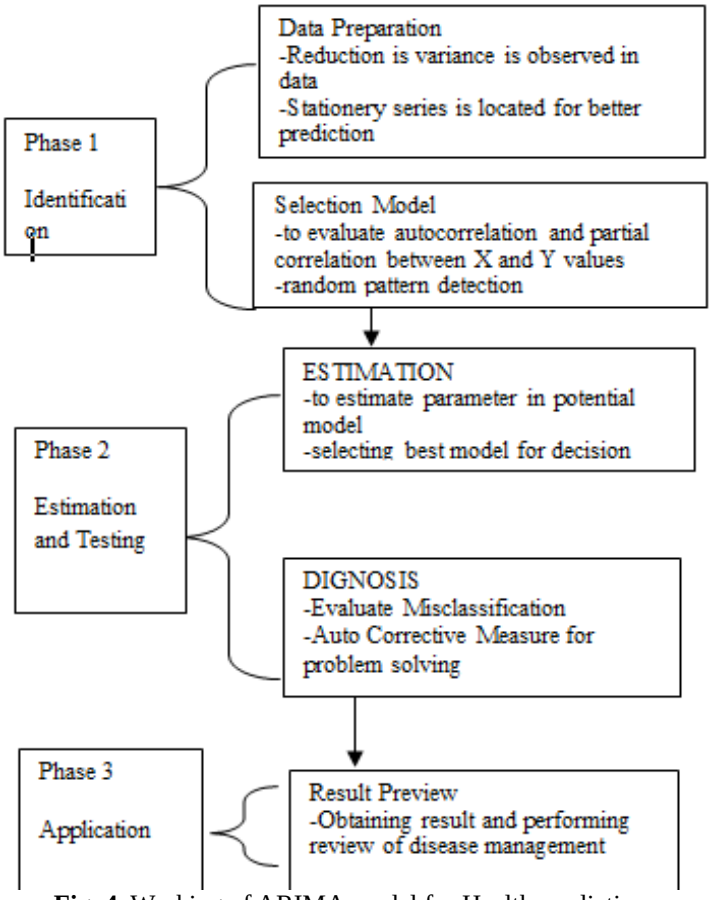

Fig. 4. Working of ARIMA model for Health prediction

Multiple Phases are associated with ARIMA Model. For better performance in health prediction KNN and Euclidean distance is combined.

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Faults and Fault Tolerance Capabilities

Technology ad relevance plays critical role in every one's life. Dependency upon this technology is increasing by leaps and bounds. This dependency has merits so does demerits. Machines used under technique of concern bound to fail at some point of time. Reasons for failure could be many.This section provide insight into faults and also answer why factor.

a.Fault/Defects

Faults are the mistakes resulting in incorrect results. Faults are interlinked hence faults in system may cause further failures to occur. Several faults caused by single error and identical faults caused by distinct errors .In the code faults are symbolized as problems.

b.Errors

Errors are the differences between the compute, observed and the truly specified value. If some parts of the products of the computer software result in an unwanted state, error will occur.

c.Failure

Under the stated performance condition, this necessary task is not performed. Failure occurs when the intended function is no longer provided by a software program. Users identify the different levels of failures that may be major or minor depending on the effects and system outcomes such as monetary value, human life and lost property. Several faults may be caused by a particular failure. Failures are considered as incorrect external events. (Ogheneovo 2014).

The problems in addition to above include constraints, reuse, logic, faulty code etc. Due to these reasons the performance of the system degraded and also it is not work according to the requirement of users. So we need fault tolerance techniques to handle problems like performance degradation, proper working of system etc.

Table 2. Fault tolerance Strategies in existing literature

S.no.	Title	Year	Published By	Type of Fault handled
1	Fault Tolerant Approaches in Cloud Computing Infrastructures Alain(Tchana, Broto, and Hagimont 2012)	2012	ICAS	Handled fault at different level application level, virtualization level and hardware level.
2	A Family of Fault-Tolerant Efficient Indirect Topologies(Bermudez Garzon et al. 2016)	2016	IEEE	Fault tolerance in network for high performance computing are done and it uses simple indirect topology to handle the faults
3	Fault Tolerance Management in Cloud Computing: A System-Level Perspective(Perspective et al. 2012)	2016	IEEE	Relies on generic fault tolerance mechanisms that handle the fault at server end
4	Fault tolerance techniques and algorithms in cloud computing(Devi n.d.)	2014	IJCSCN	Handle the faults that enter in the system or software.
5	Optimising Fault Tolerance in Real-time Cloud Computing IaaS Environment(Mohammed et al. 2016)	2016	IEEE	Handle faults in real time computing on the cloud infrastructure.
6	Fault Tolerance in Cloud Using Reactive and Proactive Techniques 1Kalanirnika(Kalanirnika and Sivagami 2015)	2015	IJCSEC	Manage faults in memory and perform recoveryusing checkpoints
7	Fixed-Priority Allocation and Scheduling for Energy-Efficient Fault Tolerance in Hard Real-Time Multiprocessor Systems(Systems et al. 2008)	2008	IEEE	Manage faultsin hard real time systemsusing optimistic fault tolerance algorithms
8	On Fault Tolerance in Data Centre Network Virtualization Architectures (Joshi and Sivalingam 2013)	2013	IEEE	Handle faults in Virtual Data Centres using the address handling techniques at server end.

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9	Fault tolerance and QoS scheduling using CAN in mobile social cloud computing(Choi, Chung, and Yu 2013)	2013	Springer	Handle faults in mobile devices in computing environment and use CAN structure for fault management
10	A Performance Study of Deployment Factors in Wireless Mesh Networks(Robinson and Knightly 2007)	2007	IEEE	Manage the faults that occurred in mesh topology during the connectivity and also gives the mechanism

Fault Tolerance Mechanisms which are available to be used are listed as follows:

Table 3. Fault tolerant capabilities comparison

Technique	Advantage	Disadvantage
Checkpoint(Kalanirnika and Sivagami 2015)	Progress will be saved	In case of failure before checkpoint all progress has been lost
Replication(Wang 2012)	Data should be recovered easily	Memory consumption is more
Shadow Page(Transactions, Design, and Integrated 2011)	Recovery is efficient since two copies of page table are maintained .the modification are made to one page table and in case of problem data canbe recovered from other page table. Consistency is high	Utilise more memory
Snapshot(Hursey et al. n.d.)	It works on API Aggregate remote files on global snapshot so it work on global area	Interlayer coordination is difficult
RAID (Jhawar and Piuri 2013)	Redundant disks are maintained to handle data	Resource consumption is more
Message monitoring(Jhawar and Piuri 2013)	Integrates WS-RM standard	QOS factor is critical
Redundancy(Marculescu et al. 2003)	Multiple Copies of same data for handling failure situations	Memory utilization is high
TSV(Three Silicon Vias)(Zhao, Khursheed, and Al-hashimi 2015)	Both fault tolerance and recovery is provided	Only hardware platform is considered
Theft Induced Check pointing and systematic logging(Jafar et al. 2009)	Both crash faults and nod volatility can be tackled	Complex faulty environments cannot be tackled

Most commonly used fault tolerant strategy in the above listed table is checkpoints and deviations. In the future this work can be extended to achieve greater accuracy and better prediction.

Conclusion and Future Work

Health prediction is critical for the early detection of disease. Large number of models is devised for this purpose. This paper described most proficient models used for prediction purpose. ARIMA model is multi objective model used to predict disease and also rectify misclassification present within the data. In future work on ARIMA can be extended by merging it with Euclidean distance and KNN classification.

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