



# JOURNAL OF Big Data & Smart City

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**Sustainable Smart Cities: A Fog Computing Framework for a Smart Transport Network**  
(Robin Zarine, Muhammad Saqib)

**Detection and Classification of Diabetic Retinopathy Using Retinal Images**  
(Ayman Azam, Muhammad Nauman Bashir, Kamaludin Mohamad Yusof)

**A Framework to Implement AI-Integrated Chatbot in Educational Institutes**  
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**"Tageerat" A Mobile App to Empower Rural Women Entrepreneurs of Oman**  
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**Study of Factors Influencing Green Logistics Leading towards Sustainable Development in Oman**  
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**Smart Civil Defense System**  
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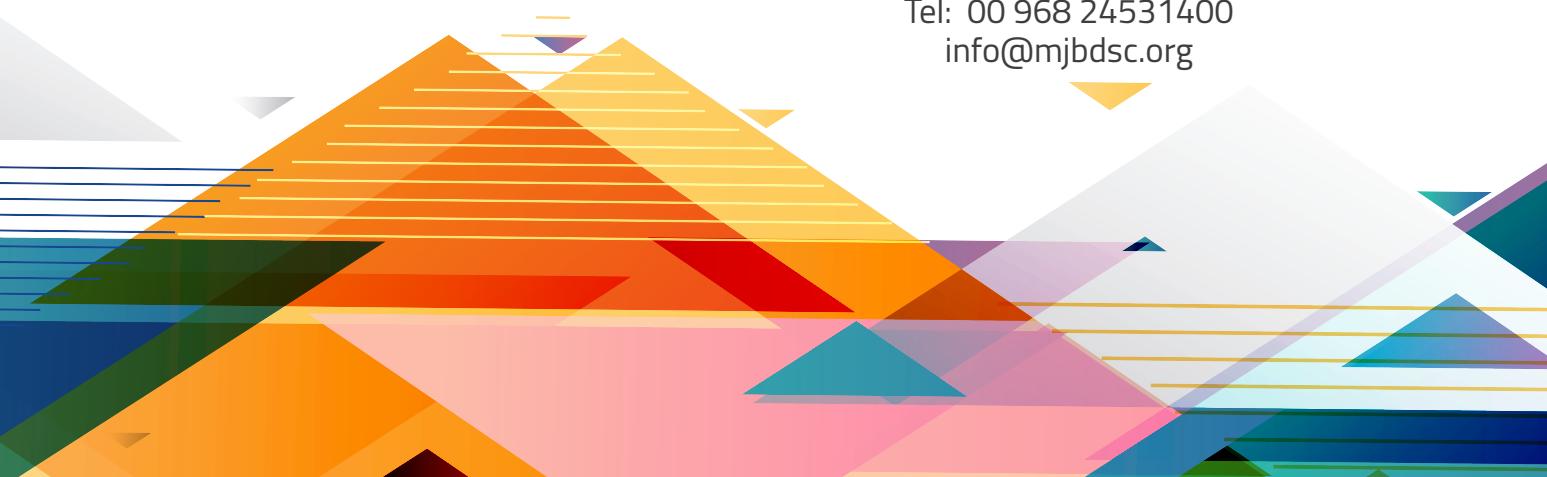
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On behalf of the team members of the Journal and my co-editors (Prof. Ahmed Nawaz Hakro, Prof. Anupam Srivastav, Prof. Mounir Dhibi), I am delighted and privileged to announce the publication of the inaugural issue of the Journal of Big Data and Smart City (JBDSC). It is an open access journal with two issues a year, with an Arabic translation available for every scholarly contribution.

The launch of this journal is part of the strategic action plan of Middle East College in order to fulfil its research aspirations. The preparations for its launch have taken almost two and half years and it is a continuation of Middle East College's engagement in scholarly activities including the organization of five international and four national conferences on related themes. The conferences have attracted a very large number of participants and this journal is the culmination of these research activities.

Journal of Big Data and Smart City (JBDSC) provides an exciting platform to scholars, researchers, students, and other related professionals and policy makers to showcase their scholarly interests in Smart City applications, building on Big Data technologies. The journal aspires to be vibrant, accessible, engaging and challenging at the same time.

The objective of JBDSC is to publish work on interdisciplinary research in the form of high quality and original research papers with insightful views and relevance. Needless to say, all the selected papers are subjected to a double-blind review process.

The journal welcomes the contributions in the area of Big Data and Smart City, especially work involving multidisciplinary collaborations or combining and understanding multiple fields in wider possible contexts. This journal is dedicated to the integration of theoretical, experimental, and computational approaches with Smart City information and communication technologies. The research papers of the journal also include methodological reviews of particular themes and further add to the value of the contributions to the field.

I am thankful to those who submitted papers, both individually or collaboratively from academia and industry. They will guide us to identify areas of early development and ensure the success of the journal.

I take this opportunity to thank all those who contributed to the launch of this journal. My special thanks to Dr. Kiran G.R, Dean, Middle East College, for his ideas, untiring dedication and commitment, and complete support to this adventure. I am extremely thankful for the kind approvals granted by MOHE and MOI for this scholarly endeavour, and the kind consent extended by our respected members of the advisory board of the journal.

Thanks are also due to my co-editors (Prof. Ahmed Nawaz Hakro, Prof. Anupam Srivastav, Prof. Mounir Dhibi) and editorial support team members (Mr. Jitendra Pandey, Mr. Shaik Mazhar Hussain, Mr. Vikas Rao Naidu) whose generous time and dedication made it possible for this issue to be published well in time. I take this opportunity to thank Dr. Nizar Al Bassam for his dedication, professionalism, and sense of urgency in following up with all the processes and getting the issue into a publishable format.

Middle East College has entered the next phase of its strategic research plan after having successfully passed the Institutional Assessment Audit conducted by OAAA. The organization has the maturity and experience to become a vibrant academic and knowledge producing community and this journal is a stride in this direction.

Best wishes and thank you in advance for your generosity and support.

Dr. Saleh al Shaabi  
Editor in Chief  
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# Sustainable Smart Cities: A Fog Computing Framework for a Smart Transport Network

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## Abstract

Smart transportation operations within cities is essential to keep pace with city developments. Therefore, local authorities have to make efficient use of their existing infrastructures. Smart transportation is currently the trending smart ways for undertaking such tasks, but their adoption often gets delayed due to the lack of appropriate framework. Cities aim at maximizing the return on their investments in terms of social and economic benefits as their budgets are generally limited. Therefore, having an appropriate framework in place to assist in deploying a Smart Transportation Network to support their aim is crucial. This paper explores how the fog computing framework can be applied when opting for smart city initiatives and in this case the Smart Transportation initiative. The paper also highlights the role of big data and big data analytics in such framework.

**Keywords:** Smart city, Smart Transportation, Big data

## 1 Introduction

Developed and developing cities constantly attract new residents, business investments, and visitors from all around the world. Such attraction requires advanced services and the state-of-the art road infrastructure to allow for the ease of movement, comfort, safely, and without delays especially for those operating on more formal schedules. As cities develop, more city operations are needed leading to an increase in the number of road vehicles required to support those operations. As a result, the likelihood of road congestions and traffic accidents inevitably increases making cities less attractive to stakeholders [1]. Furthermore, resource consumptions rise, operational efficiency regresses and cost amplifies due to heavy delays [2]. In the effort to manage and mitigate the negative impacts, many infrastructures are being implemented such as traffic lights, side road cameras, and tower cells for mobile devices to mention a few. Those infrastructures have the capabilities to create or capture high volume and large variety of data at very high velocity which in this modern day is referred to as Big Data [3]. Such kind of (big) data can pose quite a challenge to traditional processing techniques but with appropriate processing, storing and analyzing techniques, useful information relating to transport network management may be extracted highlighting the concept of Smart Transportation Network.

## الملخص

عمليات النقل الذكية داخل المدن ضرورية لمواكبة تطورات المدينة لذلك، يتبعن على الإدارات المحلية أن تستخدم بكفاءة البنية التحتية الموجودة لديها. النقل الذكي حاليًا هو أحدى الطرق الشائعة للقيام بهذه المهام ، لكن اعتمادها غالباً ما يتاخر بسبب عدم وجود إطار مناسب. تهدف المدن إلى زيادة العائد على استثماراتها من حيث الفوائد الاجتماعية والاقتصادية لأن ميزانياتها محدودة بشكل عام. لذلك، بعد وجود إطار عمل مناسب للمساعدة في نشر شبكة مواصلات ذكية لدعم هدفها أمراً بالغ الأهمية. تستكشف هذه الورقة البحثية كيفية تطبيق إطار الحوسبة الضبابية عند اختيار مبادرات المدن الذكية وفي هذه الحالة مبادرة النقل الذكي. كما تسلط الورقة الضوء على دور البيانات الضخمة وتحليلات البيانات الضخمة في هذا الإطار.

## 2 Key Concepts

### Smart City Concept

The concept of Smart Cities which relates to the improvement in quality of life through the creation of durable opportunities for cultural, economic and social growth within a healthy, safe, stimulating, and dynamic environment has been recognized by local authorities as the way forward [5]. Some key technologies have been suggested as essential for getting the smart city concept to work including Smart energy, Smart transportation, Smart data, Smart infrastructure, Smart mobility and Smart IoT devices [6]. This concept has led to development of smart policies centered on innovativeness, efficiency, sustainability, renewability, and environment friendliness which is why the word “Green” is currently becoming an integral part of the Smart City concept. Tomar and Kaur proposed some related examples such as Energy Efficient Green Technologies, Green Smart Building, Green Smart Transport System, Green Smart Agriculture, Green Smart Waste Management, Green Smart Education System, Green Smart Security System, Green Smart Water and Sanitation, Green Smart Town Planning, Green Smart E-Health, Green Smart Environment, Green Smart Energy management [7].

Smart city approaches through big data analytic can offer multiple opportunities to achieve such and it has also been acknowledged by other researcher suggesting that road use efficiency within cities is very well possible if cities

could smarten up their operations in terms of effectively sharing of traffic information that can significantly reduce both fuel consumptions and delays [2]. Emergent Internet technologies can provide the way for integrating and sharing common communication mediums which can be very supportive to the smart city concept [8]. One of the emerging technologies is the Web 2.0 technologies. It promotes online collaboration, creativity and security which local authorities can make use of through their public policies to encourage inhabitants to actively participate in ‘Smart Cities’ developments [8]. Another emerging technological concept is the Industry 4.0 which includes the Internet of Things (IoT) and the Internet of Services (IoS). IoT allows for the development of smart products meaning added intelligence is used within sub-components and development processes while IoS allows for the development of smart transport network and logistics [9]. The popularity gaining by IoT and IoS based systems alongside the power of big data analytics can have a critical role in supporting the development of Smart Transportation Management System within the context of Smart City.

### Fog Computing Concepts

The development of the Internet of Things (IoT) has seen networks of smart objects emerging with the capabilities to interchange information over the internet. They can collect, store, and process information within their proximities, and even act upon them to provide useful info to end users [27]. With the increasing rollout of the Internet of Things (IoT), even the road infrastructure is now having its own networks of smart objects such as traffic light/sensors to monitor and control the traffic flow at junctions, radar with the ability to measure speed and take pictures, smart devices in automated vehicles and many more. These smart objects can communicate their state to each other offering opportunities for real-time information access that can prevent road congestions and accidents, and even transportation network performance status.

Besides the usual monitoring of common traffic violations that is less impacted by network latency, the interest for low latency, location awareness and real-time applications relating to IoT is growing. So, the fog computing framework introduced by Cisco in 2012 is adopted as a good fit as it proposes computing resources to be deployed as close as possible to the data sources similarly to the characteristics of IoT. The adoption of this framework is supported by previous research suggesting its applicability to vehicular fog computing [27] [28]. This framework contradicts the advocating of complete centralized and remoteness proposed by cloud computing network.

Through Big Data Analytics, such data can be converted into appropriate format for storage and subsequently processed to provide road users and managers with

relevant and meaningful road and traffic information in real time. This will allow road users to re-trace their route on the move to avoid the negative impact of road congestions or even receive early safety warning. Much effort and resources are being used by relevant agencies to devise sustainable strategies to maintain their cities attractiveness. This includes approaches to reduce road congestions, road safety improvement, and environmental protection to achieve sustainable quality of life through good governance and intelligent management of resources [4].

### Fog Computing Architecture

The architecture of fog computing is based on 3 layers commonly referred to Layer 1 or Device Layer, Layer 2 or Fog Layer, and Layer 3 or Cloud Layer [29] [30].

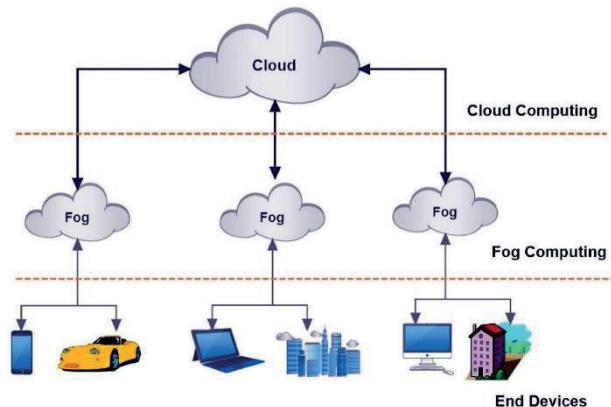


Fig: 1 Fog Computing Framework [31]

**Layer 1 or Device layer** consists of end user and IoT devices which, in this case, will be traffic light/sensors, radars and smart devices installed in automated vehicles. These devices are distributed geographically to cover the area of interest and they act as the information collection points by sensing information through triggered events.

**Layer 2 or Fog layer** acts as the intermediary between the Layer 1 and Layer 3 during information transmission. This layer consists of network devices such as router, access points, gateways, switches, and video surveillance cameras that are deployed between the cloud and the IoT devices. These devices have the capabilities to manage processes, to briefly store collected information, to execute real-time analyses, and to handle latency sensitive information. So, they are often assigned the task of local analyses and providing quick decisions. Therefore, they are frequently referred to as fog server and they are geographically distributed amongst the IoT and cloud devices.

**Layer 3 or Cloud layer** consists of Cloud Computing services with capabilities to store and process very large volume of data (big data) in real time. Its storage and

processing power depend on the capabilities of its data center. This is the layer that manages the decisive analyses, decisions-making and permanent storage. As local analyses and quick decision making that does not require in-depth analysis are often assigned to Layer 2, retransmission of data to the Layer 3 can be selective thus more efficient.

The fog computing architecture maps well with big data-driven policymaking framework. Shaheen et al. proposed a 5-stage framework that can be considered during the adoption of smart city interventions. The framework basically states:

- Define the problem so to decide whether big data methods are appropriate for solving the problem.
- Data collected must be relevant with the possibility of evaluating its integrity
- Develop an appropriate analytical method to identify data patterns that may not otherwise be evident through a manual data analysis
- Ensure no potential ethical issues arise as a result of the analyses
- Refine policies and build capacity for ongoing refinement

While implementing the framework, the common public concerns such as ‘Protecting Privacy through anonymized Data’, ‘Cybersecurity’, ‘Public Records Protection’, and ‘Ethics’ need to be considered [30].

### Technology Evolution

Recalling the traditional ways of traffic management where traffic policemen were used at some traffic intersections and roundabouts to direct the traffic. With the continuous increase of road vehicles resulting to both recurrent and non-recurrent road congestions, such may be considered as an unimaginable practice in this modern age. However, it is still being seen practiced in many parts of the world. Technologies have played and are still playing a major role in the progress of road traffic management. It is suggested that the continuous evolution of technologies in particular with regards to smart city, big data and the power to analyze data are transforming traffic management systems and road infrastructure design [10]. The evolution of technology is considered to have undergone three different phases. The first phase was referred to as “Enhancing operational efficiencies”, the second as “Sharing real-time information” and the third and latest one as “Interactive services” which considered to be very much in its infancy stage in less developed parts of the world and much more advanced in the more developed part of the world but still undergoing development [11].

**Phase 1 (Enhancing operational efficiencies)** focused mainly on deploying traffic management personnel to

traffic intersections and roundabouts to ensure a satisfactory flow of traffic. It gradually proved to be inefficient with the rapid development of the road segments, intersections and roundabouts resulting to city developments. The increasing number of traffic intersections and roundabouts rapidly overtook the available traffic management personnel making it necessary to look for alternatives. Therefore, adjustments were made in the kind and ways technology was used during that phase. Traffic lights were installed to efficiently control the flow of traffic by coordinating with adjacent traffic lights to create a more non-stop drive. So were CCTVs to provide remote surveillance of the intersections and roundabouts for any infringement of the traffic control setup by drivers. Intelligent sensors too played the same role to detect incidents and provide alerts to the command centers. It, thus, reduced traffic management personnel with their associated resources required on site. Enforcement cameras were also implemented to deter speeding along highways and the “running” of red lights at road intersections to improve road safety reducing road non-recurring incidents. This contributed more than 50% road congestions and delays [2]. The rate of collecting traffic data, the volume and variety were very significant during that phase; but, all that data was used to provide fairly static traffic information with very little dynamic information, since not much data mining was done. Traditional data processing techniques were more geared towards the analyzing of structured data and to some extent semi-structured data but not unstructured data as was the case of data being captured [12]. Similar arguments were echoed by Razbonyali and Güvenoğlu where they highlighted that traditional database management systems were being outpaced by the growing needs of data and their capabilities were not good enough to process the unstructured nature of data being collected [13]. As a result, Phase 1 was mainly useful to traffic management authorities allowing them to be very effective in managing recurrent road congestions such as peak hours, which are more predictive but not as well in managing non-recurrent road congestions such as road accidents. Through alerts provided by the intelligent sensors, traffic management authorities could respond quickly; but they were constrained as they have to alert other authorities involved in responding to road incidents. Despite these, the response time to non-recurrent road congestions could still be considered satisfactory. Yet, there was no effective ways to warn drivers to avoid further build-up of road congestions.

**Phase 2 (Sharing real-time information)** tried to mitigate the weaknesses of phase 1 by getting the different authorities to collaborate and share real-time traffic information to drivers by different means such as radio, SMS, web services, handheld devices and television. It can contribute significantly towards road efficiency use, design and development. Drivers can plan their trips ahead

of their travelling for the fastest and safest routes while traffic management administrators can take better informed decisions relating to congestions alleviations [14]. As expected, with the continuous road infrastructure development, many more traffic data capture devices such as the number of road radars, enforcement cameras, traffic lights, CCTV and intelligent sensors had been deployed and so was the rate, volume and variety of collected data. However, most of the devices were one-way broadcasters. Thus, they lacked collective intelligence within their real time data collection processes. There was no way for users to provide any feedback on traffic situations. Furthermore, high cost, the lack of sensor coverage across the road infrastructure, and efficient/effective transmission techniques hinders/ed the availability of continuous real-time traffic information.

Though the advancement in quality of communication network such as the use of fiber optic allowed for high volume of data to be easily transmitted to Traffic management authorities systems. The authorities had to be well equipped to receive high volume of data, to format large variety of data and to store those data. Having access to such kind of traffic data, traffic management authorities had the opportunity to process them into meaningful traffic information that could be provided to road users allowing them to take informed decisions on possible alternative transportation mode with best possible departure time during travel planning to avoid delays and build-up of road congestions. The same would be made available to all the collaborating authorities allowing for better response time to non-recurrent road congestions such as accidents for quick recovery of normal traffic flow. Those informed decisions significantly enhanced the quality of traffic management services being provided. While phase 2 was successfully being implemented to mitigate the weaknesses of phase 1, city developments continued and stakeholders' demands kept growing. Though the traffic information was shared in real-time mainly through traffic related authorities, it was based on broadcast mode meaning sending the traffic information to all subscribers whether it was needed or not [15]. Often, subscribers would receive irrelevant traffic information while missing the relevant ones. Therefore, the need for a more customized or personalized traffic management service arisen.

**Phase 3 (Interactive services)** offered the continued effort to further enhance the road use efficiency and satisfy the stakeholders' demands. This phase tried to create an interactive transport community among the transport operators, service providers, government agencies, and travelers to provide more personalized information and services. The benefit of an interactive system over a broadcast system is that it provides the users with the option of querying the processed traffic data and extract only relevant and useful traffic information in real-time. The benefit continued to expand through the continuous technological developments of GPS-equipped devices

such as mobile phones and online maps which can provide real-time traffic situational updates [15]. As a result, effective route planning could be achieved reducing road congestions.

As it may be noted in phase2, the broadcast traffic information was very useful in devising well informed travelling plan and could have some impact in reducing road congestions. It should be noted though that given the length of road segment in between exit points, if the broadcast traffic information does not come at the precise time needed which is just before entering a road segment, it would have very little impact in reducing road congestions. The drivers should be able to query traffic information whenever needed, especially, before entering any particular road segment. This should allow the drivers to review and devise new traveling plan during the travelling itself to identify alternative routes with best travel time based on real time traffic situation. This should further enhance the quality of traffic management services being provided within cities and further reduce resource consumptions such as fuel that may negatively impact the environment.

Land transport management solutions are still being developed in many countries aiming to further improve phase 3 and the efficiency of traffic management services. Developed and developing cities have to continuously review their road traffic situations and integrate the necessary development within their existing systems to maintain a satisfactory level of efficiency within their cities. Research and development in technologies are ongoing globally to implement ideas such as vehicle-to-vehicle, vehicle-to-infrastructure and vehicle-to-pedestrian interactions to further support traffic management efficiency.

### 3 Proposed framework

#### Layer 1: Collecting Traffic Information

In this section, some common ways for collecting, processing and disseminating relevant traffic information are discussed. Given that the evolution in technology for traffic management is at phase 3 and beyond (from previous section), the focus is mainly on systems that support the creation of an interactive transport community.

To create an interactive transport community, as much traffic data as possible need to be collected. This depends largely on sensing technology that are installed alongside roads such as traffic radars, enforcement cameras, CCTVs, traffic lights and intelligent traffic sensors both above and underneath the roads. Traffic data collected by sensing technology are transmitted to the supporting infrastructures for processing and disseminating in two main ways [16]. As expected, transportation development needs keep growing and so is the need for interactive traffic management services. Concepts such as Intelligent Transportation System (ITS) are inevitable as they

facilitate the creation of interactive transport community by integrating the road users, roads and vehicles supported by advanced technologies as one system. Therefore, while road users benefit from receiving convenient traffic information, they also contribute towards the provision of traffic data [17].

The first method being the spot data which involves collecting traffic information by measuring traffic volume, speed and occupancy of a particular spot which is a very common infrastructure setup within developing cities (traffic radars, enforcement cameras, CCTVs, traffic lights and intelligent traffic sensors). This method can be very useful for the cities assuming that all the critical spots along the road infrastructure within the cities are covered but due high deployment and maintenance costs of those infrastructures, the deployments are normally restricted to areas regarded as cost effective.

The second method being the link (spatial) data which involves collecting the traffic information described in the first method and other traffic related data that is regarded as relevant to contributing towards a better traffic management services.

## **Layer 2: Simple Processing and Transmitting Information**

As discussed earlier, Layer 2, which consists of the fog server, is often assigned the task of local analyses that do not require in-depth analysis so that quick decisions can be provided. With that respect, appropriate and timely processing and dissemination of the collected data and meaningful information can reach drivers on time creating opportunities for congested routes to be bypassed thus avoiding further congestion build-up. And also enhancing road safety. The fog server can be geographically distributed amongst the IoT and cloud devices.

Travel patterns and unexpected road incidents that may create non-recurrent road congestions can also be detected and recorded. It is obvious that this method is more suitable for the aim of creating an interactive transport community but the pressure of handling even higher rate and volume of data and even wider variety of data such as videos by the traffic management authorities must be noted [18]. The collecting, processing and disseminating of traffic information process continue to become even more complex thus requiring very specialized processing method and very powerful processors with much better communication infrastructure. The continuous upgrading of the existing infrastructures such as installations of HD-CCTV, high-end processing systems and optical communication infrastructures are making link data collection possible and more affordable. But it is to be noted that this method provides 99% accuracy on traffic volume and speed data while only 96% accuracy on occupancy data [16]. 96% accuracy on occupancy data may still be considered significant for many cities that are

severely being impacted by road congestions thus spending a lot on unnecessary fuel consumptions due to hours of delays [2] while struggling to protect the environment from its associated pollution. A lot of research is currently being undertaken to mitigate such issues and to smarten the operation of cities in terms of traffic management services. With many more interconnected technologies emerging, even larger amount of varied data is being captured and so is the need for more complex processing, storing, managing, mining and disseminating of convenient information. Authorities are now looking at Cloud Computing as the possible solution [19].

## **Layer 3: Cloud Computing Services**

In this section, the necessary changes in the methodology used to process that large volume of traffic data collected, the wide variety of traffic data collected and the continuous rapid increase in the general traffic data to be collected due to the high rate of traffic data capture are highlighted. Previously, most traffic data that was collected had fairly simple format such as text or still pictures. But now, traffic data format has changed significantly including very rich format such as videos. Mining such traffic data has become very complex and therefore significant pre-processing has to be carried out before any mining techniques can be applied.

To illustrate the complexity, let us consider recorded videos during a not so clear weather using the spatial data collection methodology. The choice of camera plays an important role in the quality of videos captured. Infrared cameras would produce better quality videos than colour cameras, but of course at a higher cost. Once the videos are captured, the necessary or relevant data has to be extracted from them and therefore the videos have to be cleansed before any pre-processing can be done. Such data cleansing requires very specialized data transformation method followed by even more complicated techniques for pre-processing and finally carry out the actual required processing to provide the necessary and relevant traffic information that can be used by drivers. Imagine the number of videos being captured all over a very large city on a second by second basis and require undergoing those process stages discussed with all using very specialized data transformation method. We can already have an idea of the kind of storage requirements for those videos and other rich type format data continuously being transmitted and the kind of processing power requires processing them [16].

Emerging internet and communication technologies relating to intelligent transportation systems (ITS) continue to provide enormous amount of real-time data that need to be transformed into meaningful information for road users. These emerging technologies can help improve the effectiveness and user friendliness of ITS resulting in significant social and economic benefits that

cities are looking for. The data processing power and mining capabilities for such big data analysis are not always within the reach of less developed cities due to sophisticated infrastructure such as data centers, high installation and maintenance costs and expert requirements. Cloud based ITS can be viewed as more affordable ITS solutions as they cater for the sophisticated requirements such as data processing and mining capabilities [20].

It has also been highlighted by other research the need for innovative big data processing and mining together with optimization techniques to effectively and efficiently transform the vast amount of real time traffic data to meaningful information to support real-time decision-making capabilities. Again, this suggest that city authorities can turn to cloud based ITS for possible affordable solutions [21].

It can be noted that the requirements for collecting, storing, processing and disseminating of such traffic data which can be referred to as big data to support the concepts of smart cities can be quite challenging but investing in human and social capital and modern ICT infrastructure to fuel sustainable growth and quality of life is not an opportunity that any city management team and traffic management authorities would want to miss. Cities that are managing to even partly embrace and incorporate this within their existing systems are already visioning the freedom, the creativity, the opportunity and the prosperity such can bring in their future [22].

#### **4 Common Intelligent Traffic Management Solutions**

In this section, some common traffic management solutions are explored to see their impact and spread across developing cities. Their key elements for their progress or obstacle is also be looked at. Many commercial solutions such as Traffic.com, Metrocommute and EtakTraffic had been released to assist in enhancing the traffic management services by effectively collecting traffic data, and efficiently processing and disseminating of traffic information to drivers. In terms of effectiveness and efficiency, these solutions could well serve their purpose but their deployment and maintenance costs had prevented their widespread deployment. The widespread of any potential supporting solution depends largely on the deployment and maintenance cost and therefore cities need to identify solutions that their widespread use will not be prohibited because of that. Radio Frequency Identification (RFID) use with other existing signaling system can be a cost effective in real time traffic management solution. Its installation time is less and so is the maintenance costs but it can still offer early detected of congestions allowing preventive measures to be undertaken on a timely manner [23].

With the widespread use of wireless technology and the affordability of its associated devices, vehicle to vehicle

(V2V) technology is being considered as a good way for collecting and sharing of traffic data and also vehicle to infrastructure (V2I) technology can easily support traffic data transmission through the existing supporting infrastructure such as sensor stations if there is a need to transmit them centrally, and eventually having centralized high-end processing system for processing and disseminating the traffic information. The wide spread use of the supporting infrastructure for the V2I may still be prohibited by their high deployment and maintenance cost though. However, there has been suggestion that V2V solutions can be implemented without the use of those infrastructures meaning it would have a minimum or no additional deployment cost. It can be supported by the already deployed infrastructures.

#### **5 Socio-economic implications**

The proposed framework for the smart transportation network could have the following socio-economic benefits:

- Reduce fuel consumption and pollution
- Enhance road safety thus reducing road accident
- Minimize congestions and delays
- Reduce travelling stress thus healthier and happier citizens
- Optimize use of traffic data for better decision-making
- Real time information sharing
- Improve and create new online services for citizens
- Create business opportunities (applications)
- Improve city attractiveness for investments
- Enabling smart city policies adoption

#### **6 Conclusion**

Managing big data to promote smart cities in terms of relieving the pressure being put on the road infrastructure is every city traffic management team wish but it is quite challenging to achieve. The proposed framework can provide decision makers with an option to deploy smart transportation network initiatives which is very relevant to smart city. It can enhance operational efficiency and sustainable which will inevitably improve the quality of life of the citizens. This can also assist in the reduction of resource consumptions such as fuel with its associated negative impact on environment and above all, a close to non-stop drive model road infrastructure that would be attractive to all existing and potential stakeholders. Additionally, it can be used as good supplements to support the sophistication requirements of big data processing and mining and furthermore assist local authorities to better design and deploy future road infrastructure development.

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## Detection and Classification of Diabetic Retinopathy Using Retinal Images

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### Abstract

Nowadays the number of diabetic patients is alarmingly growing. Diabetes has a strong effect on patient eyes as it results in the formation of hemorrhages and narrowing damage or abnormal growth of eye blood veins. This paper outlines the result of a MATLAB program developed based on simple algorithms as an attempt to detect and classify diabetes disease by digitally examining the images of the eye-retina of the patient as a means of the non-invasive method. The algorithm follows image processing stages of median filtering, image skeletonization, image thinning, and identifying the results using image erosion and Speeded up Robust Features (SURF). The diabetic retinopathy classification is done by comparing the results achieved by the system to the values of the standard ranges defined by ophthalmologists. Empirical research was able to detect and classify diabetes in three categories as normal, moderate, and severe along with the detection of hemorrhages. This research work is to support physicians to get efficient testing of diabetic patients at the reception before consultation and before actual examinations.

**Keyword:** diabetic retinopathy; median filtering; image skeletonization; image thinning; SURF operations; image erosion

### 1. Introduction

According to the World Health Organization (WHO) around 2.2 million people all around the world are affected by diabetes. Diabetes attacks various parts of the human body but the most significant effect of diabetes can be observed in the eye-retinas of the patient. Diabetes befalls when the pancreas fails to conceal enough insulin slowly affecting the retina of the human eye [1]. As it progresses, the vision of a patient starts failing to cope up with the normality, leading to diabetic retinopathy. The retina is the light-sensitive tissue at the back of the eyeball. A healthy retina is necessary for a good vision. The nerves and blood vessels in the eyes of a diabetic patient get narrower and the hemorrhages may appear on the outermost layers of the eyes, called diabetic retinopathy [1]. In some patients these vessels can leak and cause blood to flow at the surface of the retina.

**الملخص**  
في الوقت الحاضر يتزايد عدد مرضى السكري بشكل مثير للقلق. مرض السكري له تأثير قوي على عيون المريض لأنّه يؤدي إلى تكوين نزيف أو النمو غير الطبيعي لأوردة الدم في العين. توضح هذه الورقة البحثية نتيجة برنامج MATLAB الذي تم تطويره استناداً إلى خوارزميات بسيطة كمحاولة للكشف عن مرض السكري وتصنيفه من خلال الفحص الرقمي لصور شبكيّة العين للمريض كوسيلة للطريقة غير الغازية. تتبع الخوارزمية مراحل معالجة الصور للفترة المتوسطة، وهيكلة الصورة، وترقيق الصورة، وتحديد النتائج باستخدام تأكيل الصورة والميزات القوية المتسارعة (SURF). يتم تصنيف اعتلال الشبكيّة السكري عن طريق مقارنة النتائج التي حققها النظام مع قيم النطاقات القياسية التي حددها أطباء العيون. كان البحث التجاري قادرًا على اكتشاف وتصنيف مرض السكري في ثلاث فئات على أنها عاديّة ومتعدلة وشديدة إلى جانب الكشف عن النزيف. يهدف هذا البحث إلى دعم الأطباء للحصول على اختبار فعال لمرضى السكري في الاستقبال قبل الاستشارة وقبل الفحوصات الفعلية

In some patients, extra blood vessels grow on the surface of the retina so the patient may see spots or general blurredness in vision. Diabetic retinopathy is one of the most obvious and earliest symptoms of diabetes. Around 75% of the blindness all over the world is due to diabetic retinopathy [1].

In this respect, retinal images attained through a fundal camera can assist in analyzing the nature, and status of diabetes. The basis of the sorting of different stages of diabetic retinopathy is the detection and quantification of blood vessels and hemorrhages existing in the retinal image. The diabetic retinopathy classification can be done by comparing the results achieved by the system to the values of the standard ranges defined by ophthalmologists as provided in Table 1.

Table1. Standard values of *hemorrhages*

Standard values of hemorrhages		
Normal	Moderate NPDR	Severe NPDR
1467±9169	1269± 13365	1380± 16156

This research is focused on the detection of hemorrhages and the classification of diabetes using retinal images taken from the camera. Section 2 of this article discusses related work. Section 3 details the methodology adopted for the experiment of this research. Section 4 discusses the results of experiments while Section 5 concludes the results of this experiment followed by the references.

## 2. Related Work

Diabetic retinopathy has four stages:

- i.Mild non-proliferative diabetic retinopathy (NPDR).
- ii.Moderate non-proliferative diabetic retinopathy.
- iii.Severe non-proliferative diabetic retinopathy.
- iv.Proliferative diabetic retinopathy.

In recent years, these topics has been considered by many pieces of research all over the world using advanced techniques of neural networks, machine learning and deep learning. Various algorithms have been reported in the literature and few of them are summarized here by identifying various variables that were considered during the algorithm development of this research work.

Authors in [1] have presented an automatic diagnostic and display of diabetic retinopathy by using image processing techniques taken by a fundus camera. MATLAB codes are used to perform the software processing of the project by taking a typical image resolution of 1320X1203 pixels while displaying the images. The research work follows an algorithm which has four stages which in turn display the results on the monitor as:

- a) Preprocessing equalizes the illumination misbalance in images by removing the uneven surfaces, contrasts, brightness, and color imperfections. This stage also removes the noise from the images.
- b) The segmentation stage divides the image into two clusters distinctively.
- c) The abnormality detection stage collects the information of lesions along with detecting blood spots and vein artery cross over points in the images.
- d) Algorithms utilize all the above stages to finally come to a decision.

Authors in [1] have demonstrated that the most sensitive and accurate way of detecting diabetic retinopathy is by the detection of the presence of exudates within the macular region of the retina of the patient. This leads to the importance of detecting exudates in retinal images. This research work also uses the fundus camera to capture the patient's eye-retina images and then processed using a devised algorithm in MATLAB. According to this article, there are three major stages of the algorithm which specify and help in designing the framework of this research as:

a) The exudate detection stage finds the exudates in retina images using grey-level variations and their outlines which can be firmed by using morphological reconstruction techniques.

b) The optic disk detection stage uses the morphological filtering techniques and the watershed transformation.

c) The algorithm uses the exudate and optic disc data of the small images and then results are compared with human grad detection.

The research work carried out in [1] presents a novel algorithm for the detection of the lesion using computer-aided techniques such as image processing and presents a supervised classification algorithm for detecting retinal hemorrhages. This algorithm uses the reference standard hemorrhage locations which are delineated by a retinal specialist using splat based image representations. Supervised classification predicts the likelihood of splats being hemorrhages with the optimal feature subset selected in a two-step feature selection process from resulting hemorrhages map. A hemorrhage index is assigned to the image level output.

Authors in [1] have presented a novel algorithm to detect diabetic retinopathy using digital signal and image processing techniques. This work explains different types of diabetic retinopathies as well. This article more closely observes the impact of age on retinopathy as if the diabetic is not properly treated with age can lead to loss of vision. The research work carried out in [1] has proposed the usage of non-diabetic images for the detection of exudates by using Fuzzy C means clustering. In this research work, 40 digital retinal images of the patient are obtained by a KOWA-7 non-mydrasis retinal camera with a forty-five field of view which is then processed using the algorithm.

## 3. Methodology

Our research work was intended to study the retinal images taken from Fundus Camera to identify diabetic related issues. This approach is to develop a MATLAB based efficient software that may utilize the images by pre-processing them for noises removal and detecting issues. The software compares these identified vessels and possible hemorrhages with predefined parameters of database and then classifies them as different stages of diabetic retinopathy like normal, moderate, and non-proliferative diabetic retinopathy on the basis of standard values and produces result [1].

The empirical experiment of this research work as depicted in Figure 1 show various stages of the image processing followed:

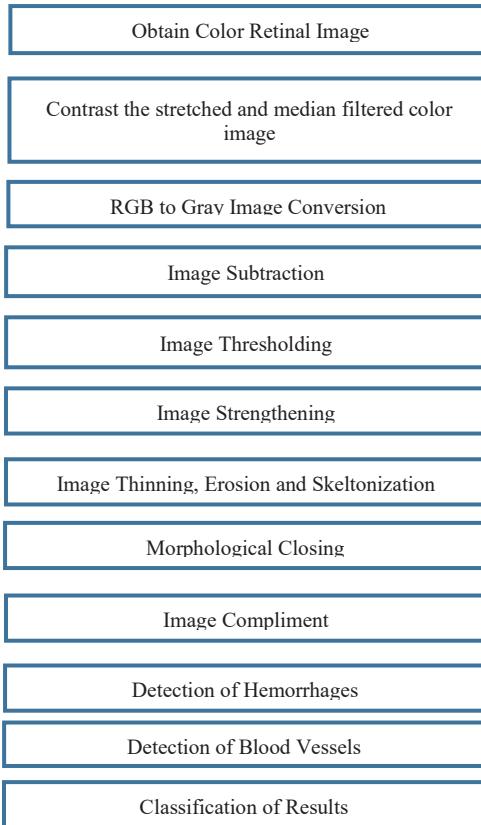


Figure 1: Image Processing Stages

The various stages of image processing that are adopted in this experiment are described in this section. The flow charts for various stages are illustrated in figure 2. Considering the values of Table 1, the system is developed using the MATLAB programming language. For this reason the MATLAB R2012b with 32 bits compatible version is used.

**Input images:** The images of the retina of the eye are not taken directly using the Fundus camera as hardware at the time of the experiment instead images were stored in the database which were actually taken using the Fundus camera and were stored in banks for analysis. Also before processing, they were compressed.

**Blood vessels detection:** There are three fascinating characteristics of the blood vessels in retinal images that assist in differentiating them from other features [1]:

- i) The anti-parallel pairs can be estimated by piecewise linear segments due to tiny curvatures exiting in the blood vessels.
- ii) Blood vessels have lower reflectance compared to other retinal surfaces, so they appear darker as compared to the background. It was detected that these vessels approximately never have ideal step edges. However the intensities differ by a small amount from vessel to vessel.
- iii) It is very well known that the width of a blood vessel decreases as it propagates radially outward from the

optic disk such is a gradual change in vessel capacity. Generally the widths of the vessels lie within a range of 2-10 pixels ( $36\text{-}180 \mu\text{m}$ ).

In our experiment, the following steps are used for blood vessels detection:

- a) Blood vessels were detected in white pixels against black background after applying the designed matched filter.
- b) The matched filtered image was then converted to binary equivalent with a global threshold value of 0.1490 determined empirically.
- c) A matrix was generated, to store the matched filter number, and then the pixel gray levels in particular directions, multiplied by a factor, which was checked against the threshold level.
- d) If the gray value multiplied by the factor was greater than the threshold, the pixel was declared as a blood vessel.

In the case of images of patients with diabetes, the density of these vessels increased too many folds, rendering a clear indication of the development of diabetic retinopathy in the patient. The density was estimated by finding the total area of the blood vessels i.e., the total number of white pixels in the image [1].

**Hemorrhage detection:** There is a typical change in the color of the images of retina due to the usage of the flash lights in fundus photography. The nonlinear curve was used to transfer the brightness of the fundus images in hue saturation value (HSV). Emphasizing on the brown regions the brightness corrected fundus images were then gamma corrected on each red, blue and green image (RGB). The value of gamma is empirically set to 1.5. Following stages were used for the hemorrhage detection in images:

- a) Two smoothed images of different window sizes were obtained using the smoothing filter and differenced to extract blood vessels and detect hemorrhage candidates.
- b) The image was applied threshold using a global thresholding value of 0.1490.
- c) The false-positive blood vessels were eliminated using morphological operations.

The hemorrhages were detected and their density was calculated by finding the number of white pixels in the image [1]. This process is elaborated in this section of the flowchart as:

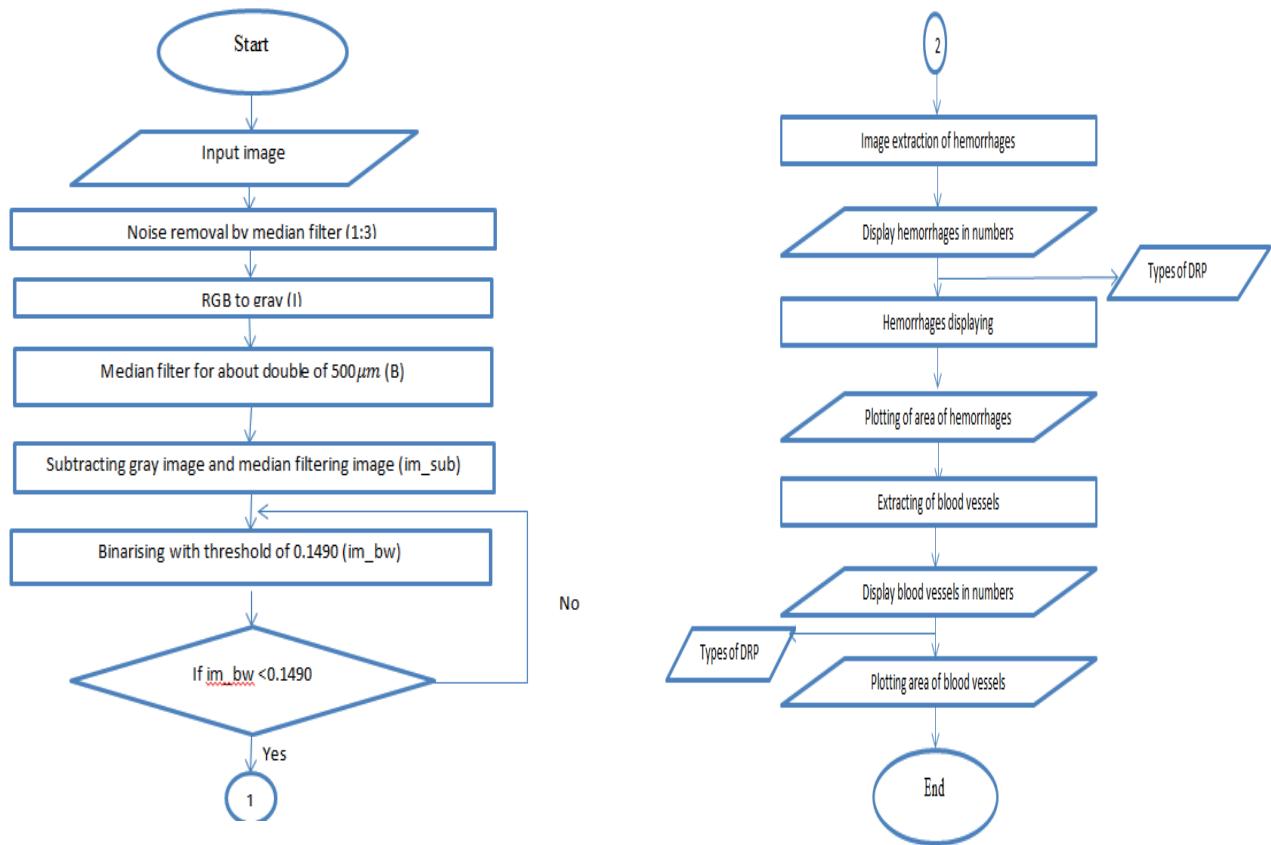
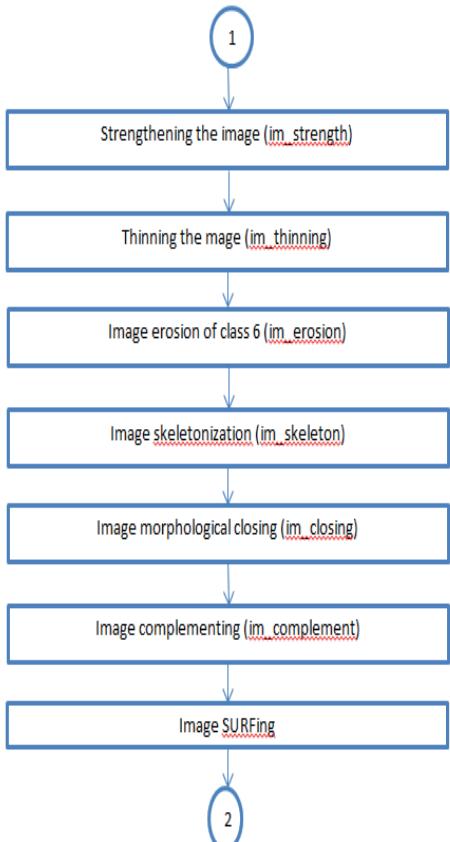


Figure 2: System Flow Charts



Following the system flow chart, the experiment results are to be displayed here as images and numerical. After getting the database images of the fundus camera, their contrast is increased as a preprocessing step so that the features are enhanced, and then it is fed into the program. Then the noises are removed by using median filtering from input images using the salt and pepper noise removal process [1]. This process results in better visibility of the nerves, blood vessels, and hemorrhages due to the usage of median filtering. The image after the noise removal, are converted to gray from the RGB scale to obtain more visible and dark sections of the nerves, blood vessels, and hemorrhages. The gray converted image is then filtered again using the median filters with a value twice of the blood vessel width. Literature shows the width of blood vessels is 250 micro-meter. The purpose to apply this filtering is to remove the nerves which are not blood vessels but does interfere in the eradication of blood vessels. Simply this filtering removes the nerves which are not required.

The gray image is then subtracted from the defaulted median filter with a value of 500 [1]. In the subtracted image, structures of the retina are canceled out and the image is left out with blood vessels and hemorrhages only which is then binarized using suitable threshold value i.e.0.1490 [1]. Then image strengthening is carried out looking if the pixel is “1” and if 5 or more pixels in its 3-by-3 neighborhood are also 1's; else, set the pixel to set to 0. This reduces the overcrowding of vessels and eliminates the repeating structures and keep the important ones only. Since in this image thinning, the pixels are

removed so that object shrinks and does not have any holes to be connected to stroke, while the object shrinks for holes to be connected to the ring which is halfway between each hole and the outer boundary of the image. In this step image erosion is performed with a disc structuring element of size 6 [1]. We performed this process to further make the blood vessels even thinner. For further processing and suppression of blood vessels skeletonization is performed after the image erosion process.

Finally, the morphological closing operation is performed and it is used to completely suppress the blood vessels and to get a definite size of the hemorrhages. After the morphological closing, the image is complemented so we can count the number of hemorrhages in the retinal images. The feature SURF is used to detect landmark points in the image and that describes those features in vectors and it is robust against noise in the image. In this step, the total hemorrhages of the image are then displayed. Here the hemorrhages which are majorly responsible for diabetic retinopathy are eradicated out. The areas of hemorrhages in comparison with the input image are observed which tells us that where actually the hemorrhages are in accordance with the original image. In the last step, the image showing the blood vessels is displayed.

#### 4. Discussion of Results

An image from database of retinal images was used to test the designed system. Following are the screenshots of the system processing on the selected image. The selected input image is indicated in Figure 3.

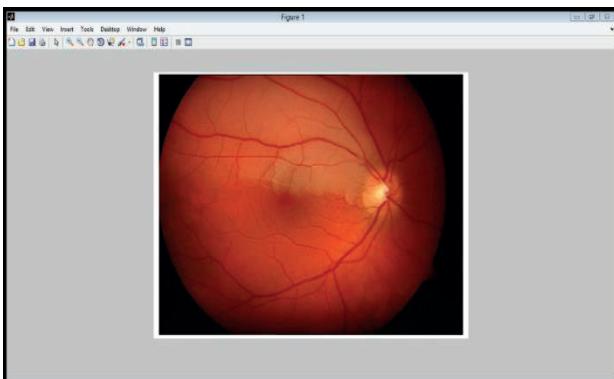


Figure 3: Displaying the Input image

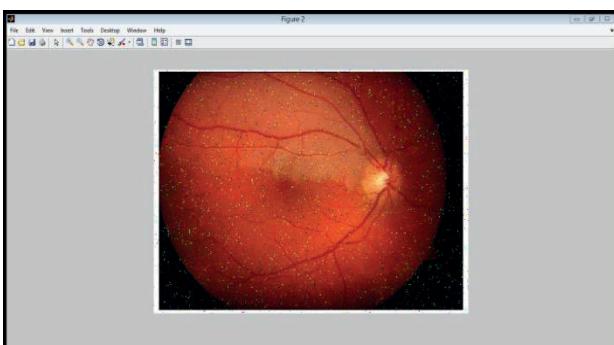


Figure 4: Salt and Pepper Noise

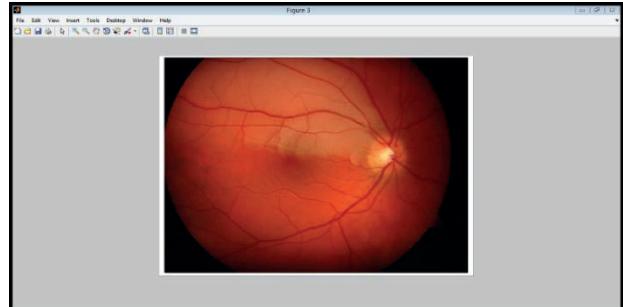


Figure 5: Median Filtering



Figure 6: RGB to Grey Conversion

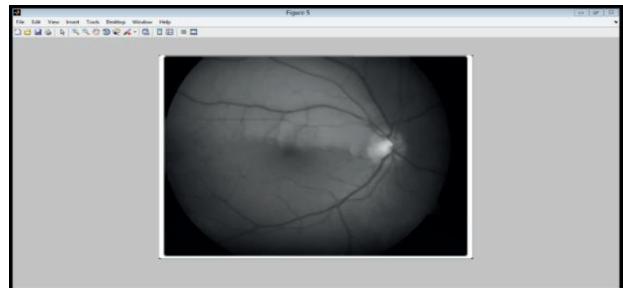


Figure 7: Median Filtering of the Image

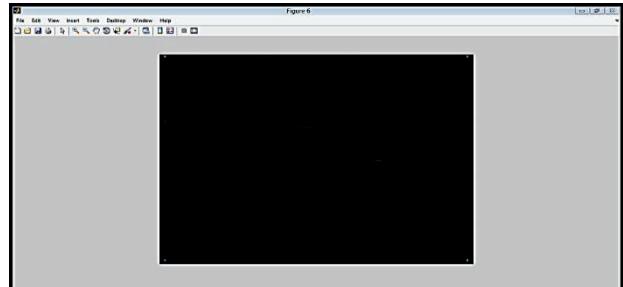


Figure 8: Subtraction of the Image

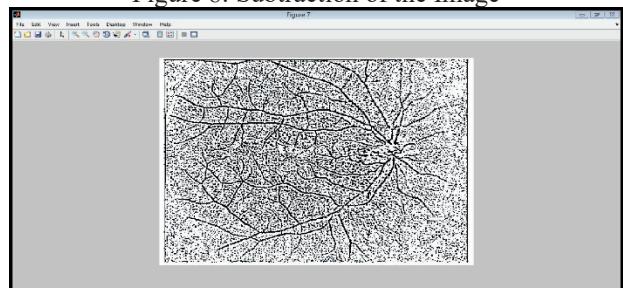


Figure 9: Binarizing the Image with the Threshold

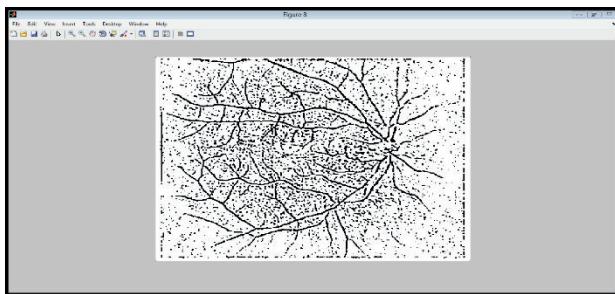


Figure 10: Strengthening the Image

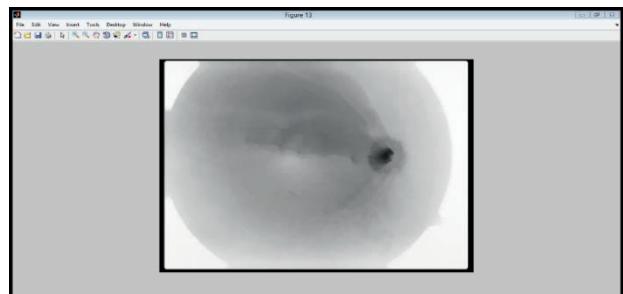


Figure 15: Image Compliment

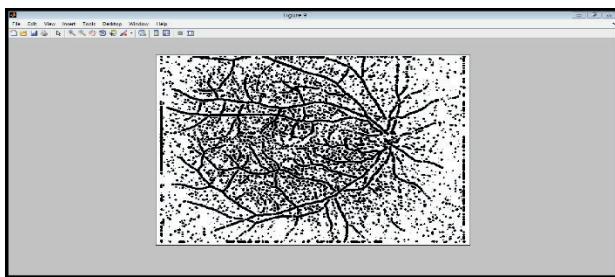


Figure 11: Thinning the Image

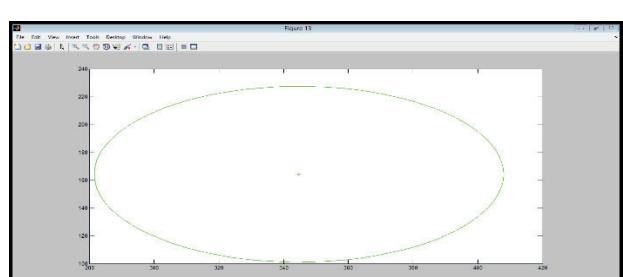


Figure 16: Image SURFing

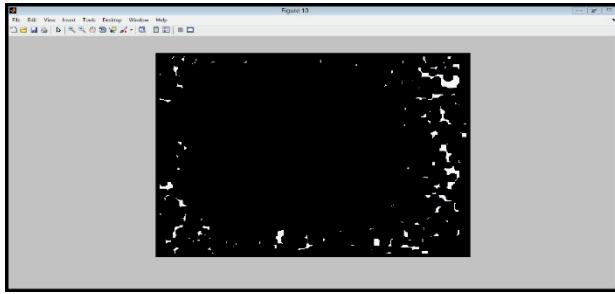


Figure 12: Erosion on the Image

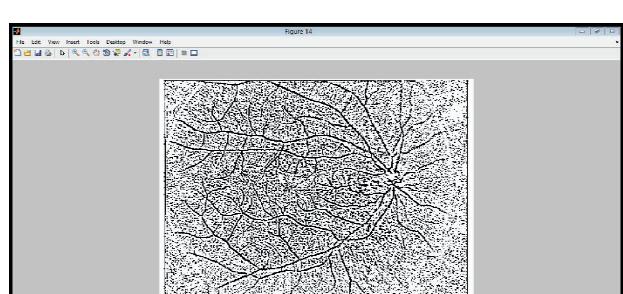


Figure 17: Total Hemorrhage Displaying

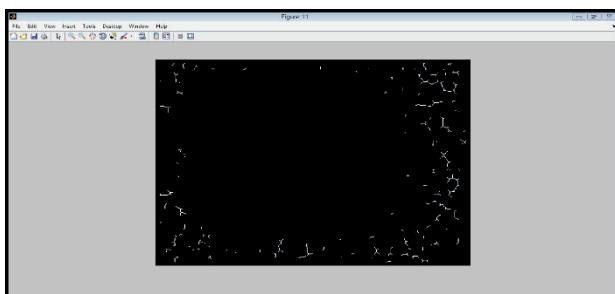


Figure 13: Skeltonization of the Image

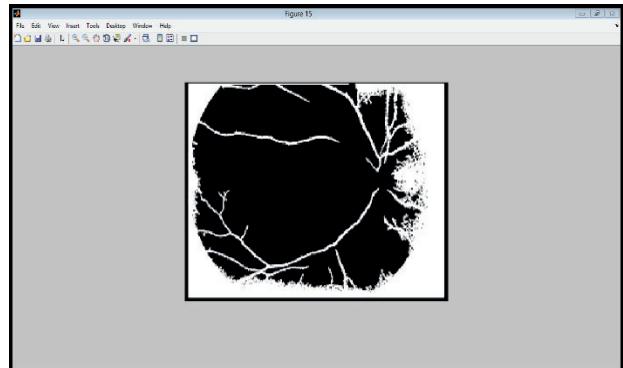


Figure 18: Hemorrhage Displaying



Figure 14: Image Morphological Closing

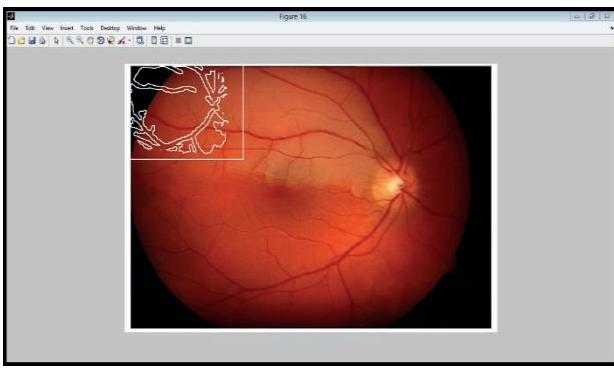


Figure 19: Hemorrhage Area Displaying

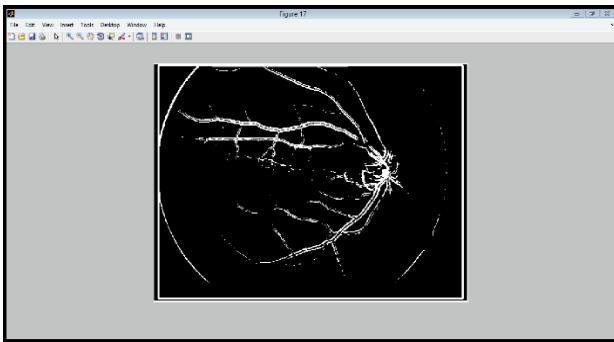


Figure 20: Extracting Blood Vessels

Figure 4 to Figure 20 illustrate the results of various intermediate stages of the system working and are in line with the flow chart as discussed in section 3. After having the preprocessing techniques and removal of the noises in the image. The image is used as an input. Four various images were used to test the system and then they were classified using the standard table of classification of diabetic retinopathy given in Table 1, on the basis of number of hemorrhages.

After the whole process the selected sample image in Figure 3 to Figure 20 was classified into the severe NPDR. One example is illustrated here. Various other images from the database were used to check for the system working and on the basis of their results, 85% of results were found accurate as per the declared database.

Few of the challenges faced during the system implementation were that this project requires a high level of understanding of technology and:

- Fundus cameras are expensive.
- Flash mechanism in camera causes reflections and a certain minimal reflection can cause the distortions in the eye image.
- Image produced is 2 dimensional in spite of 3 dimensional.
- Difficulty in accessing the abnormalities due to lack of depth appreciation in the images.
- Portability is not considered in this scheme. Unusual images can be produced because of artifacts errors.

## 5. Conclusion

This research work was carried out to support the medical field and hence to support the immediate society using technology. The major contributions of this article arise from the formulation of a new approach, to the model and identify the XYZ and ABC features of images using

MATLAB that provide improved computational efficiency in the positioning techniques. By manipulating the manner in which feature information of both A and BVN signatures is incorporated into the model, it shows that significant improvements in the performance of the algorithm are realized. Detection of diabetes at an early stage can help in cure. This work was to come up with an efficient algorithm to help the medical practitioners in diagnosis by outlining the result of a MATLAB based program. This is an attempt to detect and classify diabetes by digitally examining the images of the eye-retina of the patient as a means of the non-invasive method. The diabetic retinopathy classification was done by comparing the results achieved by the system to the values of the standard ranges defined by ophthalmologists. Empirical research successfully detected and classified diabetes in three categories as normal, moderate, and severe along with the detection of hemorrhages. The results of experimental research were found to be around 85% accurate in line with the predetermined data set of manual testing. The research focused on the detection of two diseases with just a single image.

Following are the recommendations for the future prospect of the project:

- The medication prescriptions can be fed into the database so after the classification of diabetic retinopathy the patients can get the prescription of medicines too thus making the project more efficient.
- The results of the investigation can be stored for the patient so that in the following investigation, the doctor can observe whether the patient's situation is improving or declining.
- Other features can be also focused on retinal images for the eradication of other diseases.
- The alternative methods of capturing the input images other than fundal images can be considered and compared.
- Mobile applications can be developed so that testing can be done in the mobiles thus increasing mobility and competence and effectiveness.

## 6. Acknowledgements

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# A Framework to Implement AI-Integrated Chatbot in Educational Institutes

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## Abstract

The purposes of this paper are to explore the usefulness of multipurpose Chatbot in educational institutes such as schools and colleges, to understand the potential barriers in the development process, to explore the user's expectations from a multipurpose Chatbot, and to propose a Chatbot development framework that meets the requirements. The goal is to help the developers who may wish to develop a Chatbot system. Usually Chatbots are built for one specific purpose, for example, to answer general queries, a prospective student might have regarding admission. This paper aims to provide an Artificial-Intelligence (AI) integrated Chatbot framework that can help develop a multi-use Chatbot. Study is based on qualitative data collected from case studies and journal articles. Primary data is also collected from interviews conducted with appropriate staff and students in a Higher Education Institute. Integrating AI into the Chatbot to make it self-reliant, intelligent and learn from user interaction is necessary to make it ideal for multiple fields. Developing it requires complex algorithms, database management and extensive labor, thus making it very costly. However, if developed, this single Chatbot can help students, faculties and other staff greatly, not just as an assistant in answering frequently asked questions, but also in learning and teaching. The Chatbot can be integrated with mobile app making it a part of daily life. A Chatbot built for multiple purposes certainly holds more complexity than a single general purpose Chatbot. Due to high complexity, the Chatbot is suggested to be first implemented for use in one field, then gradually expanded to other. This being said, having the software developed and tested in real life would have helped to better understand the flexibility and functionality of the proposed plan.

## الملخص

يهدف هذا البحث إلى استكشاف فائدة برمجية تشارب (Chatbot) المتعددة الأغراض في المؤسسات التعليمية كالمدارس والكلليات، وفهم المعيقات المحتملة في عملية تطويرها، وسبل تطلعات المستخدمين من استخدامهم لهذه البرمجية المتعددة الأغراض وأخيراً اقتراح إطار عمل لتطوير البرمجية بحيث تلبي الاحتياجات المطلوبة. كما تهدف إلى مساعدة المطورين الذين قد يرغبون بتطوير نظام لبرمجية تشارب. وعادةً ما يتم إنشاء برمجيات تشارب لتحقيق غاية محددة، كالإجابة مثلاً عن الاستفسارات التي يرغب طالب الذي يود الانخراط بالمؤسسة التعليمية بطرحها وتخص القول فيها. كما يهدف هذا البحث إلى تقديم إطار عمل لبرمجية تشارب مدمج بالذكاء الصناعي من شأنه المساعدة في تطوير برمجية تشارب المتعددة الاستخدامات. والدراسة مبنية بصورة كبيرة على البيانات النوعية المجموعة من دراسات الحالة والمقالات المنشورة في المجالات العلمية. كما تم جمع بيانات رئيسة أيضاً من مقابلات التي أجريت مع أعضاء الهيئة التدريسية والطلاب في الكلية، وهي في هذه الحالة كلية الشرق الأوسط. إن دمج الذكاء الصناعي في برمجية تشارب لجعلها تقوم بعملها اعتماداً على نفسها، وذكية وتعلماً من تفاعل المستخدم يعد أمراً ضرورياً لجعلها مثالية لاستخدامها في مجالات متعددة. كما أن تطويرها يتطلب خوارزميات معقدة، وإدارة قاعدة بيانات وكثير من العمل المكثف، مما يجعلها مكلفة جداً. وعلى أي حال، يمكن لبرمجية تشارب وحدتها، في حال تطويرها، أن تساعد الطلاب وأعضاء الهيئة التدريسية وغيرهم من الموظفين بدرجة كبيرة، ليس كمساعدٍ في الإجابة عن الأسئلة المتكررة، ولكن أيضاً في التعلم والتعليم. ويمكن دمج برمجية تشارب مع تطبيق الهاتف المحمول ما يجعلها جزءاً من الحياة اليومية. إن برمجية تشارب الخاصة بأغراض متعددة تتضمن بالتأكيد على تعقيد أكثر من برمجية تشارب المخصصة لهدف عام واحد. ونظرًا للتعقيد الكبير الذي يكتفي بها، فإن الدراسة تقترح استخدام البرمجية أولاً في مجال واحد، ومن ثم توسيع استخدامها تدريجياً ليشمل مجالات أخرى. وبناءً على ما سبق، سيساعد تطوير البرمجية واختبارها في الحياة الفعلية في الوصول إلى فهم أفضل لمرونة الخطة المقترحة وفعاليتها

**Keywords:** Technology, Education, Chatbot, Artificial Knowledge base

## 1. Introduction

A Chatbot is a software often integrated with artificial intelligence (AI) to simulate a human in text or voice interaction. Chatbots are generally built for specific tasks such as to virtually assist someone or to help people navigate daily life, etc. Although Chatbots have come a long way since first developed, they are yet to pass the Turing test [5]. Nevertheless, the fact that they can temporarily deal with simple human tasks can greatly reduce overheads for companies and organizations by reducing the need to hire additional employees to do the job. Moreover, employees can have more time to focus on complex tasks, thus increasing productivity and efficiency [14].

Based on how Chatbots operate, they can be classified into several types. Most Chatbots are domain specific and developed for a specific need. For example, a Chatbot might be developed to handle queries a prospective student might have before joining a university. Based on searches made, rarely if any study has been done to develop a multi-use Chatbot that is capable of helping user in multiple sectors. That is, for instance, a Chatbot developed for educational institute is capable of guiding people who might have any queries regarding admission, assist students in navigating through courses and help teachers in teaching and learning. However, building a multi-purpose Chatbot can add to existing complexity, especially when attempting to integrate AI into the system that can enable it to learn and evolve overtime. This sets a roadmap in first exploring the benefits of multi-purpose Chatbot in educational institutes, comprehend the potential barriers in development, user's expectations from these Chatbots, and lastly proposing a shallow outline of the Chatbot's architecture.

### Study Design and Purpose

Literatures based on the functionality of Chatbots, their designs, usefulness and obstacles that hinder development of a Chatbot have been reviewed. Additionally, interviews were conducted with a few faculty and students of Middle East College (MEC) to find their expectations from a multipurpose Chatbot. The paper is developed based on these literature reviews and the interviews conducted with the aim to support developers who wish to develop a multi-use Chatbot for an educational institute.

## 2. Literature Review

In [7] they had proposed a prototype of a Chatbot in the field of education. It was developed to aid students' learning for some specific subjects. The emphasis was

mainly on the communication and the selection of the appropriate responses. For detecting the questions natural language processing (NLP) techniques were used and the domain ontologies were used to select the answers.

In [9], the authors have demonstrated in their work about the Chatbot that they implemented to improve the content delivery for a group of assessments in higher education. They held that it could address only five out of seven principles stated by Chickering and Gamson. They said that the most difficult part in developing the Chatbot was to train the Chatbot for responses.

### *Exploring the benefits for students and teachers*

A study conducted by [6] found that people preferred to use Chatbot because it maximized productivity, acted as a source of entertainment and increased curiosity regarding its reply. Their study also found that users tended to form social bondage with the Chatbot thus making them want to use it. Applying this in context of education, [15] assured that Chatbots could provide instant answers to learners and make educational flow more interactive and dynamic. Chatbots could also significantly help students in learning in terms of memory retention and learning outcomes when compared to students who self-learned by using search engines [1]. Chatbots could also be developed to understand learning styles of users and respond to their feedbacks which could also encourage trust, improve bondage, and motivate users. Additionally, [12] found from their study that students tended to believe chat mates more than a search engine, thus emphasizing the importance of Chatbots in education. According to [8] MOOC's (Massive Open Online Courses) consisted of three components – the lectures, quizzes and the peer tutors. MOOC'S have already had a positive global impact as it is revolutionizing the way students learn. Thus, Chatbot in education can therefore be thought as an automated tutor that solves a learner's queries.

### *Barriers to confront*

The communication between humans and Chatbots are not so natural and requires further research to improve [15]. According to [13], the primary issue when developing a dynamically responsive (answers queries which are not predefined by developer by searching knowledge base) Chatbot is to enable Chatbot to process natural language effectively. Additionally, the programming complexity due to use of AI machine learning algorithms restrict the efficient functionality of Chatbots. The authors also mentioned in their study that there was insufficient input to feed Chatbots to correctly answer the user. However, for the latter, [11] proved that it was possible to extract

question-answer pairs from online discussion forums using a cascaded framework. Based on set conditions so as to not gather irrelevant or poor quality answers, the Chatbot was able to extract from 2,000 threads within two minutes. The sheer volume of information extracted can boost up the Chatbot's knowledge base more quickly than any human ever can.

Regarding the conversational user interfaces (CUI), [9] believed that messaging application were most popular worldwide due to their simple CUI. In their study, the authors showed that there was no standardized method to represent all discussions or a large series of formal conversation systems. Depending on the application, certain CUI is more versatile over others and has to be chosen carefully. They also point to the findings that having a human to verify the dialogue can hinder the repetitiveness in dialogues.

Even with the latest technological advancement making a Chatbot that can think and act like human is a far set goal. According to [2] who reviewed analyzed nine studies that affect Chatbot design, believe that Chatbots are unable to improve at an affective pace due to not having common design practices among developers. This is because researchers often work in isolation and tend not to disclose any improved techniques they find. They further added to the point that additional research and a need for common solution is required.

### 3. Expectations of potential users

The responses of the interviewees showed that few people were concerned that there would be loss of job in teaching and in other sectors if a powerful, multipurpose Chatbot is to be introduced. However, majority of interviewees wished to have the Chatbot integrated with a mobile application that can be accessed with ease. In MEC, most services (e.g. students' attendance records, library books catalogue, etc.) are digitized and can be accessed via web portal. Nevertheless, they argued that a Chatbot which is aware of user (faculty/admin/student etc.) should provide answers to their queries in real time. A student who wishes to know if a book is available in library should simply text the Chatbot and get instant reply. Students and teachers should be able to ask study related questions to the Chatbot and get tailored answers based on user. Similarly, a staff who wishes to know scheduled date of an assessment need not check the course calendar, but simply text the Chatbot to get an instant reply. Likewise, a prospective student who does not have a user ID should be able to ask questions to Chatbot accessible via institute's website as a guest user and get answers to it. The Chatbot should be able to hand over conversation to appropriate staff if in case it is unable to answer. Among all, probably the most important feature

demanded was to enable certain people to know the most frequently asked questions to the Chatbot. Using the collected information, teachers shall know what part of subject students are unclear about. This can help the teacher focus on it and make teaching time more worthwhile.

Overall from the interview, it is clear that there are high expectations from a multiuse Chatbot where the demand is to make almost all services easily accessible from one application. Based on the literatures reviewed and findings from survey, the following key points are noted that needs to be considered when developing a multi-purpose Chatbot for educational institute.

- A simplified CUI for the Chatbot. Ensure that dialogues keep the user engaged [9].
- Dynamic Chatbot with machine learning algorithms that can answer questions which are not predefined in knowledge base [1].
- Define algorithm to search for answers from third party sources, e.g. discussion forums, to aid students and teachers in education [11].
- Keep log of users' activity. This can help teachers and other responsible personnel to view users' activity.
- Chatbot should have access to user's details (user role, course information etc.) to provide tailored results.

### The Chatbot Architecture

Figure 1 shows a general outline of the system architecture of the Chatbot. Components of the Chatbot can be classified into five types:

1. The Interface (Front end and Back end)
2. Natural Language Manager Module
3. Knowledge Base (including Third party sources)
4. Response Generator
5. Task Handler

#### **Component 1: The interface**

Users and administrators using the Chatbot system interact with the machine using the interface, which could be a PC or portable device such as tablet or smartphone. Ordinary users or the intended end users such as faculties and student use the 'front end interface' to log in to the system before using the chat bot. Since users log in to use the system, the Chatbot can identify the user type and answer certain queries only for a particular user type. For example, a Chatbot could reply "Cannot disclose information!" or "I am not aware of it!" if a student asks, "When is the next faculty meeting date?" The interface could also allow guests to log in, who could be a potential student and get his queries answered, although very limited, such as for queries regarding college's tuitions and majors offered, etc.

Users could communicate via text, voice or mixture of both modes.

The administrators and domain experts interact using the ‘back end interface’ to manage tasks such as updating the database and troubleshooting – tasks that effect the Chatbot’s behavior. The logic of the algorithms is managed here.

#### **Component 2: Natural Language Manger Module**

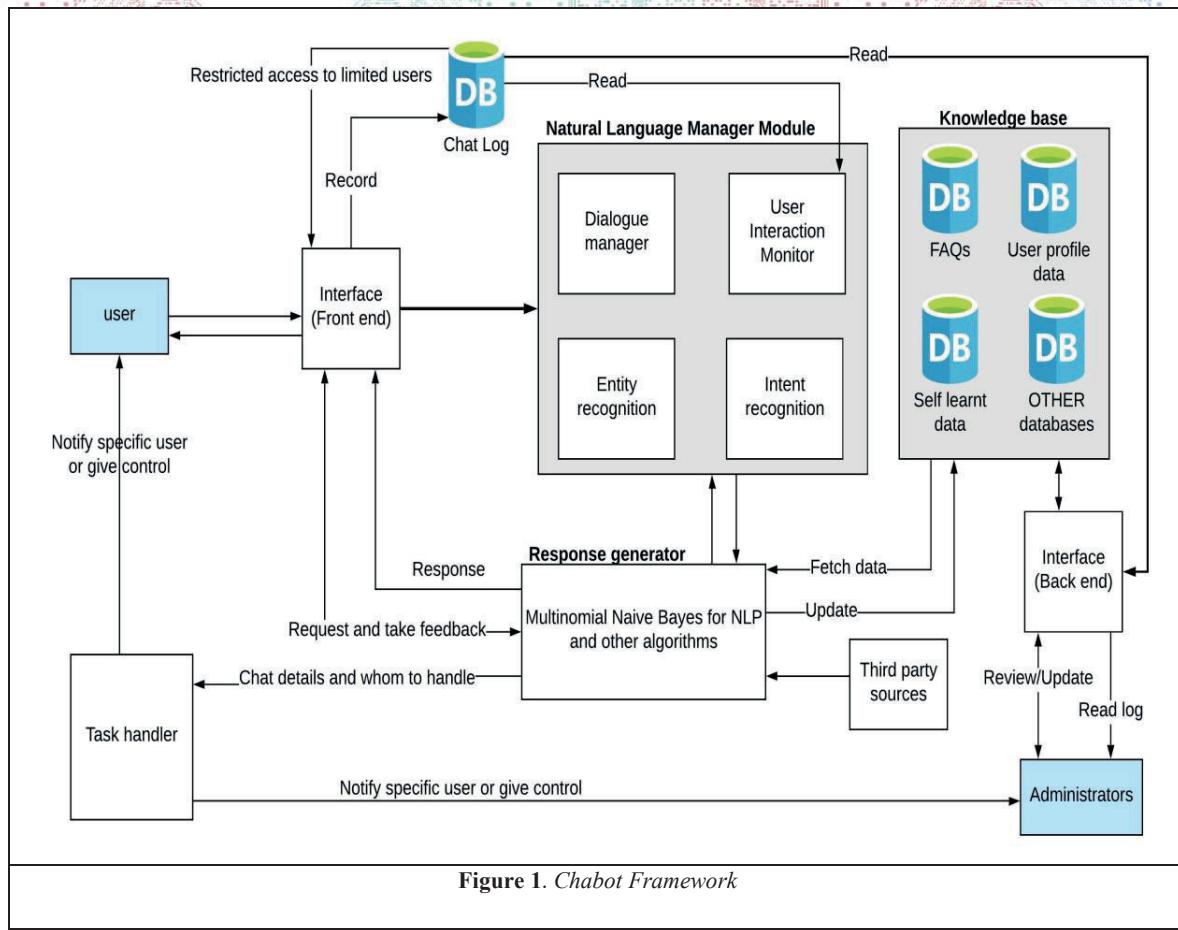
The objective of this component is to infer meaning of user’s question and provide raw data that Response Generator component can use along with the bot’s Knowledge Base to derive a response. It consists of four primary parts: Entity Recognition component, Intent Recognition component, User Interaction Monitor component and Dialogue Manager.

Entity Recognition component extracts key words in user’s input while Intent Recognition component tries to identify the user’s intent and matches with the intents it supports. Interaction Monitor component considers other parameters not directly provided by user but could potentially vary the responses. This includes previous chat history (from Chat Log database in figure 1), repetitiveness of questions, interaction time, type of questions, etc. If the data forwarded to Response Generator is insufficient to derive a response, the Response Generator could send a request to

Dialogue Manger component along with necessary data to continue flow of conversation. The dialogue management component of the system should be developed so as to keep users engaged and not feel that they are chatting to a machine. Chatbot replies like, “Never heard of that. What is it related to?” or, “Sorry! Could you be more specific?” can help maintain user’s engagement. This requires careful structuring of sentences. Additionally, where required the Chatbot should clarify with user so as to not process incorrect command, e.g. “You mean change code to 1025, right?”

#### **Component 3: Knowledge Base**

This is a collection of databases developed by administrators and domain experts. It includes databases consisting of Frequently Asked Questions (FAQs), Course details, etc. along with User Profiles database and database to store data learnt by the Chatbot. User Profiles database could include details of all registered employees and students along with constraints that determine user’s privileges which the Chatbot could use to limit users from knowing certain information. The latter database (‘self learnt data’ in diagram) should be used to store the best answers from conversations where Chatbot had to answer questions not pre-defined based on user’s feedback.



**Figure 1. Chabot Framework**

This is, for example, when the bot had to rely on third party sources for answer, the bot could assure the correct fullness of response by requesting feedback from user. If the user rating is high, the Chatbot may store the answer in the database and set a priority digit to resemble user's satisfaction. If another user asks a same/similar question, the bot can then quickly fire that response along with request for feedback. Overtime, the Chatbot can build its knowledge base with responses rated for higher satisfaction.

#### **Component 4 and 5: Response Generator and Task Handler**

This module is the main processor of the Chatbot that comprises of several algorithms including Artificial Intelligent algorithms to generate appropriate responses by gathering input from Natural Language Manager Module and searching and analyzing local Knowledge Base. It then tailors the data to generate grammatically correct and meaningful information so that it can be forwarded to Front End Interface. If it fails to find a suitable response, this component should search for Third Party Sources. It should

also forward certain data to Task Handler component so that it can give chat control to specific personnel who could potentially solve the user's query. In certain scenarios if the data is insufficient to derive a response, the component should send required data to Dialogue Manager Component and request to continue conversation.

#### *The importance of Chat Log database*

Chat Log is the database used to keep records of all conversations between every user and the Chatbot. This helps User Interaction Monitor component to provide valuable data to Response Generator so that it can provide a better response to user's queries. For example, the Response Generator can know if the user's question is related to previously discussed topic, perhaps few days ago. As figure 1 illustrates, the contents of database can also be accessed by certain user types, such as the faculties. This can aid them in understanding if certain subjects are unclear to student by monitoring the number of times it was asked to the Chatbot. Faculties can thus focus on those concepts in class.

#### 4. Limitations

Since the interview was conducted within a higher Education Institute, most of the answers were tailored to needs of people associated with the institute. The sample size of the data is small, that is only 20 people including the staff and the students were included. A wider array of data was therefore not taken into consideration. Additionally, the Chatbot architecture presented here needs to be tested for usefulness and efficiency before being implemented.

#### 5. Conclusion

Although Chatbots have developed greatly over the past decades, there is still a need to develop the human-machine interaction and the ability to form semantically accurate meaningful sentences by analyzing the input data. Public also needs be educated about the purpose of having a Chatbot and comprehend that in education Chatbots are not meant to replace teachers, but they are actually aiding in progressive communication between learner and teacher [15].

With the work presented above, the authors hope that developers can know what to expect when developing a multi-purpose Chatbot system for educational institute and probably find a simplified guideline that can be followed during the development process. Since this article addresses some of the weaknesses and research gaps in Chatbot development, a scholar can use it to seek and explore as yet undiscovered area or perhaps propose a better, more efficient design for developing a multi-purpose Chatbot.

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## “Tageerat” A Mobile App to Empower Rural Women Entrepreneurs of Oman

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### Abstract

Women entrepreneurs can contribute to the development of the rural society of Oman. They can support their families economically and financially aid their children for a better education opportunity and address many other social challenges. Sultanate of Oman is famous for the local homemade cosmetics and handicrafts. There are many cultural regulations for the rural women, which prevent them from establishing a formal business and dealing directly with the customers. A mobile application can give them a platform to get global opportunities for the growth, raise their issues on a social platform, and make a community of their own. Economically independent women are empowered in more ways than one. In rural societies where women are marginalized, an opportunity to start a small-scale business on their own can be a welcome sign for boundless opportunities. Women entrepreneurship means an opportunity to climb up the social ladder, ascertain their potential, start affirming their privileges, and in due course become a part of the decision-making process amongst their own families and societies. This paper will suggest an only woman mobile application to help the rural women get in touch with the global customers and assist in the upliftment of their family and society. This application is available in 2 languages, English and Arabic. It will clearly highlight the impact of Information and Communication Technology (ICT) in empowering women entrepreneurs. This application has been made for iOS currently and will be made available on Apple play store. This application will give the rural women a platform to showcase their home-made products and assist in improving the market for the local products of Oman. The features that have been incorporated in the application are based on the interviews conducted with 20 women entrepreneurs and it has an easy to use interface. The technology used is Swift 3 language, Xcode and Firebase.

**Keywords:** women's entrepreneurship, small scale business, global reach, ER, Block Diagram, DFD, Context Diagram, OS, SMEs.

### Introduction

A lot of women entrepreneurs are there in the market, some are established while some are still struggling. Any business requires the skills, experience, financial investment as well as marketing. All these can be easily accessible to urban population as they are well educated, know the facilities, and acquire the support provided by the Government. They can deal with a bigger market directly. Delivery of the products is also easier for them.

There are several women who make cosmetics and other handicrafts as per the age old traditions of the Sultanate of Oman. Many of these women wait for some exhibitions or events like Muscat Festival to get a platform to reach out to their customers.

**الملخص**  
يمكن لرائدات الأعمال المساهمة في تطوير المجتمع الريفي في سلطنة عمان، إذ يمكنهن دعم أسرهن اقتصادياً ومالياً، وكذلك تقديم العون لتوفير فرص تعليم أفضل لأبنائهن، ومواجهة العديد من التحديات الاجتماعية الأخرى. وتشتهر سلطنة عمان بمواد التجميل والحرف اليدوية المصنعة في المنازل. ويوجد العديد من النوازل الثقافية الخاصة بالنساء الريفيات، ما يمنعهن من تأسيس شركات رسمية والتعامل بصورة مباشرة مع الزبائن. ويمكن لتطبيق من تطبيقات الهاتف المحمولة أن يزودهن بنصيحة للحصول على فرص عالمية من أجل تحقيق النمو، وإسماع صوتهن على منصة اجتماعية واحدة وتشكل مجموعة تضمهن جميعاً. ويتم تمكين النساء المستقلات اقتصادياً بطرق كثيرة. وفي المجتمعات الريفية التي يتم تهميش النساء، يمكن لفرصه في بدء مشروع على نطاق صغير اعتماداً على أنفسهن أن تكون انطلاقة واتقة لإتاحة فرص لا حدود لها أمامهن. إن المقصود بقيادة الأعمال النسوية إعطاءهن الفرصة للصعود في التراتبية الاجتماعية، وتأكيد قدراتهن، والبدء بتأكيد ما يتمنين به من ميزات، وسيصبحن في الوقت المناسب جزءاً من عملية صناعة القرار في أسرهن ومجتمعاتهن. ويقترح هذا البحث استخدام تطبيق خاص بالنساء فقط ويعمل على الهاتف المحمول لمساعدة النساء الريفيات في التواصل مع الزبائن في العالم ومساعدتهن في الارقاء بأسرهن ومجتمعهن. وهذا التطبيق متاح باللغتين الإنجليزية والعربية. وسيسلط الضوء بوضوح على تأثير تقنية المعلومات والاتصال (ICT) في تمكين رائدات الأعمال من النساء. وقد صُمم هذا التطبيق حالياً للعمل على أنظمة تشغيل (iOS) وسيكون متاحاً في متجر أبل (Apple Play store). وسيمنح هذا التطبيق النساء الريفيات منصة لعرض منتجاتهن المصنوعة في البيوت ومساعدهن في تحسين السوق الخاص بالمنتجات المحلية المصنعة في سلطنة عمان. والمزايا التي أدخلت في التطبيق تمت بناءً على مقابلات أجريت مع العديد من رائدات الأعمال من النساء وتميزت بواجهة سهلة الاستعمال. والتقنية المستخدمة فيه هي تقنية (Swift 3 language) و(Firebase) و(Xcode).

Due to cultural regulations, these rural women do not interact much with the customers and sometimes the local language only being known to them, it becomes difficult for them to interact with the customers.

Mobile applications are the best and easiest way to online-shopping and making the life easy. This research work aims at the study of how a mobile application effects the society and country and begins to help women entrepreneurs. It is important to develop and support the women in our society by using the technology. So, this application comes to helping women. They can share the details of their homemade products with many people all over the globe without any difficulties.

The main objective of this application is to give rural Omani women

the opportunity to start small scale business from their home. The new application will support women by teaching them how to use the mobile application in an easy and faster way. In addition, it saves their time and money as there is not much financial investment to start the new venture. This application will be available in two languages Arabic and English, so the women who are not comfortable with English can also use it. This app was developed using iOS OS. Later it will also be released as a new version for Android OS.

### **Impact of the application**

To evaluate the impact of the application in the growth prospects of the business, a comparison between the previous operational scenario, while using the application and future implications of the application when it will be available on all platforms (both iOS and Android)

**Table 1.** Comparison of past, present and future operational scenario

Without the application	Women who wanted to start a new business, must think about the customer, the market and the budget etc... Additionally, it took a long time to spread the product information to the customers and expand their business.
While using the application	Within minutes the product information, offers, and other information would reach the customers and the order delivery will also be faster. More customer satisfaction could be achieved.
Future implications	More support to the Omani community as well Omani women. Gather all small scale women entrepreneurs on one platform. Low cost to establish SMEs business. Improve the Omani market for local handmade products and introduce them to the world. Faster delivery, more customers, improved customer satisfaction and more business opportunities.

This comparison is based on the verbal feedback taken from the women entrepreneurs who were asked to use the application for testing purposes. A complete comparative analysis however, will be done once the application is also made available for android operating system as there are only few women who started using it for iPhone.

### **Project Scope**

This mobile application is available within the Sultanate of Oman as well as around the globe and will promote the home business for Omani women. It is helping in representing the age old Omani tradition of homemade cosmetics and other products on the international platform. Only Omani women citizens will be able to register as seller. The project took about 6 months to complete. It was developed using Swift 3 language, Xcode and Firebase.

### **Objectives**

- To enable registration for the customers and sellers.
- The user interface is friendly and easy to the user.
- Bilingual: offered in dual languages such as Arabic and English.
- Categorized display of product information.
- Additional choices offered on the similar category of product will also be exhibited.
- The seller email will be used as username to register.
- The user's confirmation on registration expects sending an acknowledgement email.
- The seller has the rights to add/ delete/edit the product information
- The admin can register the seller.
- Customer will receive an order confirmation through an SMS.
- Report on the user/orders can be auto generated by the admin.
- Customer/seller can view previous orders.
- Customer uses a shopping cart to choose the products, finalizes (add/drop) their selection before placing the final order.

### **Goals**

The goal of this research work is to encourage the rural Omani women to be financially liberated and start a small scale business with the marketing base as mobile application. They can start the business with a little financial investment. It will serve as an interaction platform/interface between the seller and the customer. Special offers on festivals/occasions such as Eid/ Ramadan, National Day, Teachers' day, Mother's Day and any other such events will be given to attract more customers.

### **Literature review**

A website "Boutiqaat.com" has been reviewed. It is a famous online shopping website in Oman. It is selling clothes and beauty products. It offers different categories, for example, make-up, perfumes, bath & body cosmetics, skin-care range, hair-care, eye-wear, Arabic fashion etc. [4]

"Dokkan Afkar" is the website offering a similar application. This application is available merely for Gulf countries. It is also available on platforms such as both apple store and google play store. It displays a variety of products from electronic equipment, stationery items, garments, domestic items and others. Also, when the customer selects a specific category to view its specifications, the application offers the products that are of the same category [6]. There is support from the government and also some private non-profit organizations to encourage women to work. Lots of articles in the newspapers and website show how the small and medium scale businesses had been helpful in changing the plight of women. There are many exacting systems for purchasing the products in all categories however this application is especially for Omani women. The opinion of many Omani women entrepreneurs was considered in this regard. They mentioned about the "Alraffad Fund" and the government support to them, and how their business improved. Moreover, they also discussed about the experiences and skills they learned from their business. In addition, they talked about the freedom to choose any type of business and how their self-confidence improved. They also talked about the Omani women day and how they get the care and attention in our society [6]. The previous process of opening new business took long time to spread and reach to large number of people but while using this application will help your business to expand and all the society will come to know about it.

Entrepreneurs: Their responses for the questionnaire summarized	
Sana Al Kassab	She took around two years to establish her business and get connected to the customers. It was difficult to disseminate product information to the customers and about her business as well. She is also facing problems in delivery of the products.
Am Qais	She took more than two years to spread the information regarding her business and products amongst people. She faces lots of problems still in communicating with her customers. Delivery problems encountered for far away locations.
Am Said	She started business from home. Initially the profits were very less as reaching out to the customers was difficult. She also wanted to follow some rules for communication and placing of orders. The details of the orders were not systematically received and hence problems encountered during deliveries.
Am Abdaslam	She was interviewed face to face. She took more than one month to spread news about her business and products. That was also limited to her village. Spreading the business to cities and distant places was a dream for her. Delivery to far off places was difficult.
Am Musab	She took around 5 months to establish herself. She wanted to have fixed pricing for the products and bargains should not be allowed. Delivery of orders was an issue.

Table 2. Evidence of interview responses.

Swift3 is an easy and protected programming language used to write programs for a wide variety of devices like computers, tablets or mobile phones. It is an Open source language from Apple company and it is particularly for Apple devices. Swift3 language is easy, it does not require a lot of archives. So, the memory requirement is less. In addition, it has advanced Swift 2018.

The programmer can make a good and interactive user interface without the need of typing the code because the program offers a design panel to the programmer that contains all the buttons, windows, scripts, etc. [11].

Firebase is a platform that offers many options for the development and room for data from interactive web pages and applications and allows the programmer to synchronize data automatically as it offers instant data synchronization between the database and application. The user can also sign in using a variety of options like Facebook, Twitter, and Google Account. Additionally, it protects the data and any changes made in the database server will be immediately reflected in the application. Moreover, the data can be changed at any time even when on offline mode. Firebase can also generate automatic screenshots and reports and can identify errors in your application. [11].

This research shows the new method using which more support is provided to our society especially to the women who face difficulties in reaching out to the masses with the details of their home made products, their description, pricing etc., The existing applications focus on online buying and selling in general but not specifically for women entrepreneurs. This application will simplify the process for Omani women entrepreneurs. Firebase cloud database can easily manage for large number of users. So, at the beginning while women entrepreneurs install the app and upload the product info, it will keep the info as per product

categories. After the size of database is increased, and more number of users get registered, than we will pay to accommodate their details in the cloud. The first three months for the App will be free for all. Then the users will pay a nominal fee monthly as per the growth of the application.

## Methodology

Understanding the requirements clearly plays a major role in getting the application right. There was not a particular site where the study was conducted. Rather the input for the study was taken from the different women entrepreneurs by taking their interviews on phone and asking them to fill an online questionnaire. Hence some women entrepreneurs were interviewed and asked to fill an online questionnaire to understand their expectations from the application.

## Sample collection

An informal interview of 20 women entrepreneurs was conducted. This served as an input to refine the requirements of application being developed. Some of the interviews were done face to face but for others due to the time constraints and non-availability of the entrepreneurs, questions were shared on Google Docs. Some of the responses have been attached for sample in Table 2.

## Data Analysis

The responses clearly stated that the women entrepreneurs emphasized on the need of an only women online shopping mobile application which should be available in the local language as well. They further added that the women in urban areas are technical, they are more aware, and hence this application will be of much use particularly for rural women. These women are bounded by more cultural restrictions. They are technical less aware of the use of mobile applications and less comfortable with applications available only in English language. They further suggested some of the expected features in the interview which formed the basis of the objectives finalized for this mobile application.

## SWOT analysis

The important aspect of this analysis is to recognize the strengths and flaws of the system, the hazards that hinder the system and the appropriate prospects to exploit them. It helps to develop a sustainable plan for the future. It helps us to understand the inner and outer environment of the project with clarity. SWOT is also called as ‘strategic management process’ and it helps in the strategic planning in projects and its analysis.

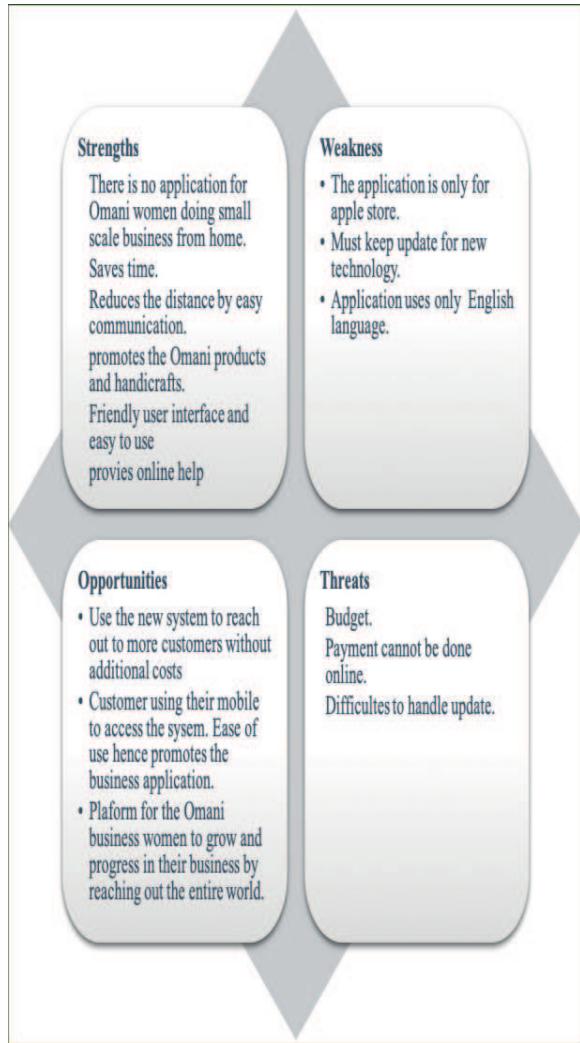


Figure 1. SWOT Analysis

Dynamic System Development Methodology will be a selection of the best methodology that will aid us to accomplish the project effectively. It is a model that splits the effort of the group and categorizes all features of the system and progresses to provide a strong indication of the system.

The key reasons to select this model are:

- It helped me prioritize the requirements.
- Communication with end user at all the stages helped in reaching out to the requirements better.
- New versions of the applications will be launched in the market with the changing requirements of the users or the technology.

## Design Diagrams

### Context diagram

It shows this application as one process and the input and output for this process in general. The purpose is to understand the process flow between the customers and entrepreneurs.

### Data Flow Diagram (Level 0)

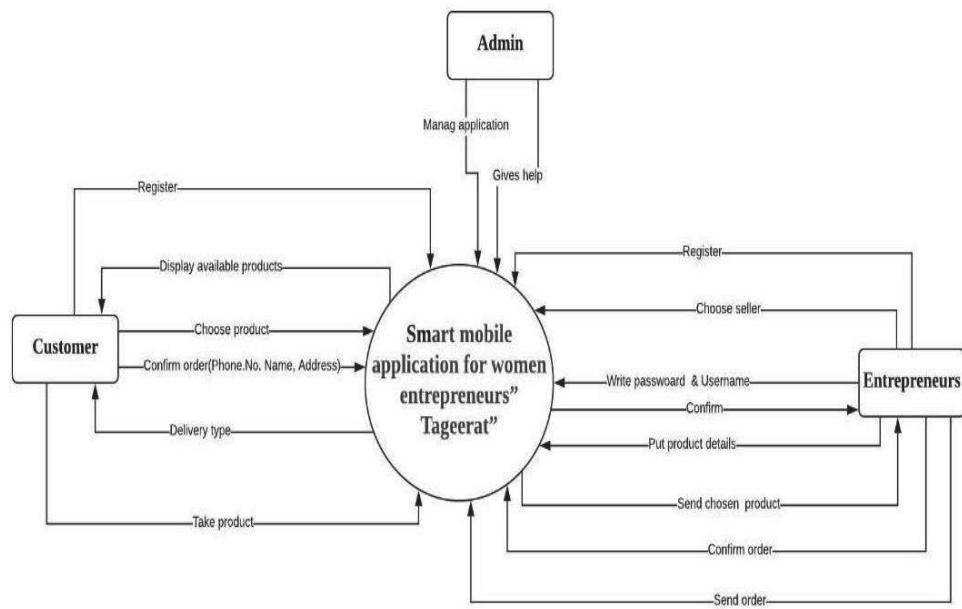


Figure 2. Context Diagram

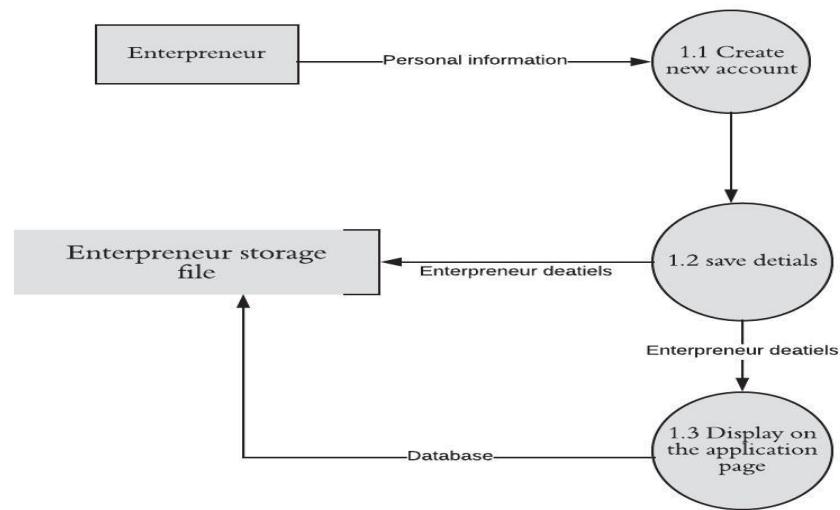


Figure 3. Data Flow Diagram Level 1

It is representing the flow of the process in the application.

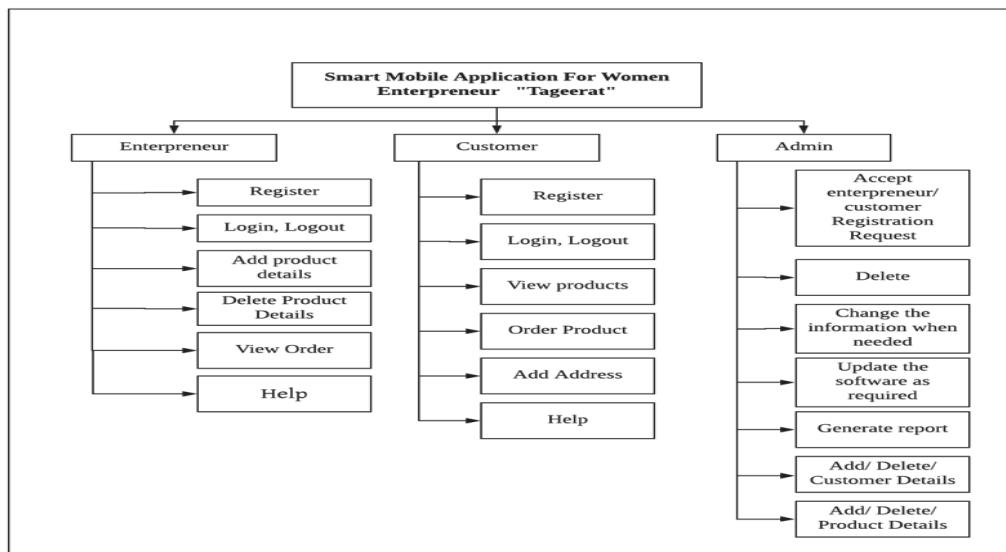


Figure 4. Block Diagram

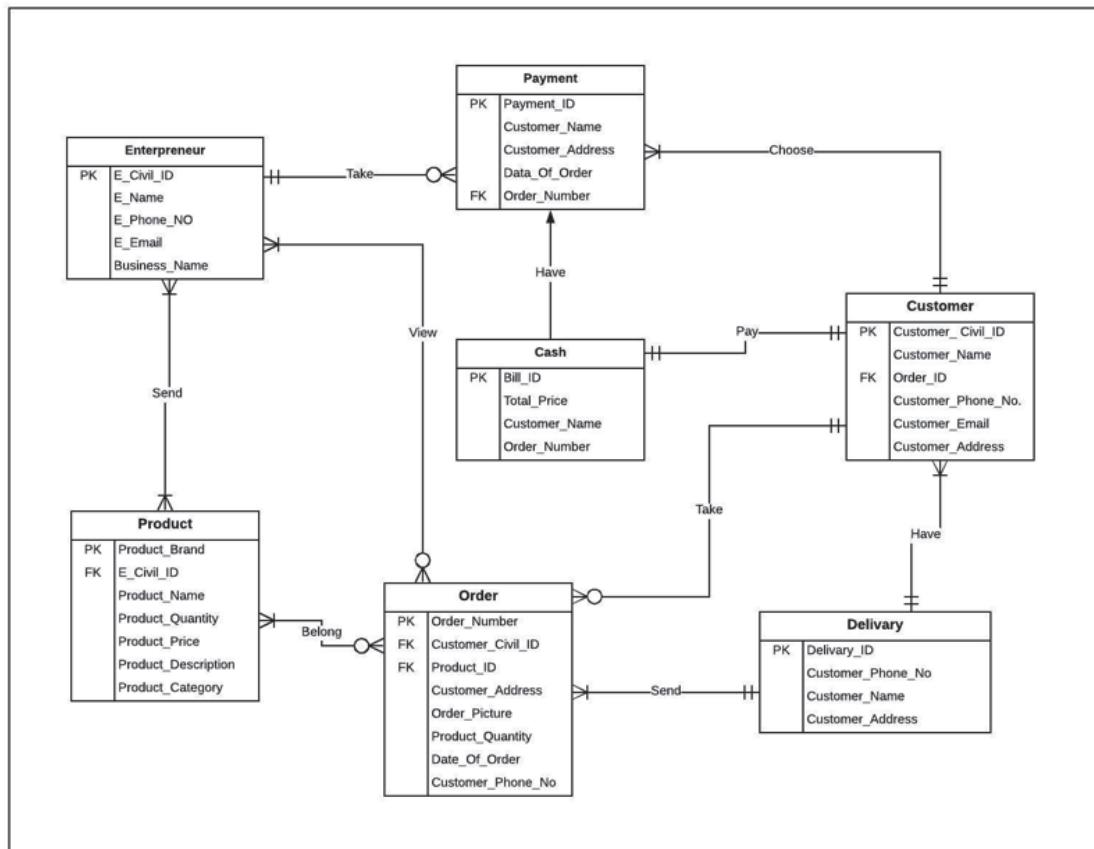


Figure 5. Entity Relationship Diagram

## *Block Diagram*

It shows individual users with the admin and the process for each one in steps by block. There are only three categories of users here: the entrepreneur, the customer, and the admin. The admin will have complete ownership of the application. There are multiple functionalities being offered for the entrepreneur and the customer as given in the Figure 4.

## *Entity Relationship Diagram*

The entity relationship diagram shown in Figure 5 gives the interaction amongst the various entities, the relationships and the cardinalities.

### **Strengths of the application**

The forte of the application is the handiness of the application offered in two languages (English, Arabic). It offers a relaxed, clear, and unique user interface.

## Future implementation

The limitation of this implemented work is that when a seller registers, it should ensure the identity as a female of Omani origin. This can be done by verifying the Civil-Id. This requires getting connected to the government servers, which could not be done due to lack of permissions.

The online payment also could not be implemented due to restrictions on getting connected with the bank servers for verification. The developer's insight was to develop the application for Android platform as well, but due to limitation of time it has been left for future implementation.

The payment to apple store needs to be done for each month and must be from the developer's account.

The delivery process could not be integrated with the application as it requires communication with Aramex or Oman shipping company to deliver all orders. Online help has been provided for the process.

This app was developed using the Xcode program. It helps to fully design the app and helps can run the link between the app pages as well the language change. Firebase database was used for store and synchronize data [11]. The database shows all details of the users. It has clear interface that helps to understand the steps of storing data managing administration.

## Result

As mentioned in the beginning that this application was developed used two program (Xcode, Firebase) and Swift language that was minimum required requirements to implement it. At the end mobile application “ Tagreat” was fully designed and implemented and the testing process was done by the supervisor of the project. End user testing could not be done due to time constraints.

## Deployment

To deploy “Tageerat” mobile application, the minimum requirements are: Software: Xcode (most recent update), Network, memory Space, permission from IOS developer team. For Hardware: IOS Laptop and Apple phone. For the database: new account (Google) when the number of user increase.

## Conclusion

This work has been done with the intention of doing something for the society. There are so many rural women who are doing small businesses from their homes but because of the cultural limitations from the society, they do not succeed. This application will help them to expand their horizons without creating any social problems for themselves.

### Acknowledgements

We would like to thank the Department of Computing, Middle East College for giving us this opportunity to showcase our work to the society through this research paper.

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## Study of Factors Influencing Green Logistics Leading towards Sustainable Development in Oman

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### Abstract

Logistics is not a new area, but it is definitely one of those which is constantly evolving. Logistics can be defined as the cost effective and efficient management of the process flow from raw materials to finished goods. This also entails the related information from the point of origin to the destination of consumption which is the customer. The technological developments have mainly driven the evolution which has led to improvement in efficiency, reliability of freight and passenger transport systems and cost effectiveness. While considering all this, it is important to note that the negative environmental impact of achieving the logistics is also deeply spread. While the applications of logistics are generally positive for the efficiency of transport systems, it is now equally important that logistics should also be environment friendly, conserve natural resources and maintain ecological balance. This is what is meant by 'green logistics'. This study investigates green logistics status in Oman in the purview of sustainable development and also the factors that influence its progress. It is seen that in the context of business development as reported by the World Bank, Oman's ranking is improving to position itself as an investment-friendly location. Enhanced standings and ratings of diverse variables are seen to draw more foreign businesses into the country, and if this trend holds, logistics sector development may be higher than expected. The future key development trend will be improved by enhancing customs processes and the supplementary facilities of transportation, as per the report [27] "Oman Logistics and Warehousing Outlook 2022". This paper analyzes the awareness of companies in Oman in terms of green logistics and also looks at the factors that drive the need for it. This research is a qualitative investigation. Primary research through interviews with professionals from logistics companies across Oman and a waste management organization were conducted. The data are supplemented by detailed literature review of studies done globally. The findings of the study implied the awareness of green logistics in organizations is evident. Though there are effective steps taken in that direction from the government, a stronger in-depth implementation strategy involving the different stakeholders in the commercial sector is required to interlink economic, environmental and social goals to achieve sustainability.

**Keywords:** Green logistics, environment, sustainability, development, technology.

### الملخص

ان دراسة الادارة اللوجستية ليست بالحق الجديد من حقوق المعرفة، ولكنها بالتأكيد أحد الحقول التي تتطور باستمرار. ويعززها المجلس الأمريكي لإدارة اللوجستيات بأنها: "عملية التخطيط والتنفيذ والإشراف على انسانية فعالة ومناسبة الكلفة وتخزين المواد الخام، والجودة في المعالجة، والسلع التي أنهيت معالجتها، والمعلومات ذات الصلة من نقطة المنشأ حتى نقطة الاستهلاك لتلبية احتياجات المستهلكين". لقد دفعت التطورات التقنية بصورة رئيسية التنمية التي أدى إلى تحسين في الكفاءة، وموثوقية أنظمة الشحن ونقل المسافرين والفعالية من ناحية الكلفة. وفي ظل النظر في كل هذه الفوائد، فإنه من المهم أيضًا، من ناحية أخرى، القول بأنه ثمة زيادة أيضًا في التأثير البيني السلبي لتحقيق هدف الادارة اللوجستية. ونظرًا لأن تطبيقات الادارة اللوجستية إيجابية عمومًا لفعالية أنظمة النقل، فهناك اقتراح بأن الادارة اللوجستية يجب أن تكون صديقة للبيئة، وهذا هو المقصود "باللوجستيات الصديقة للبيئة". وتهدف هذه الدراسة إلى البحث في اللوجستيات الصديقة للبيئة في سلطنة عمان في ضوء التنمية المستدامة في السلطنة وكذلك عوامل النجاح المحورية. وفي سياق تطوير المشاريع وفق تقارير البنك الدولي، فإن ترتيب السلطنة يشهد تحسيناً لتحتل لنفسها مكانة كموقع صديق للاستثمار. وتجذب المراتب والتصنيفات المحسنة الخاصة بمحظوظات متعددة المزايا، فربما يصبح الشركات الأجنبية إلى السلطنة، وإذا بقي هذا الاتجاه سائداً، فربما يصبح تطوير قطاع اللوجستيات أكبر مما هو متوقع. وفي المستقبل، ستحسن اتجاه التنمية الأساسي من خلال تعزيز عمليات الجمارك ومرافق النقل المساعدة، وفق التقرير الموسوم بـ "رؤية عمان في اللوجستيات والمخازن 2022". وسوف تحمل هذه الدراسة وعي الشركات في سلطنة عمان فيما يخص اللوجستيات الصديقة للبيئة كما ستركت أيضًا على القطاعات التي تتزيد الحاجة إلى قطاع اللوجستيات. وسيجري بحث في المصادر الرئيسية من خلال إجراء مقابلات مع بعض شركات الادارة اللوجستية في أرجاء عمان مدعومة بقراءة تفصيلية في الدراسات السابقة التي تناولت هذا الجانب الذي أجريت عالمياً.

### 1 Introduction

The concept of logistics is spreading rapidly in the Middle East. This critical concept is inside every activity in each business. Logistics is a process of organizing business activities to make sure the resources, material, place, and time are correct. Technology advancement has supported the improvement in efficiency levels of this domain. At the same time, the need to know how to implement this process without creating any adverse effects or damage to the environment is important in the current times. In the last decade, the undesirable impact or sufferings of the logistics process have increased. The circulation of merchandise stirs up the air to create clamour, vibration and pollution. It causes mishaps, and makes an impact on global warming and climate change. The logistics effect on environmental change has invoked strong consideration lately worldwide. Pulling some reins on contamination have lightened to a certain extent the other ecological issues. Besides new logical research has

uncovered that a worldwide temperature alteration exhibits a lot more prominent and quicker risk than suspected. These expanding concerns have set in motion environmental directions, which associations are expected to attempt as socially dependable business practices. To address logistics activities centered on natural mindfulness, there has been a research focused on green logistics administration, which seeks to capture commitment when undertaking environment activities [1]. Making logistics sustainable in the more drawn out term should include more than just reducing the carbon footprints.

Manageability doesn't just have an environmental measurement. Supportable improvement was initially depicted as the co-linking of natural, financial, and social targets [2] in the Brundtland Commission. Green logistics management is to intensify the organization's environmental commitment and performance by providing support from the government, stakeholders, and business people [3] [4]. Green logistics hopes to convert all the logistics activities (material, transportation, warehousing, inventory, packaging, etc.) to be environment-friendly and sustainable. While the primary focal point of this study is on factors that diminish the environmental impact of logistics, some reference is additionally made to their monetary and social ramifications. This research primarily focuses on the onset of green logistics in the Sultanate of Oman considering the fact that the country wishes to consolidate its position as a logistics hub in the near future. Green logistics works on the dimensions of reduced cost and time with minimum impact on the surroundings. This study focuses on the factors that drive sustainable development and the pressing need to implement green logistics in Oman. The paper has the following sections excluding (1) Introduction; (2) Research method, (3) Reviewed literature, (4) Findings and discussion, (5) Conclusions and (6) Acknowledgements

### 1.1 Logistics and Sustainability

Logistics is the term broadly used to depict the transport, capacity and taking care of items as they move from raw material source, through the generation framework to their last point of deal or utilization. Although its central activities have been crucial to financial advancement and social well-being for centuries, Piecyk and Bjorklund felt that it is in the past five decades that logistics has come to be respected as a crucial determinant of trade execution and a significant field of scholastic ponder. Amid this period, the overwhelming worldview for those overseeing and examining logistics has been primarily commercial [5].

Challenges to environmental conservation due to impact of inventory, supply and logistics systems and management have been gaining a considerable attention in previous studies in the past few years. These challenges have been focused upon in various academic and industry-focused publications and conferences. To prove their point, Carter and Easton [6] concluded that sustainability in supply chains is gaining roots in the literature and will be an essential area of focus in future research.

In implementing sustainability in supply chains, Abbasi and Nilsson [7] identified five main challenges, namely price, complexity, operationalization, culture and mindsets, and uncertainties. The authors concluded by highlighting the need for a holistic approach that helps to establish policies and strategies for supply chains and to incorporate sustainability. McKinnon [8] held in his study that green logistics aims to move and convey crude materials and items at the most reduced conceivable costs whereas keeping up the most noteworthy guidelines and limiting natural effect within the handle. The study suggests development in all stages of the supply chain, right from the conception of the item to the ultimate utility of things.

A number of previous studies have focused on the broader area of Sustainable Supply Chain Management (SSCM). As one of the first such researches in this area, [9] reviewed the literature and came up with a framework for integrating sustainability into supply chains. They found that tending to more than one measurement of supportability (natural, social, and financial) yields way better outcomes, noticing mainly that the economic estimation with associated with either of the remaining two (environment and social) is superior than tending to it alone. They stated that managing all three ranges of the triple-bottom-line is the most excellent arrangement.

In literature, several researches have studied Green Supply Chain Management or GSCM in contention with different aspects namely: product design [10], process design [11], [3] [4], manufacturing practices [11], purchasing [12] [10]. This concept is strictly related to SCM and its definitions, to which must be added more considerable attention to environmental issues. In academic literature, scholars have provided different meanings. In particular, a GSCM strategy needs to ensure that companies adopt purchasing practices that are environmentally friendly which also includes considering procurement of reusable and recyclable material that may harm the environment less [13] [33].

Rodrigue et al. [14] observed that despite the fact that the most compelling objective of sustainability is to develop and implement the appropriate strategies for changing the three columns, there are, in any case, generic variables limiting the achievement of sustainability such as cost, lack of awareness, coordination and communication. Once these obstructions, which have an impact on the environment, are resolved, the production of economic and social quality as shown in Table 1 illustrating the benefits can be accomplished [14].

Economic	Social
Improved customer satisfaction Good relations with stakeholders Green image Higher delivery reliability through optimized route planning and less truck downtime	Reduced environmental impact (e.g. CO2-emissions, noise levels) Better utilization of natural resources (e.g. fuel, packaging)
Higher productivity through higher motivation of the employees Reduced liability risk Reduced taxes	Development in harmony with culture and available resources Reduced social cost (e.g. health problems in the communities)
Improved financial performance	Access to clean water and clean energy Creation of jobs

**Table 1:** Economic and Social benefits

The study done by them adds value to and contributes to the enhancement of previous literature on the definition of green logistics by characterizing the previous research to examine all the elements of green logistics that contribute to the country's economic development, focused on building a stable and robust monetary policy. It also shows the role of the government in supporting factors in the environmental and social sector that will result in lower costs and provide a significant advantage [14].

## 2. Research Methods

This study is a qualitative one and used qualitative data collection methods to understand the factors driving green logistics in Oman and its overall awareness. Qualitative data can't be measured, it can be observed (Observing and interviewing a participant) are the ways of collecting qualitative data. After the data are collected they are analyzed as descriptions. This implies qualitative analysts study things in their normal settings. Qualitative research is an empirical research where the data are not in the form of numbers [15]. The secondary data for this research were mainly obtained from the study of previous studies and past literature. One of the limitation of this study was the lack of adequate studies available on green logistics specific to Oman. Additionally, primary data were collected through interviews of experts from logistics organizations and also from a waste management organization in Oman. The logistics companies carry out different activities for their customers, which includes procurement, warehousing, transportation, inventory management, order processing, and packaging. The interview questions were developed after reviewing the past literature and prolonged discussion. The companies were contacted by phone and email to get approval for conducting the interviews and collecting data to support this research. As Oman is growing in the logistics sector, the government has in place several policies to reinforce the logistics industry. Simultaneously as a country, Oman is focusing on bringing in strong policies and strategies towards environment conservation [16]. Green practice selection alludes to the choice of a logistics organization

to utilize green practices to react to fundamental issues. Green logistics centers on sifting emanation, lessening vitality and regular assets utilization, diminishing waste, and reducing materials abuse. The green practices usually utilized in the logistics business incorporate solidifying shipments, discarding waste capably, buying essential items, decreasing vitality utilization, lessening stable/water waste and emanations, using cleaner transportation techniques, and utilizing recyclable bundling/holders [17] [18] [19]. A logistics organization may embrace a few green practices for reacting to an assortment of natural issues simultaneously.

Among the logistics components, transportation and warehousing are two significant capacities given by most logistics organizations. The most natural effect of logistics tasks emerges from these two capacities [17]. These two logistics functions expend a measure of energy while circulating and putting away items in the physical stream. Murphy and Poist [19] likewise found that in the US, Canada, and West Europe logistics professionals have viewed vitality protection as a significant ecological issue in the logistics business. Along these lines, this research concentrated on the reception of green practices in the organizations in Oman and the role of the senior management in driving green strategies and reducing carbon footprint. Future research can investigate the response of other green practices, for example, stable/water waste and outflows decrease, and cleaner transportation strategies.

## 3. Reviewed literature

### 3.1 What is Green logistics?

Green logistics describes all efforts to quantify and minimize the environmental impact of the classification activities. This includes all the up-and-coming functions of products, databases, and services between startups and deployment points. The goal is to create a sustainable business value using the balance of economic and environmental efficiency [20]. In her blog, Carla Araujo [21] states that green logistics began in the mid-1980s. It was an idea that reflected the systems of materials and methods using advanced technology and equipment to reduce environmental damage during operations. Additionally, there are a plethora of solutions that companies can apply to become greener, from simple to very advanced, progressive actions, from easy to cut edge, dynamic activities. The fundamental issues on the planet are just deteriorating. Establishments need to attempt to be eco-cognizant while playing out their activities and at the same time, reducing the cost conceivably. There are as yet numerous things an organization can do to limit their ecological impression. Logistics includes transportation and resource-intensive processes such as procurement, inventory management, warehousing, order fulfilment and distribution. By going 'green' it also includes processes such as reverse logistics and disposal logistics that concern reuse, recycling and waste disposal [20]. According to

Hans (2011) as cited by Seroka-Stolka in [22], green logistics is described as the efforts and controls put in place to reduce the negative influence of logistical operations to the ecological balance and achieving a more sustainable equilibrium in the relationship between the economic, environmental and social objectives.

### 3.2 Green logistics scenario in the world

Logistics as a domain is crucial to the global economy, and therefore the industry can play a crucial part in the way business is done concerning the environmental impact. The aim is to achieve zero emissions by 2050. Solutions to address these developments are suggested and used in the full range of price systems, from reducing the consumption of raw materials and reducing environmental pollution to reducing residues at the end of a product and integrating them into new processes to create importance. Logistic activities include such processes because logistics management has a cross-functional and cross-organizational nature [23]. This change of greening the supply chain by designing a green logistics network, comply with government regulations and meet customer expectations and social responsibilities [34]. The deployment plan should help make the following decisions: Create optimal paths to minimize total transportation costs, energy savings and consequently, minimize greenhouse gas emissions. Best shipping route for each vehicle is generated at the tactical level (path planning) and optimal delivery speed at the operational level (schedule plan) [23]. Worldwide corporations are under stress to apply green methods in their value-added processes. This force stems from increased consumer knowledge of the ecosystem and rising raw material and energy prices, environmental laws and the impact of influential stakeholders [18] in the value chain in many nations. Today's leading companies, large and small, are looking for ways to go green. One such example is DHL (Dalsey Hillblom Lynn) International that applies green logistics. DHL is a pioneer of green logistics. They claim that their green strategies aim at providing supply chain solutions which help in reducing logistics related emissions, waste and optimizing the environmental footprint to meet sustainability targets [24]. They understand that if the planet is to remain habitable for generations to come, then organizations and government must work together to identify and reduce emissions, make businesses more sustainable and ultimately move toward a Circular Economy.

### 3.3 Green logistics scenario in Oman

The geographical and strategic location of the Sultanate of Oman provides the high potential to develop the logistics sector and make the Sultanate of Oman a global centre. It has many seaports that contribute to the growing development of logistics and make it a central point of logistics activities. In the Logistics briefings by Ithraa [25], the

country is targeted to employ 80,000 people and 10 million TEU<sup>1</sup> by 2020 and its logistics industry is expected to grow at a CAGR<sup>2</sup> of 7% between 2015 and 2020. The independent variables of green logistics include the three components of the financial economy, society and the environment, and the application of these components is an essential signal in determining the economy of the country, and how they affect the expansionary monetary policy indicators (wide, narrow and reserve funds) as summarised in [26]. In the context of the business as reported by the World Bank, Oman's ranking is improving to position itself as an investment-friendly location. Enhanced standings and ratings of diverse variables draw more foreign businesses into the country, and if the trend holds, logistics sector development may be higher than expected. In the future, the critical development trend will be enhanced by enhancing customs processes and the additional facilities of transportation, as per Ken Research's report [27] titled "Oman Logistics and Warehousing Outlook 2022–Freight Forwarding, Express Delivery, Lagging Services, Cold Storage, Third Party Logistics and Value-Added Services", Oman will focus on improving its logistics facilities in particular at seaports, building regional and global logistics service centers, improving network efficiency among Oman and other nations and then becoming a new logistics centre in the coming years [27].

Notwithstanding the above Oman also aims at "an environment with sustainable components, a safe and well preserved environment with effective and balanced ecosystems and renewable resources" as per Oman Vision 2040 [16]: page 9. The vision emphasizes that the country's reliance on natural resources should be minimized to rely more on knowledge and innovation based on regional and global dynamics.

### 3.4 Factors affecting Green Logistics

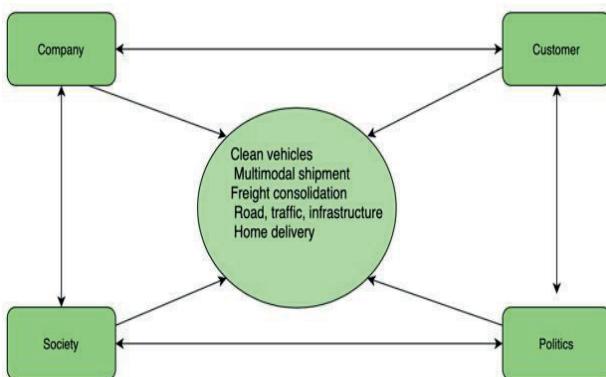
Studies summarized by Seroka-Stolka [22] in a study have shown that technological, organizational, and natural variables have positive impacts on the deliberate measures to promote green activities. Unequivocally growth of green innovation, corporate support, quality of human assets, inherent stability, and robust administrative backbone all show critical impacts on the eagerness to embrace green practices. This research [22] also cited another proposition by Diabat & Govindan (2011) in which a using interpretive structural modeling 11 types of driving factors and the associations between them show that government legislative framework and reverse logistics are major forces that will enforce a cooperation between the suppliers and production specialists to minimize environmental damage. The research results show that the government regulations and legislation and reverse logistics are significant driving forces to achieve cooperation between product designers and suppliers to reduce and eliminate the environmental impact of products.

<sup>1</sup> TEU- Twenty Foot Equivalent Unit

<sup>2</sup> CAGR- Compound Annual Growth Rate

Higher embrace of green practices can offer assistance to the exchange of mechanical information inside the company and, thus, raise the benefit to logistics providers' purposeful strategies to embrace green developments. More aggregation of environmental-related information using technology systems can make logistics companies have more related information to adopt green practices [28]. In addition, a study by Urszula Motowidlak [29] states that indices of partial actions for technological factor indicate that it will present the largest, i.e., 40% commitment to achieving of economic goals. It was considered that technology as a relevant factor would contribute to 30% to the achievement of environmental goals. Besides, it was assumed that 20% of the value of this factor would translate directly into the achievement of social goals and 10% to the achievement of spatial order.

According to Schmied [30], four factors affect green logistics: Company, customers, politics, and society (see Figure 1). Customers that need goods supplied with sustainable vehicles or reduce pollution, force suppliers to go towards green solutions, even though they wouldn't usually. Customers can go to superstores that are located in areas with a convenient road system and avoid designing in such a way that it can cause extra harm to surroundings. Maybe the most significant customer impact, maybe home delivery, as they are the direct users of this service. The society also has the power to influence all of these approaches. As consumers who expect and encourage green consumer purchases, it helps companies to go green. Politics is the most crucial element. Using force to publish laws, give incentives, control infrastructure, every solution is in close contact with politics. Whether businesses are interested in using green logistics or sticking with old technologies and solutions would depend on their actions.



**Figure1: Factors affecting green Logistics (Schmied, 2010)**

Politics, society, businesses, customers are closely linked. Customers and communities choose politics; companies have to obey politics laws and customer needs. A separate

analysis must be done to create a more accurate view of the interrelation [30].

Chan (2008) as cited in [22] suggested six kinds of obstacles from the data analyzed across 83 hotel businesses. Utilizing an exploratory investigation, he found that the six types of hindrances are contrarily identified with natural conservation: absence of ability and skills, absence of expert counsel, vulnerability of result, interest of certifiers/verifiers, absence of assets and execution and upkeep costs. Albeit hierarchical and ecological elements have been considered in a few investigations on green issues, these elements have been viewed as uncommon in the inquiry of natural administration in the logistics business. According to Lin and Ho in a study [28] done on 353 Chinese business organizations in the logistics domain, they proposed ten determinants as factors which are required for the appropriation of green practices in logistics organizations (see Figure 2).



**Figure 2: Factors affecting Green Practices (Lin & Ho, 2010)**

The study findings by [28] uncover that pressure is more because of legal guidelines of the State, legislative aid, hierarchical support and the nature of human resources. These factors affect the appropriation of green practices for Chinese logistics organizations [36]. Natural vulnerability and the unpredictability of green practice show fundamentally adverse effects on ecological practices [35]. Shockingly, the impact of client pressure isn't noteworthy for Chinese logistics organizations [28]. It is intriguing because a large portion of the investigations from the EU related to ecological issues [22] shows the impact of client pressure and their natural mindfulness on natural practices; however, these discoveries are centered more on assembling firms.

#### 4. Findings and Discussion

The review of the literature revealed some fascinating views. Three major factors i.e. economic, social and environmental and the balance of these three not as standalone factors but interlinked is what can influence the success for sustainable development leading to a circular economy. Management of any two of these factors will only result in equitable, bearable or viable development.

Alshubri in his study [26] opined that obstacles like inflation in production and distribution costs, lack of knowledge in terms of environmental shortfalls need to be addressed in his study on green logistics-based activities on monetary expansion in Oman. First of all, senior management must consider that associating ecological issues as part of organizational strategies relies upon different elements which can keep changing across time. In accordance to the positive relation between the green practices and economic growth, the government of Oman is working on the ecological systems that are effective, balanced and flexible to protect the environment and sustain its natural resources in support of the national economy as per the vision 2040 [16]. The aim is to assure the harmony between the environmental strategies and the monetary and social improvements measurements. This can be achieved by defending the utilization of regular assets to affirm their maintainability to help the economy. The government is intent on strategies that embrace a green economy approach using appropriate technology support and advanced procedures. Conserving natural resources while giving importance to social welfare like food and water security, education and health and a steady economic growth during the advancement procedure is considered as the direction forward. The utilization of present-day methods in the water and horticulture segments to accomplish water and nourishment security, and to tap renewable energy sources to advance the supportability of nature and helps replenish their assets. This aids social welfare and lightens the pressure on financial administration. As per the findings of the interview with professionals from Be'ah company which is a government organization. This organization puts resources into driving change in industries in the perspective of waste management and environmental conservation. They accept that by boosting the viable usage of assets and limiting the damaging ecological effects, they build a strong establishment for both financial and natural maintainability for the country in the long term. In an effort to adapt to major environmental issues that have advanced throughout the years, the Omani government authorized in 2006 to set up a National Strategy "to advance appropriate waste administration, effective utilization of assets, improvement of satisfactory foundation and execution of practical objectives to have an enduring effect on the nation's future" [31]. This organization is focusing on converting the waste to energy then into water project. This waste to energy to water plant will thermally get the waste to produce steam which will turn a steam turbine to create power [32]. The generated electricity will be utilized to power a desalination plant. This will help lessen Oman's reliance on gas for water generation. The spared gas can be sent out and will be extra income for the Sultanate. Oman as part of the Paris Agreement has consented to reduce the carbon outflow from the nation by 2030. This saving on energy will contribute greatly to Oman's dedication to sustainability

and is the first of its sort idea. The plant will expand the nation's green agenda.

Another of their project which is their Mechanical Biological Treatment (MBT) project is a waste treatment process that includes both mechanical and natural treatment with the point of reducing the ecological effect of landfilling waste. It settles and isolates waste, which isn't appropriate for reusing, removes recyclable material and produces a Refuse Driven Fuel which is utilized for mechanical applications. In addition, one of their projects is the Biogas Project. This project targets creating biogas, a sustainable power source generated from crude materials and refuse, for example, farming waste, municipal waste, plant material, sewage, green or food refuse. It is utilized as a fuel for heating anything, for example, cooking. It can likewise be used in a gas motor as alternative source of energy to generate power and heat [32].

Be'ah takes it as a social responsibility to also educate and encourage school and college students in the field of green practices. They believe that a strong social awareness can pave the way for a better future. So it can be stated that with the projects mentioned the government of Oman is aiming for growth in national economy without compromising on the environmental front.

Analyzing the interview responses of professionals from logistics organizations in Oman, it was evident that green logistics had not gained much ground in the country and was unheard of in the commercial sectors. It was more or less in the preliminary stages where organizations were interested in environmental conservation and were serious in their commitment to the cause. They were aware about the strategic direction the country has embarked in with respect to minimizing the expenditure of non-renewable resources and in improving the economic status through innovative and emerging global dynamics. They realized that changes were needed at all levels with increased awareness of financial-economic, social and environmental measures and controls to be put in place. They are eager to go green and would like to join hands with the government to come up with green solutions in the logistics area. The professionals agreed that this is still a relatively new side of logistics in Oman which needs to be explored and further developed. But with a collaborative effort with the government and other stakeholders, logistics organizations should be able to focus on both the financial profitability and environment conservation.

## 5. Conclusion

This research is a preliminary one about the development of green practices for logistics organizations in Oman which are economically and socially viable leading towards sustainability. The strategic vision 2040 of Oman focuses on developing a green and circular economy that is responsive to national needs and consistent with international trend in the direction of adapting and minimizing the negative impact of climate change. The research results also lead to some focus for entities like the

regulatory bodies, the logistics organizations, suppliers and even for the employees to propel green practices in the logistics industry. There should be an interlinked role to be played by stakeholders in also creating awareness in the society. The government is aiming at strategies which will bring public and private sector organizations together to oversee the drive for achieving circular and sustainable economy in a harmonious manner. This will entail a “balanced and sustainable partnership with integrated roles between stakeholders from the government, private sector, civil society and individuals to ensure effective institutional performance. Rewards and other motivation factors may play a very important role at the people and community level. Initiatives like creating awareness right from school education to professional level will prevent any negative reaction and create the acceptance of the concept. Pressure through legislative enactment will not serve as the primary method for cultivating the natural conduct of a firm. Instead, different methods, for example, expanding the ecological attention as part of corporate social and environmental responsibility, working collaboratively and develop policies which will bring in effective responsible implementation could help in achieve the long-haul objectives of green logistics.

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## Smart Civil Defense System

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### Abstract

Providing first-aid on time can help in saving many lives. In 2015, specifically on the street between Ibri and Al-Rustaq, the weather was rainy, and suddenly one of the vehicle rolled overs from the street. The passenger's injury was not so serious and his life could be saved if he had received proper first-aid on time. But because the accident happened in a rural area far from the city centre, it delayed him to reach at proper place for the treatment. Because of the delay, the passenger died on his way to the hospital. In such a situation, volunteer paramedics can be a helpful support for the emergency centres involved in the response to such accidents reports. In this project, a mobile android application has been developed to help in such situations. Through this application, volunteer paramedic will be registered and their GPS coordinates will be included by one of the staff at the civil defense. The users of the application will be able to send notifications in case of any emergency situation for the civil defense and for the nearest volunteer paramedics at the same time. The notification that would be sent would includes a brief description about the emergency situation, contact information of the sender, and the GPS coordinates. The system will automatically detect the nearest volunteer paramedics and notify them about the emergency situation. This will be helpful in providing faster assistance at the emergency site by the volunteer paramedics. Hopefully the app will help in saving lives. The mobile application will also allow people, who are non-Arabic speaker, or having speaking/hearing challenges, to report an emergency case as the existing calling system at the civil defense doesn't support these categories. The system and the android application will be used by the civil defense in the sultanate of Oman, volunteer paramedics, residents and citizens.

**Keywords:** Paramedic, Emergency, Application, Civil defense, GPS Coordinates.

### 1. Introduction

According to the United Nations Population Fund, more than half of the world's population lives in urbanized areas, approximately around 3.3 billion people. Further, by 2030, roughly 66% or 5 billion people will live in urban areas [1]. However, this is not about managing that huge number of humans but it is about rising the challenge and turning the technologies to another level.

**الملخص**  
 نظام الدفاع المدني الذكي يمكن أن يساعد تقديم الإسعافات الأولية في الوقت المناسب في إنقاذ العديد من الأرواح. في عام 2015، وتحديداً في الشارع بين عبri والرستاق، كان الجو ممطرًا، وفجأة انحرفت إحدى السيارات عن الشارع لم تكن إصابة الراكب خطيرة للغاية ويمكن إنقاذ حياته إذا تلقى الإسعافات الأولية المناسبة في الوقت المناسب. ولكن لأن الحادث وقع في منطقة ريفية بعيدة عن وسط المدينة، فقد أخره الوصول إلى المكان المناسب للعلاج. وسبباًتأخير، توفي الراكب وهو في طريقه إلى المستشفى. في مثل هذه الحالة، يمكن أن يكون المسعفون المتقطعون دعماً مفيداً لمرافق الطوارئ المشاركة في الاستجابة لمثل هذه الحوادث. في هذا المشروع، تم تطوير تطبيق Android للجوال للمساعدة في مثل هذه المواقف. من خلال هذا التطبيق، سيتم تسجيل المسعفين المتقطعين وسيتم تضمينها حادثيات GPS الخاصة بهم من قبل أحد الموظفين في الدفاع المدني. سيتمكن مستخدمو التطبيق من إرسال إشارات في حالة حدوث أي حالة طوارئ للدفاع المدني وأقرب مسعفين متقطعين في نفس الوقت. وسيتضمن الإخطار الذي سيتم إرساله وصفاً موجزاً عن حالة الطوارئ ومعلومات الاتصال الخاصة بالمرسل واحداثيات GPS. سيقوم النظام تلقائياً باكتشاف أقرب المساعدين الطبيين المتقطعين وإبلاغهم بحالة الطوارئ. سيكون هذا مفيداً في تقديم مساعدة أسرع في موقع الطوارئ من قبل المسعفين المتقطعين. نأمل أن يساعد التطبيق في إنقاذ الأرواح. سيسمح تطبيق الهاتف المحمول أيضاً للأشخاص غير الناطقين باللغة العربية أو الذين يواجهون صعوبات في التحدث / السمع بالإبلاغ عن حالة طارئة لأن نظام الاتصال الحالي في الدفاع المدني لا يدعم هذه الفئات. سيتم استخدام النظام وتطبيق الروبوت من قبل الدفاع المدني في سلطنة عمان والمسعفين والمقيمين والمواطنين

Innovating and creating smart devices with artificial intelligence is a necessary requirement that must be done in an accelerated manner to improve smart city transportation, health care, education, and housing as well. Nothing is more important than saving lives, so the most essential organization in any city is the Civil Defense and Ambulance center. Civil Defense and Ambulance center is playing a pivotal role in keeping citizens safe and protecting their lives by responding for any emergency situations as fast as they can. As Majed Al Hashmi [2] held that in some situations they are incapable of reaching

distant places using Civil Defense vehicles so they call the central civil defense center in Muscat to send helicopter, and normally it takes around forty-five minutes to reach the site. Finally, the Civil Defense and Ambulance team are working hard in order to serve people without thinking of their lives or any dangerous situations that might affect them negatively [3].

Save our self-Oman is a free application that will allow people to get the medical assistance faster than ambulance by involving the citizens & volunteer paramedics. Furthermore, the mobile application will allow anyone with an emergency situation to ask for help, and it sends notifications and the location to the nearest paramedics and to the civil defense and ambulance Centre, the paramedics will be capable of reaching for the place faster and provide the first aid that is needed reducing the chances of losing the life of injured person.

The remainder of the paper is organized as follows: Section (2) focuses on the purpose, scope and diagram for the SOS Oman application, Section (3) emphasizes on literature survey which will compare the existing system and new system which is SOS Oman application, section (4) will conclude the paper and section 5 and 6 will focus on acknowledgement and the references.

## 2. Literature Survey

There are different applications specializing in emergency around the world for example:

- ASAFTNY is an application works with both android and IOS mobile phone [7]. It was created by the Saudi Red Crescent [8]. It aims to reach ambulances efficiently for people and strengthen the relationship between the government and the people [7]. This application has many drawbacks. For example, users have a difficulty in registration and mostly face communication failures when they try to connect. In addition, ASAFTNY does not send any notification and it does not save location data. However, it requires entering a lot of information to send notification. Finally, it requires access permissions for unnecessary applications such as Gallery which reduce users' privacy.
- Emergency system in United Arab Emirates is similar to the system that is used in Oman but, Emergency system in UAE is more efficient in providing services fast. In UAE emergency system, there are emergency numbers for each situation [9]. This emergency system has disadvantage. For instance, there is no mobile application to serve people inside UAE. Civil defense in UAE has only website which contains all emergency numbers; so, people have to use the traditional way by calling specific number.

## 3. Theory

### 3.1 Purpose of SOS Oman application

The main purpose of the project is to save people lives that are under an emergency situation, this can be achieved by:

- Faster arrival of the volunteer paramedic in a shorter time than usual by sending messages to the nearest paramedics.
- Faster arrival of the ambulance by knowing the exact location.
- Providing description of the emergency and reporter details to the paramedic and civil defense.
- Supporting reporters who don't speak Arabic language and/or have hearing/speaking challenges.

### 3.2 Scope of SOS Oman application

Save our self-Oman is a mobile phone application that will cover all regions in Oman. Further, it will enable users sending emergency notification for the nearest volunteer paramedics and for the civil defense centre. Supporting non-Arabic speaker reporting emergency cases, supporting people with speaking/hearing challenge reporting emergency cases, provide exact GPS coordinates of the emergency site, and enable paramedic to respond to the reported emergency cases.

### 3.3 SOS Oman application Diagrams

#### 3.3.1 Flow Diagram

Flow diagram will give clear image of who the users of the application can be and how application would interact with them [4]. There are three users that interact with SOS Oman application. They are: admin, reporter and volunteer paramedic.

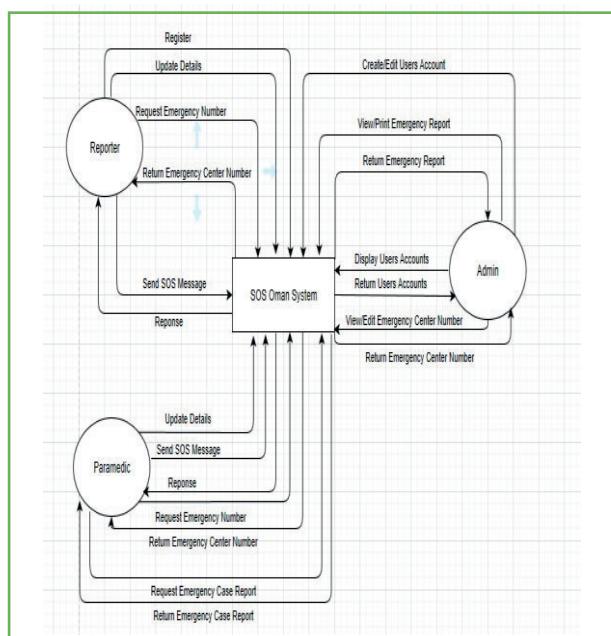


Figure 1. Flow Diagram

### 3.3.2 Class Diagram

Class diagram shows different entity and the relation between each entity [5]. In addition, each entity contains attribute and action or method of the entity [5]. Class diagram for SOS Oman application contain five entities which are reporter, civil defense server, paramedic, admin, emergency report, paramedic account and report account. There is aggregation between admin and emergency report, paramedic account and report account.

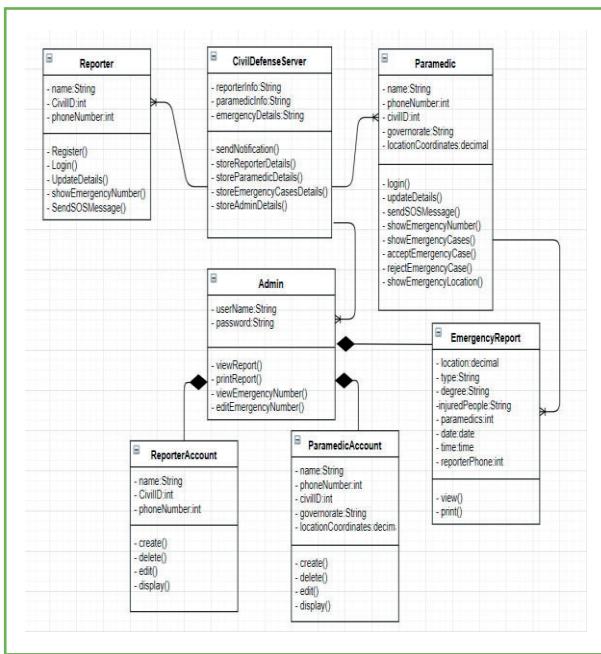


Figure 2. Class Diagram

### 3.3.3 Admin Use Case Diagram

Use Case Diagram shows each user and what action can be done with the system [6]. Admin can manage paramedic and reporter accounts.

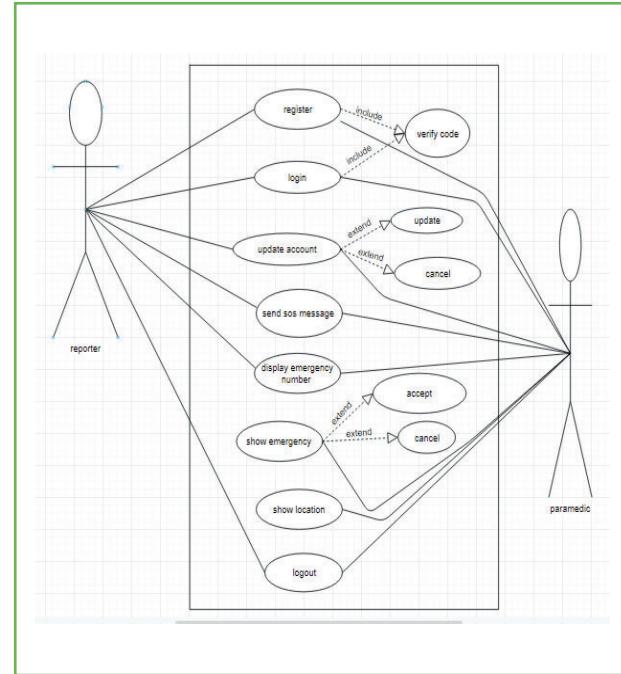


Figure 3. Admin Use Case Diagram

### 3.3.4 Paramedic & Reporter Use Case Diagram

Both paramedic and reporter can login to the application. In addition, if they have an emergency they can send SOS notification or call the emergency number. Finally, paramedic can show the emergency case and accept them to provide the help.

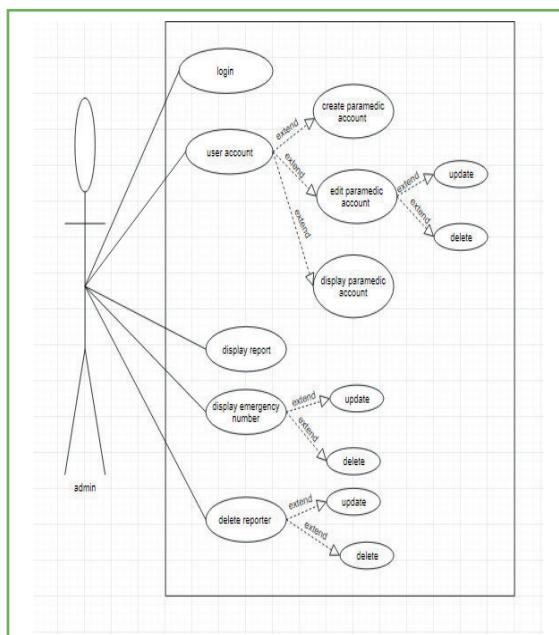


Figure 4. Paramedic and Reporter Use Case Diagram

### 3.3.5 The Logo

Logo is one of the first things that people notice about the application, and logos with good design can attract attention and create a memorable image for the users. Further, as shown in Figure 5, the main component of the SOS Oman logo is the paramedic wearing the traditional Omani uniform, indicating that volunteer paramedics contribute to providing assistance to those in need. Additionally, it indicates that Omanis could be helpful in responding to anyone in any emergency case.



Smart Civil Defense System

Figure 5. Logo of system

### 3.3.6 Limitation of current system

There is no software system in Oman that serves citizens in responding to emergencies. Except for the emergency numbers for each area and the headquarters in Muscat, and of course, most of the citizens know only the 9999 number, which is the emergency number centralized in Muscat. As AL Julanda said this might contribute to the delay in the arrival of assistance to the injured person because the emergency center in Muscat needs to contact the civil defense that is nearest to the emergency case site, this is time consuming. On the other hand, the civil defense relies entirely on the description of the caller to determine the location of the incident and sometimes the caller doesn't give an exact location, which delays the civil defense and ambulance in arriving. In addition, some cases require moving a helicopter for helping. The helicopters take more than two hours to get to the scene and there are limited number of helicopters in Oman specialized for emergencies. Finally, the civil defense does not have enough details of the incident, so they might not bring the

necessary tools for the incident that might save the injured life.

To identify the cons and limitations of the current system the following was made:

- Two interviews have been conducted with Sohar and Saham civil defense. For Saham civil defense we conducted interview on 6<sup>th</sup> /June/2019. Sohar civil defense was in Nov 26, 2019. All the people that we have interviewed in Sohar and Saham agreed that they don't officially support callers who doesn't speak Arabic language reporting an emergency case, they face some difficulties in reach the emergency location, most people call 9999 which is center in Muscat and don't know the emergency number in their cities which take long process and time.
- A questionnaire was distributed among students and staff in College of Applied Science-Sohar in order to gather their opinion of existing Civil Defense system and replacing it with a new mobile application. Further, the main aim of the questionnaire was to ensure that using SOS Oman application is useful and if the society accepts the idea of using it.

Table 1. Analysis of Questionnaire

Question	Yes	No
1.Do you know the emergency center number?	85%	15%
2.Do you think that you will face any difficulties in reporting an emergency case?	30%	70%
3.Do you think that using Arabic only is enough to deal with all emergency cases?	25%	75%
4.a Describing the emergency site depending on the caller's description will always give the exact location?	40%	60%
4.b Would using GPS coordinator is a better alternative?	70%	30%
5.Do you think that using a smartphone application that enables you to provide the exact GPS coordinates would be better than giving the description of the location to someone who might not be familiar with the area that you described?	90%	10%
6.Do you think that using a smart phone application will enable people with hearing/speaking challenges to report emergency cases?	90%	10%

7.Do you think that using a smart phone application will be beneficial to the society and might save more lives compared to the existing civil defense system?	90%	10%
8.Faster arrival of the volunteer paramedics to the emergency site will assist in saving more human life?	55%	45%

### Result of Questionnaire

The results of first question shows that 85% of the respondents knows the emergency center number in Oman. Moreover, 20% of them mention wrong emergency numbers such as 911, 998, and 999. However, the results indicate that 35% do not know the emergency center number or they know wrong number. However, the results of the second question indicate that 30% are facing some difficulties in reporting an emergency case. Further, the two main difficulties are describing the emergency site and the language. Additionally, some of the reporters might not be familiar with the emergency site so, they face problem when trying to describe it. Furthermore, 80% of respondents agree that using the GPS coordinates is the best alternative of depending on the reporter's description. However, the existing system support only Arabic officially and as we know that 42.53% of Oman population are residents and most do not speak Arabic (National Centre for Statistics and Information, 2019). Additionally, 75% of the respondents agree that using Arabic as official language for emergency response would not be enough for dealing with all kind of reporters calls. In addition, 90% of the respondents agree that using smart phone application for reporting emergency cases will enable people with speaking and hearing challenges reporting in case of an emergency. Finally, 55% of the respondents agree that involving nearest volunteer paramedics for faster aiding can be helpful in saving human life.

### 4. Conclusion

In conclusion, SOS Oman is a mobile android application and a system that aims to save humans lives in Oman by providing faster first-aid in any emergency situation. Further, SOS Oman enables the users sending notification in case of any emergency situation for the civil defense and for the nearest volunteer paramedics at the same time. The sent notification includes a brief description about the emergency situation, contact information of the sender and GPS coordinates of the emergency site. However, involving volunteer paramedics in emergency response is helpful in providing faster assistance at the emergency site, paramedics are capable of reaching the emergency site

faster than the civil defense especially in distance places. Finally, this application will be more effective in term of fast reaching to the emergency situation and saving lives. This system and android application will be used by the civil defense in the sultanate of Oman, volunteer paramedics, residents and citizens.

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