Smart Cities and GIS
Trends and Challenges in the Key Enabling Technologies

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Background

Interest in Smart Cities and Homes has increased:
in general due to:

- **Economic development in populous countries like China, India and Brazil which make up for 40% of the World Population.**
- **Increased use of ICT Information and Communication Technology devices and their technologies by people and organizations worldwide.**
- **Greater interest in environment protection and in reducing CO_2 emission; Green Economy**

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Background

in particular due to:

- **The Rise number of elderly citizens (over 65 years old, especially in Japan, Europe) and the need to make their life comfortable and healthy at affordable cost.**
- **The Rapid increase of the population of big cities**
- **The Enormous budgetary limitations on cities (Reduced budgets)**
- **The need to safeguard and optimize the operation of the Critical Infrastructures and Key Resources (CIKR) of cities (transportation systems, energy, banking and financial institutions, water resources, agriculture and food sector, hospitals and health centers, among others), all are affected and depend heavily on ICT.**

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Background & Definitions

Smart Government:

- **makes use of a Cloud-based data core to store and share information, and cooperates with various sectors to enhance resource utilization and optimize governmental efficiency.**

Smart life:

- **picks up a city's service point and citizen fulfillment; makes easy smart Applications and interactive systems for real-time communication, education and health care, to enhance the quality of life.**

Smart industry

- **industry that is environment friendly and energy efficient.**

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Introduction

- Over 50% of the World's population currently lives in cities, and
- In 2050, It is expected that 70% of our worldwide population will be living in cities (the worldwide urban population will rise by about 3 billion).

- such cities are accountable for 60-80% of the world's energy expenditure and CO_2 emission.

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Introduction

A smart city may be defined as the integration of various technologies into a planned approach :

- to sustainability,
- citizen comfort and
- economic improvement.

The principal test for smart-city notion will be to show that, state-of-the-art plans can be set up at a citywide scale.

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Enabling Technologies

For Cities Who Are Aspiring To Be Smarter:

- **Global Positioning Systems** (GPSs) **data positioning.**
- **Cloud Systems.** **Data storing.**
- **Geographical Information Systems** (GISs) **data management and presentation.**

GIS is for:

- Understanding
  - Real Time Data
  - Analytics and Visualization
- Integration & Collaboration for
- Informed Decision Making and
- Monitoring the Performance

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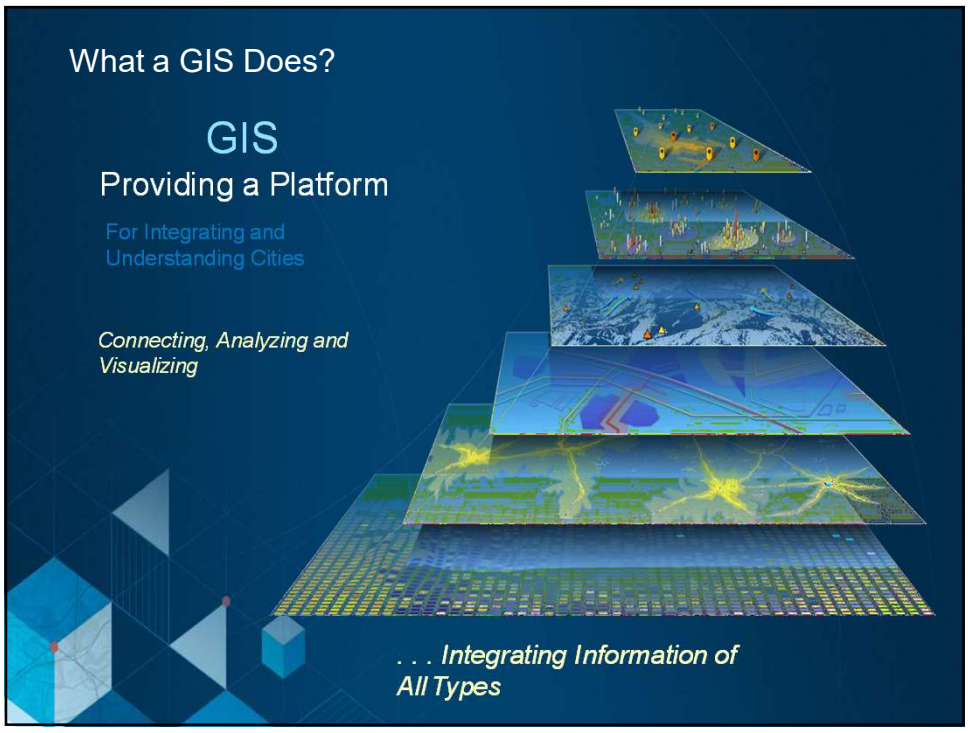

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What Is a GIS?
A System for Managing and Applying GeographicInformation
Management
Data Creation
Workflows
Planning
Common
Database
Operations
Real Time
Measurements
A Platform For A
Smart Cities

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GIS Is a Central Piece for a Smarter City, to have
e-services, Transportation, Land Management, Public Safety, Utilities ....
Transportation
Economic Development
Health
Community Development
Social Services
Utilities
Public Safety
Fire
Facilities
EMS
Infrastructure
Electronics
Land Management

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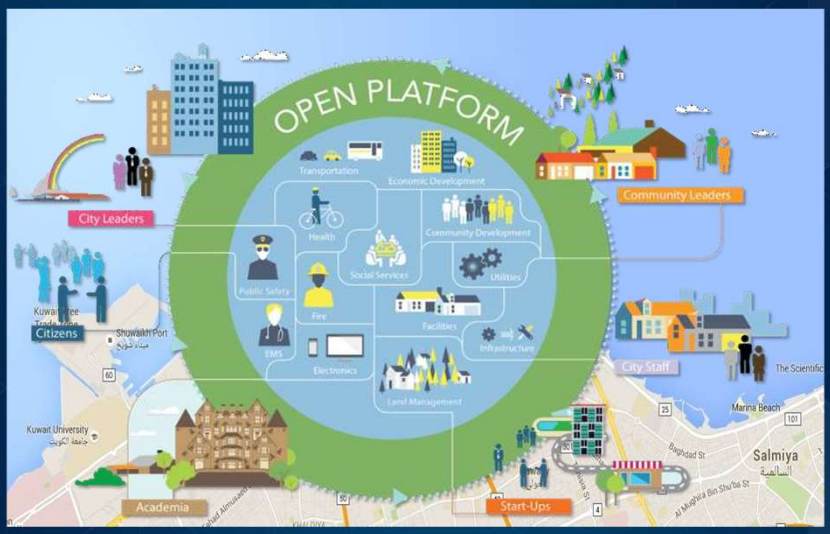
GIS Provides a Platform for a City sustainability

Economical, Social & Environmental Sustainability



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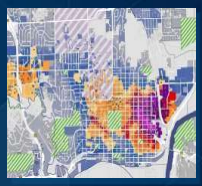
GIS Allows: Smart Urban and Regional Planning

Land Use Management

Neighborhood Planning

Walkability Assessment



Zoning

Urban Design

Urban Observatory

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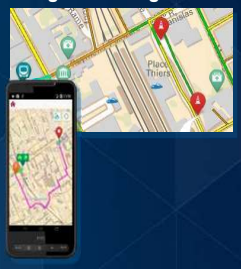
Intelligent Transportation (Navigation and tracking)

Modeling Traffic Flow

Congestion Analysis

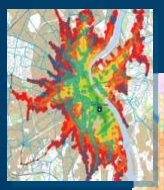
Road Closure Management

Intelligent Routing



Airport Obstruction Analysis

Transit Service



Optimizing Bus Routes

Mail Delivery Routing

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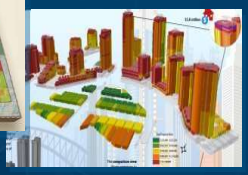
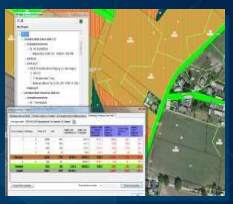
Efficient Land & Properties Management

Natural Resources Assessment

3D Assessment

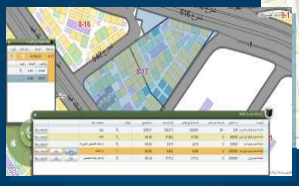


Land Consolidation



Property Viewer

Housing Management



Cadastral Management

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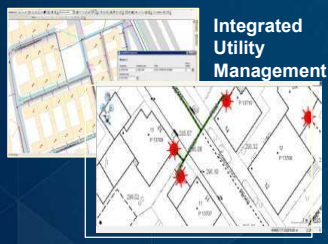
Connected Infrastructure

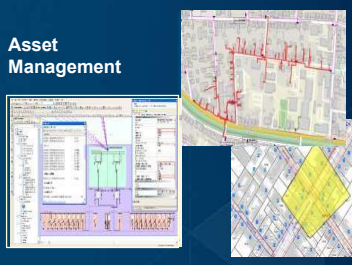
Network Management

Asset Management

Integrated Utility Management

Asset Management





Real-Time Network Monitoring

Wireless Network Assessment Outage Analysis

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Safe Cities

Incident Response

Fire Rescue

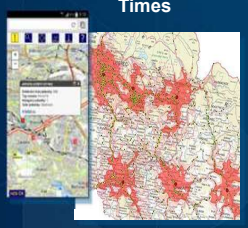
Fire Response Times

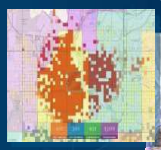
Crime Analysis

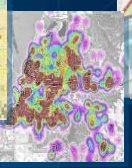
EMS

Police Calls

911 Response



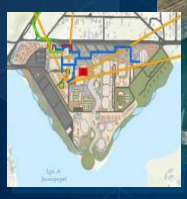




Cybersecurity

Common Operational Picture

Social Violence



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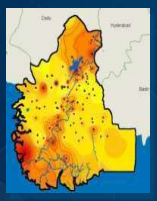
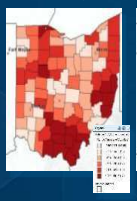
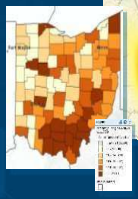
Healthy Cities and a lot more

Malaria Distribution



Heart Disease and Poverty



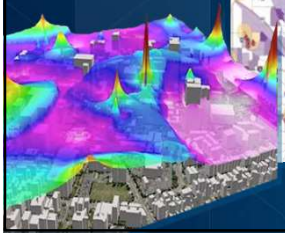


Cardiac Hot Spots

Mental Health Outcomes

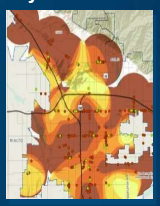
Public Health

Air Quality



High-Risk Chemical Locations

Healthy Food Access



Ebola Disease

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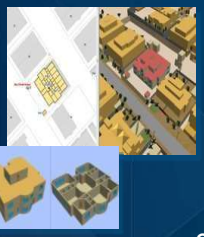
GIS allows all Advanced decision making processes: Ex. Building & Campus Management etc.

Building Evaluation



Evacuation Planning

Indoor Traffic Monitoring

Space Planning

Campus Energy Analysis

Real-Time Building Assessment

Space Utilization

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Enabling Technologies

- **The Internet (free internet)**
- **Wireless Networks and Systems** such as WiMax, Wi-Fi, Bluetooth, Zigbee, etc.
- **Smart Phones: 3G, 4G and 5G Cell** Systems
- **Body Area Sensor Networks.**
- **Smart Grids** and Renewable Energy
- **Optical Fiber** Systems and High Speed Networks
- **Internet of Things** (IoTs)
- **Wireless Sensor Networks** (WSNs)
- **Power Meters**

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Enabling Technologies

- **Radio Frequency ID (RFID)**
- **Sensor-enabled and Smart Objects**
- **Actuators and Sensors**
- **Wireless Navigation Systems**
- **World Wide Web** (WWW)
- **Social Networks**
- **Smart TV**

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Enabling Technologies

This will lead to :

- **Smart mobility:** Intelligent Transportation Systems (ITSs),
- **Network infrastructure:** to enable mobility, connection and communication of information and broadcast services and effects to the end users.
- **Data Management Systems:** There is a need to transform data into intelligence, This intelligence may be emitted through the Smart Applications and services.
- **Smart safety: Biometric Systems,**
- **E-Based Systems: e-Commerce, e-Government, e-Business and e- Service Systems.**

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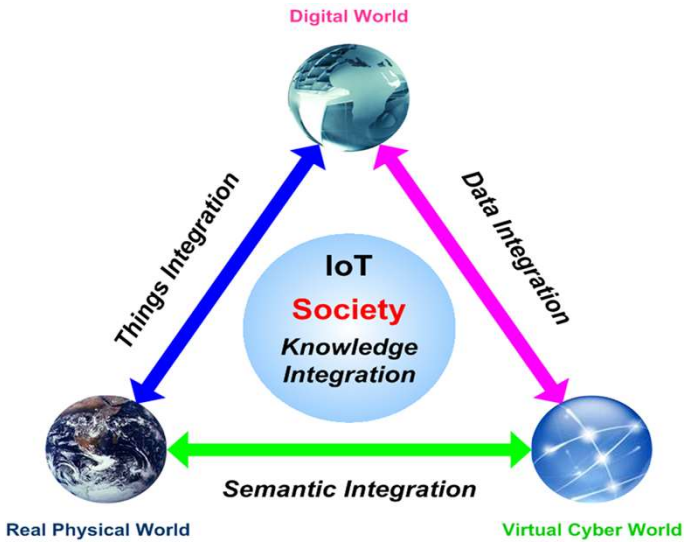
Introduction



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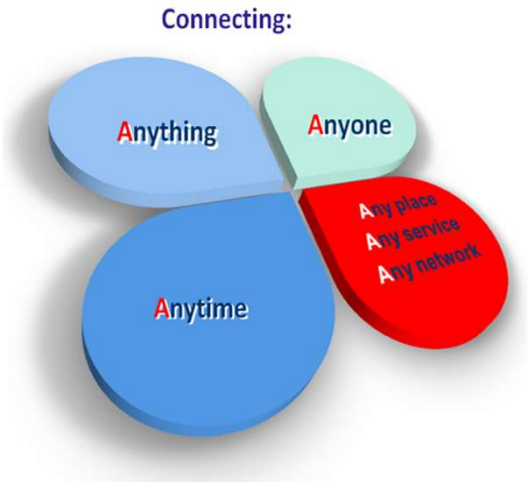
Introduction



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Characteristics

In 2007, Giffinger et al. ranked 70 European cities on six dimensions:

- **Smart economy (competitiveness)**
- **Smart people (human and social capital)**
- **Smart governance (participation)**
- **Smart mobility (transportation and ICT)**
- **Smart environment (natural resources)**
- **Smart living (quality of life).**

As a result, they defined a smart city as:

"a city well performing in a forward-looking way in these six characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens."

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Characteristics

- **In 2012, Cohen stated that smart cities could be understood and evaluated through a different set of six dimensions:**
- **Environment,**
- **Mobility,**
- **Government**
- **Economy**
- **Society**
- **Quality of life**

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Characteristics

- **In 2014 and 2015, respectively, the IESE Cities in Motion project in Spain launched a benchmarking effort focusing on smart cities, creating a more complex model because it included 11 dimensions:**
- **Human capital**
- **Social cohesion**
- **Economy, public**
- **Management**
- **Governance**
- **Mobility**
- **Transportation**
- **Environment**
- **Urban planning,**
- **International outreach**
- **Technology.**

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Characteristics

Nam and Pardo, identified three conceptual dimensions of Smart Cities:

1. **Technology (the key to transforming life and work in a city),**
2. **People (human capital and education), and**
3. **Community (or support of government and policy)**

Conclusion:

"A city is smart when investments in human/social capital and IT infrastructure, fuel sustainable growth and enhance a quality of life, through participatory governance."

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Smart Homes; Introduction

A Smart Home means:

- **A Home that 'Listens' to you**
- **A Home that 'Communicates' with you**
- **A Home that safeguards you and your investment**
- **A Home that 'modifies and fine-tune' to your daily life, health and needs.**

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Smart Home Implementation
Key Ingredients

- **Sensors: monitor and gauge activities in the surroundings.**
- **Interfaces: refers to communication between user and the system.**
- **Networks: for signal transmission in the system, which can be fixed or wireless.**
- **Actuators: to carry out the physical actions.**
- **Central Units: to making changes in the system, its maintenance, its settings, or re-programming.**
- **Controllers: make decision based on stored Programs/rules.**

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Smart Home Implementation
Trends:

Energy Management: Reduce consumption by 30%

Renewable Energy Resources: We need incentives

Cognitive Radio Technology: use the radio spectrum efficiently

Wireless Sensor Networks: to monitor pollution or irrigation

Conversion to digital broadcast TV: more spectrum to be used

Safety and Security: Biometrics means

Health Smart Homes: sensors and actuators "to follow" the people, to connect among themselves and others in daily tasks

Remote health observation: people can be monitored by utilizing different wireless techniques, Globus, the US based company makes use of the Paradigm Diabetes Management System

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Trends

Enhanced Connectivity Using Internet of Things (IoT) [14]

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Challenges in Smart Homes

- **Accidentally Smart Home: existing home that cannot accommodate and integrate the new technologies.**
- **Unprepared Interoperability : the skill to integrate different components that were acquired at different times from different manufacturers**
- **Social Implications: social aspects such as privacy, labor saving and good parenting**
- **Reliability : Developers make sure that devices never crash.**
- **Adaptability and flexibility: The involved systems must be upgradable at less effort and a low cost**

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Challenges in Smart Homes

- **Ease of Use: offers support for residents, guests and their cares.**
- **Affordability: Should be inexpensive to set up.**
- **Standardization in the smart home network services safeguard interoperability of products among various different networks, between domestic networks, continuous end-to-end services offered on a national and international scales, on numerous network stages, with totally compatible product elements.**

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Concluding Remarks

- **Smart Cities and Smart Homes are an important area of research and development technology in the 21st century.**
- **GIS and ICT technologies play a vital role in designing efficient and cost effective digital smart cities and homes.**
- **Advances in wireless networks and communications like Fiber To the Home (FTTH) are vital enabling technologies .**
- **Advances in Cloud Computing and consumer electronics have produced smart home gadgets and efficient and reliable computing paradigms.**

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Concluding Remarks

- Green ICT technologies using solar and wind energy and energy aware communication networks have contributed to the progress and success of smart cities and homes.
- Home automation has been achieved worldwide (nevertheless, it is still in its infancy stage).
- Wireless sensor networks and IoT played a great role in the design, deployment and monitoring (for increasing life expectancy), of efficient digital and smart cities and homes.

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Concluding Remarks

Main challenges in the progress and spread of digital city and home technology are:

- privacy ,
- Security,
- cost,
- interoperability and
- standardization

but we are optimistic that this technology will be moved to the mainstream and be offered in a cost effective manner to improve the quality of human life.

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شكرا

Thank You

MERCI BEAUCOUP

GRACIAS

DANKE

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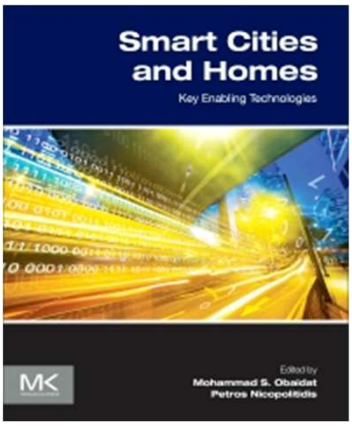
Recent Related Books

- M. S. Obaidat, and P. Nicopolitidis," Smart Cites and Homes: Key Enabling Technologies," Elsevier 2016.
  ISBN: 9780128034545.



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WATER PIPES APPLICATION

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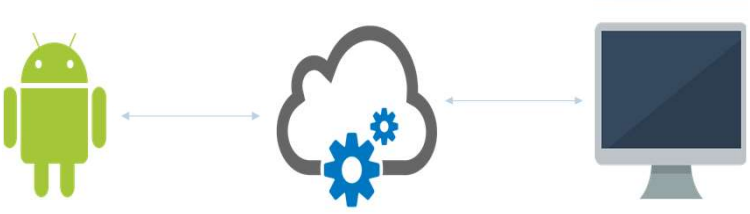
WATERPIPES APPLICATION

- Mobile application that allows reporting water and sewerage issues (complaints) through Android phones by sending location, photos, voice and description to call center web application to manage the issues.



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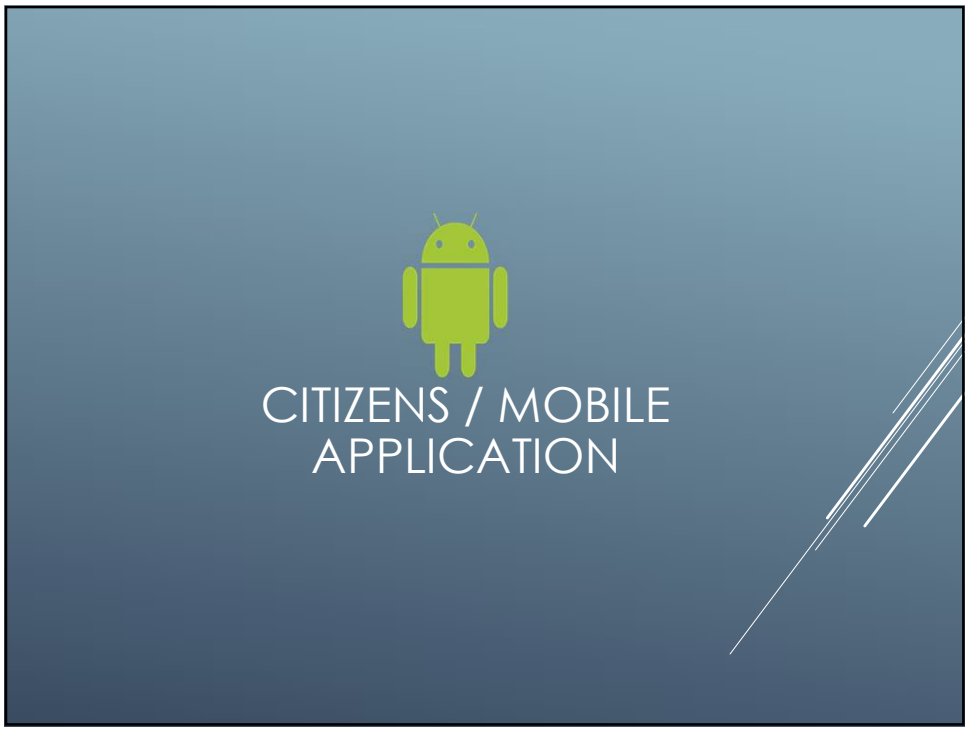

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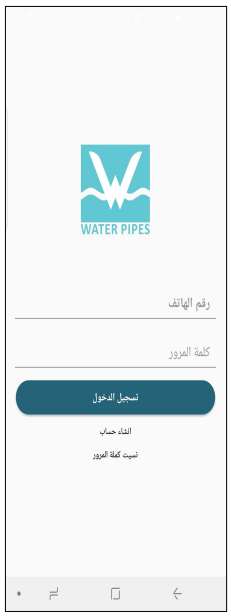

Figure 1.1: login window

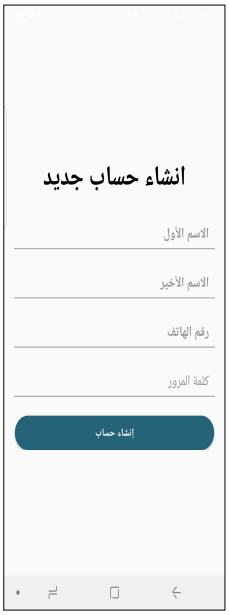

Figure 1.2: start new account window

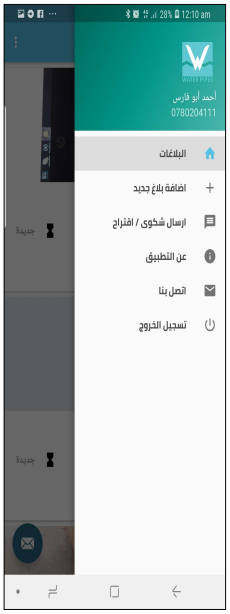

Figure 1.3: drop menu

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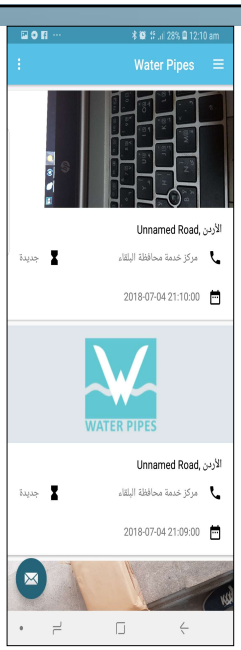

Figure 1.4: complaint location

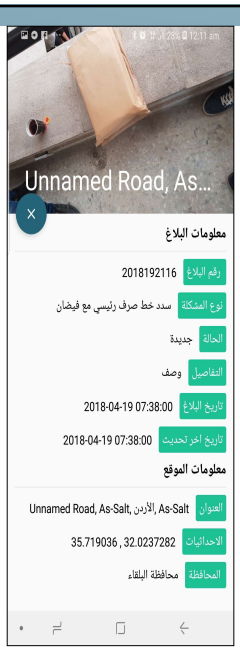

Figure 1.5: details previous complaint

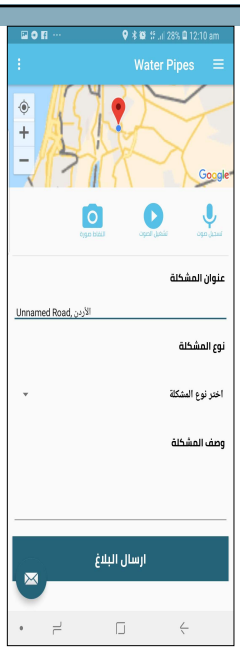

Figure 1.6: submit new complaint

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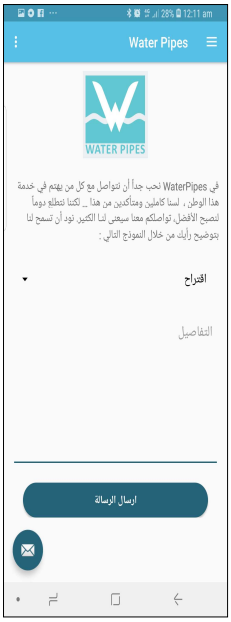

Figure 1.7: suggestion submission

Figure 1.8 to call center

Figure 1.9 about App

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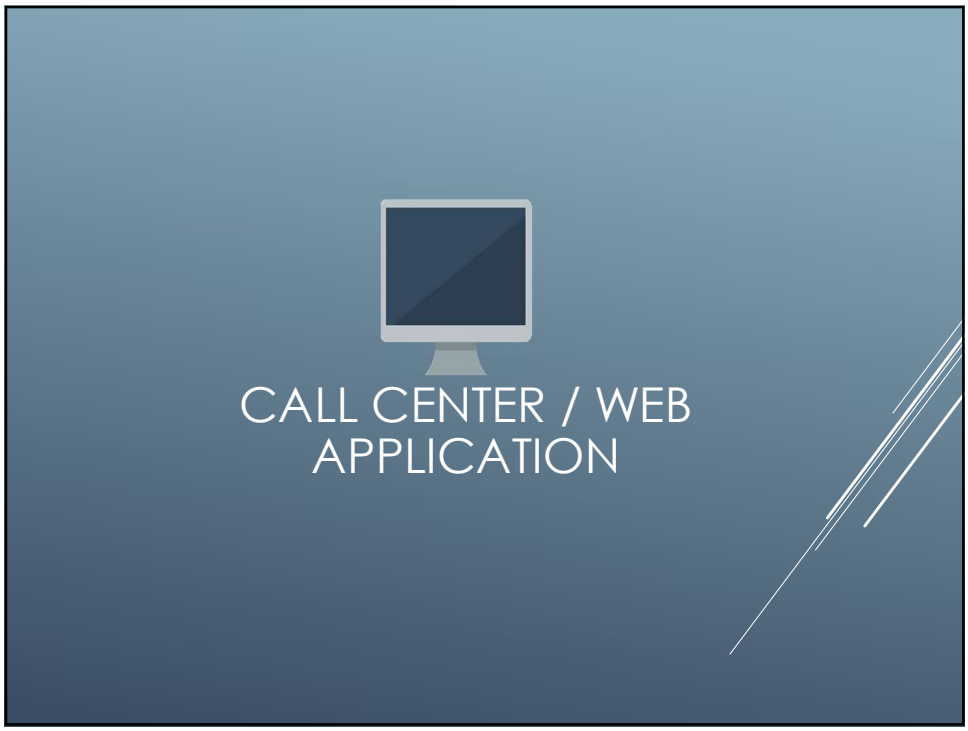

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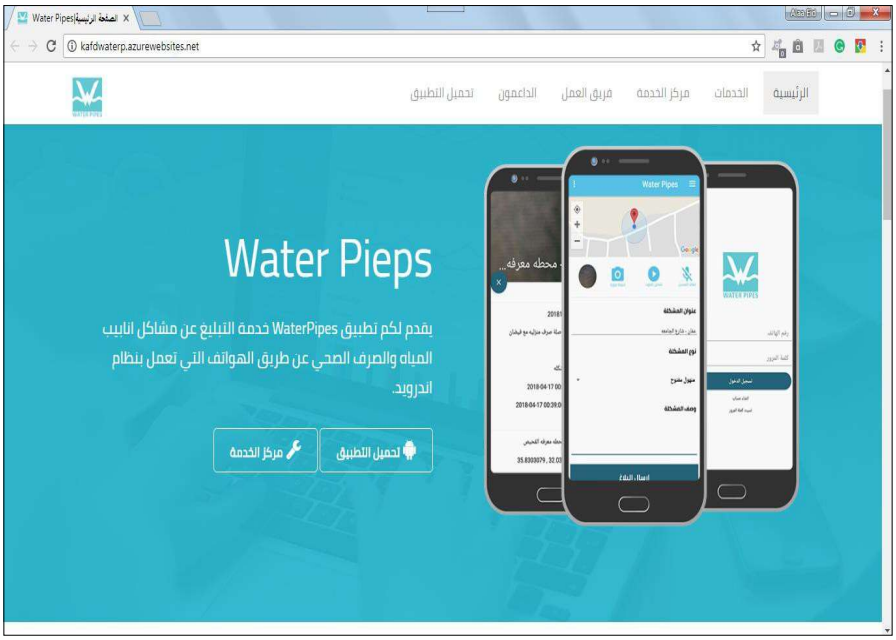

Figure 2.1 – Home Page for call center

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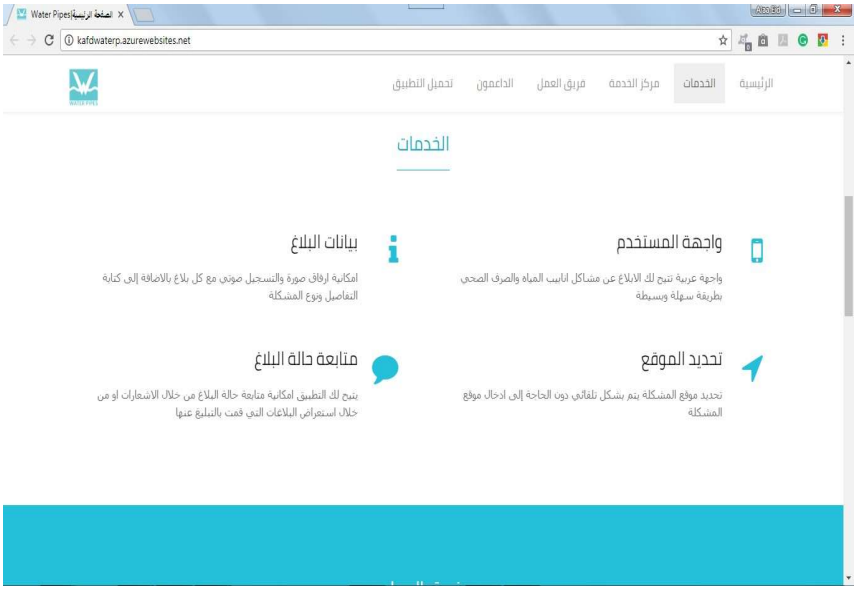

Figure 2.2 –Services & definitions

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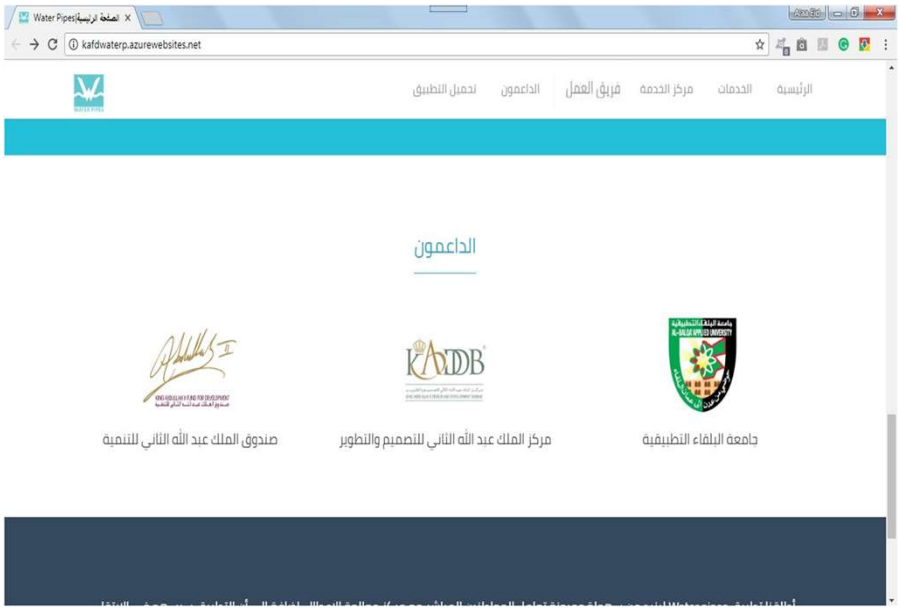

Figure 2.3 – Supporters

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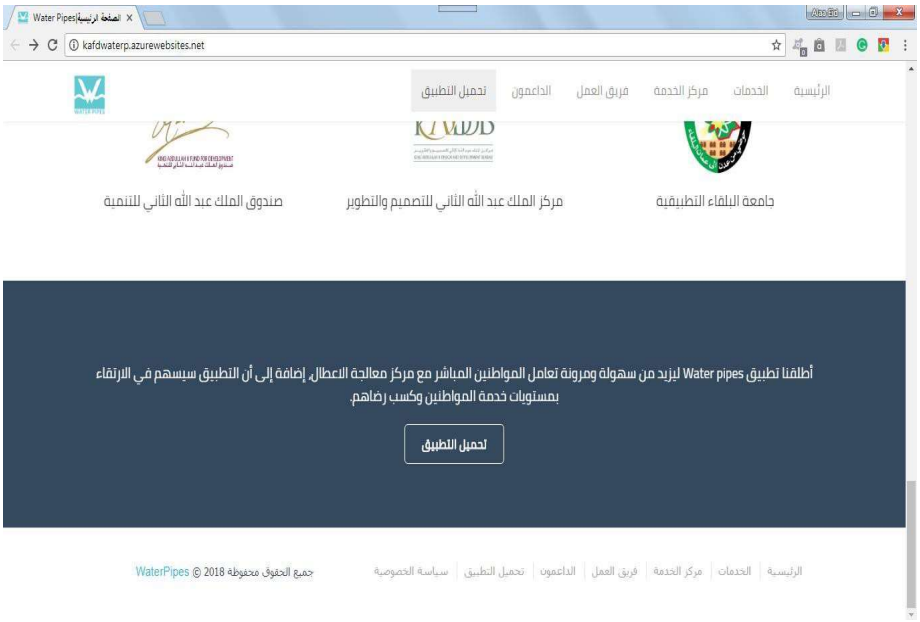

Figure 2.4 – how to Download the app

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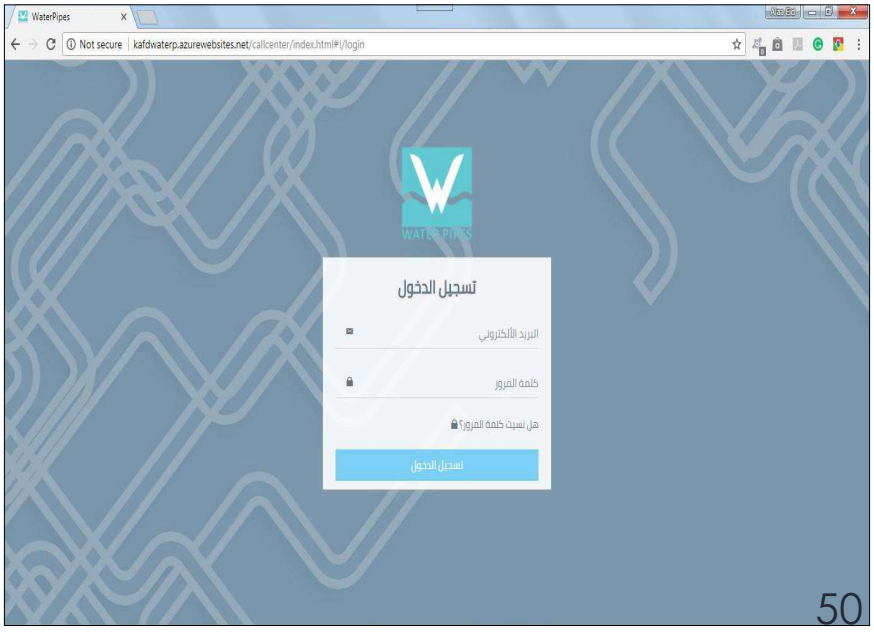

Figure 2.5 – Call Center Login Page (service center)
only for web controller

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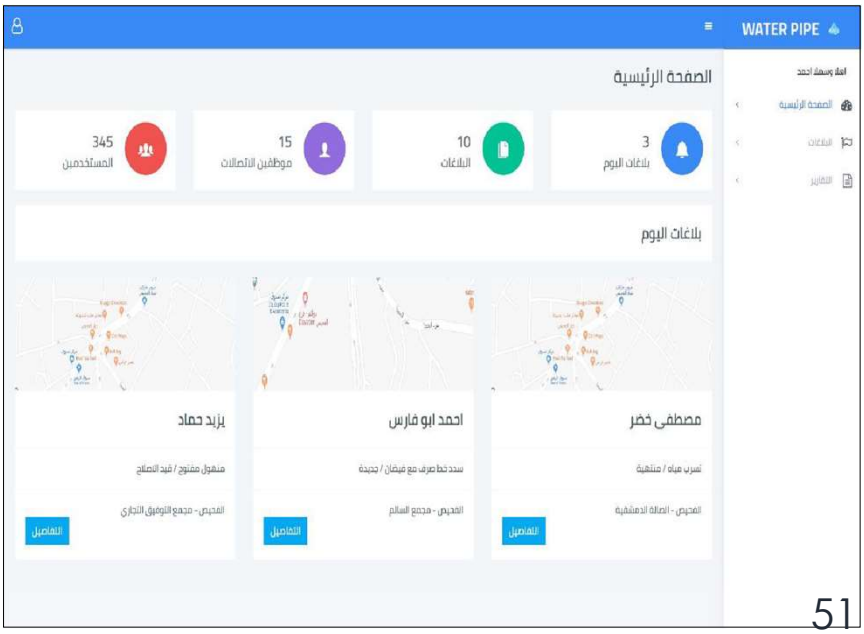

Figure 2.6 – Call Center Dashboard

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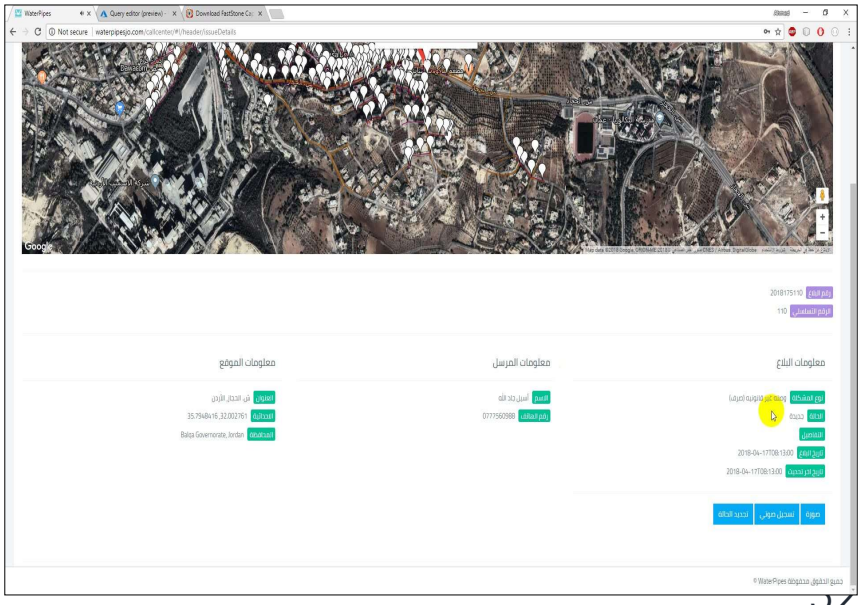

Figure 2.8 – Issue Details

52

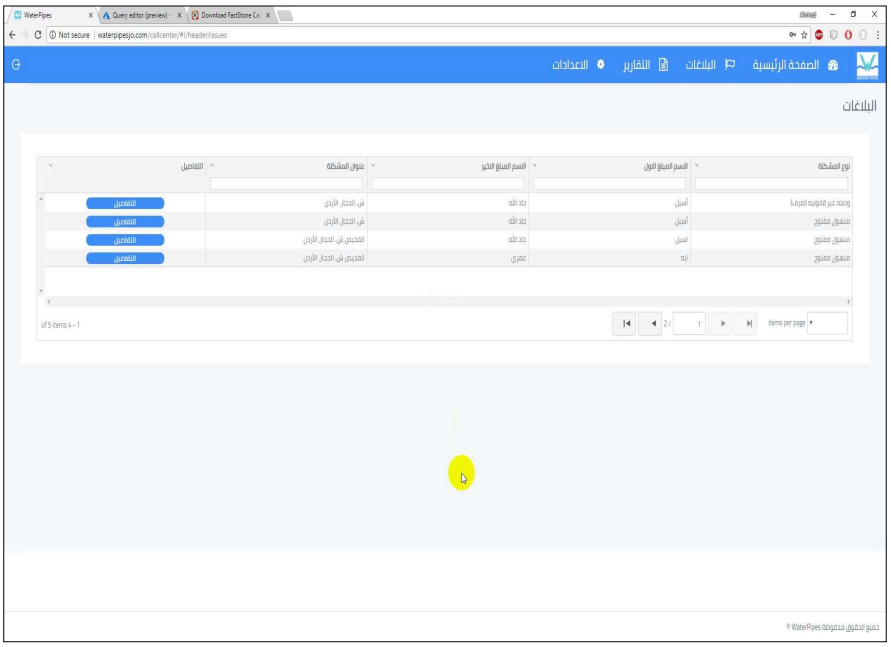

Figure 2.7 – Issues List

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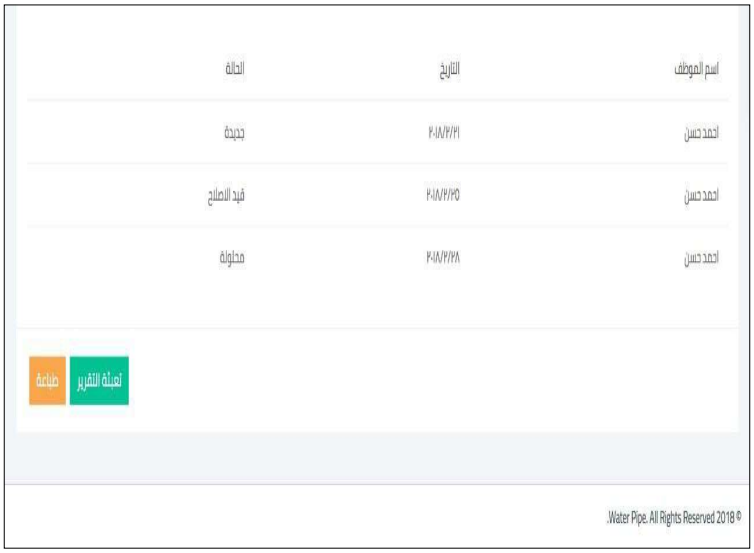

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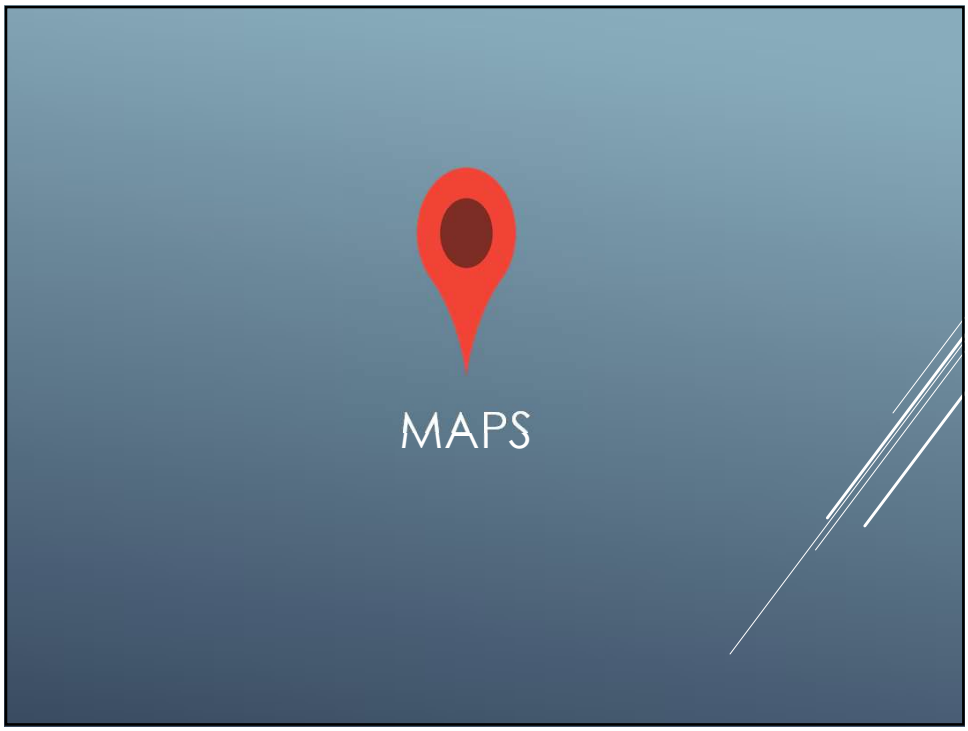
Figure 2.9 – Issue Details

54



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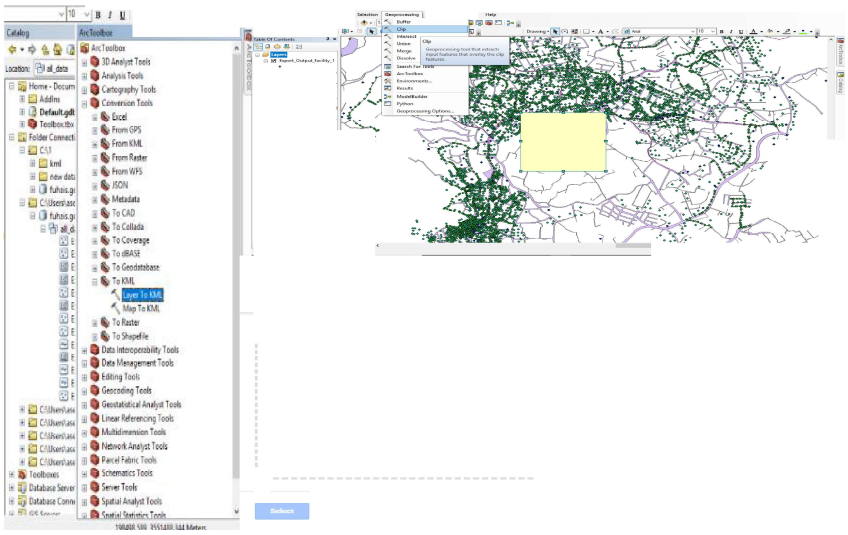

Figure 3.1 – Arch GIS

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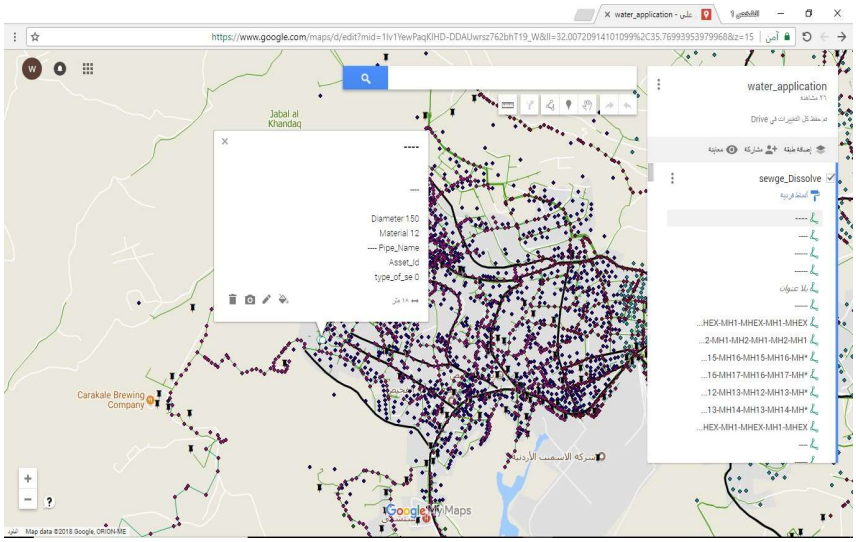

Figure 3.2 – Google Maps API

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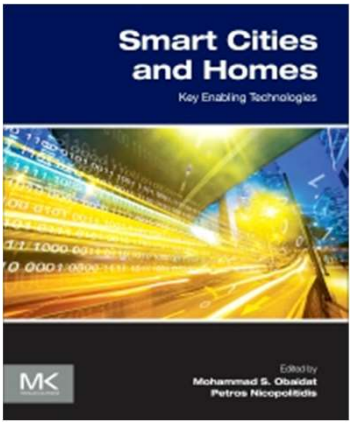

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