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Public Participation Role in Environmental Monitoring: Design and Development

Mohammad Ali Al-Anbari[1], LadenTaha Mohamed[2], KararHaider Anun[3]

[1, 2]Engineering College, University of Babylon, Babylon, Iraq
[3]Information Technology College, University of Babylon, Babylon, Iraq.

Corresponding author:mah.alanbari@gmail.com

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Abstract

The process of environmental monitoring of any area includes data collection, analysis and conversion to strategic information that helps decision makers to reach the appropriate decisions to achieve environmental goals. This process includes various aspects of environmental reality such as air, water, soil, man, plant and others, through the measuring and estimation of many indicators, which are compared to the criteria for identifying environmental problems.In view of the multiplicity of these aspects and the difficulties facing the monitoring process and the limited technical capabilities of the environmental institutions, it requires the participation of the community in this process through the voluntary participation of citizens in various forms and methods , including public meetings, telephone interviews, e-mails and surveys, at various levels and include information. consultation, inclusion, and cooperation.While recognizing the importance of involving citizens in the process of monitoring and assessing environmental reality for a long time, it is often considered ineffective because of the physical, technical and practical complexity, as well as the nature of environmental information. The aim of this research is to design and develop a smart mobile application to facilitate public participation in the environmental monitoring process, named(**PPEM**) (Public Participation in Environmental Monitoring). This application takes the data collection and local content created by the volunteer users (citizens) and sends them to the central database to turn them

into important information about the quality, quantity and location of environmental pollution, facilitate the decision-making process by the competent authorities for treatment as soon as possible, and increase public awareness. Multiple tools such as GIS, mobile devices and software have been integrated to accomplish this task.The designed and developed application(**PPEM**),will contribute to the establishment of a framework that explores the use of ICTs to enhance citizens 'participation in environmental monitoring in Babylon governorate by supporting citizens' activities, such as data collection and communications.‘

Keywords: Public participation,Environmental Monitoring,Environmental pollution ,Volunteer users,GIS,Mobile devices.

Introduction:

The process of environmental monitoring of any area includes data collection, analysis and conversion to strategic information that helps decision makers to reach the appropriate decisions to achieve environmental goals[1].This process includes various aspects of environmental reality such as air, water, soil, man, plant and others, through the measuring and estimation of many indicators, which are compared to the criteria for identifying environmental problems[2].In view of the multiplicity of these aspects and the difficulties facing the monitoring process and the limited technical capabilities of the environmental institutions, it requires the participation of the community in this process through the voluntary participation of citizens in various forms and methods , including public meetings, telephone interviews, e-mails and surveys, at various levels and include information. consultation, inclusion, and cooperation[3].Sherry’s Arnstein Ladder best describes the meaning and elements of public participation[4–6].

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Figure 1: The Arnstein’s ladder showing the different levels of public participation[4]

While recognizing the importance of involving citizens in the process of monitoring and assessing environmental reality for a long time, it is often considered ineffective because of the physical, technical and practical complexity, as well as the nature of environmental information [7-8].The review of voluntary initiatives generally indicates that it is positive to involve citizens in environmental monitoring. In addition, developments observed in areas such as models of public participation, environmental sensing and information and communication technology may contribute to increasing the impact of citizen initiatives[9].Although citizen participation in environmental monitoring is gaining more support, no

comprehensive vision has been made. On the contrary, most of the examples found are isolated and do not promote data reuse. There is a framework to address the disadvantages of citizen involvement in environmental monitoring, while exploring the opportunities created by social and technological developments. Establishing such a framework requires[3,9].

1)Analyze the issues involved in the monitoring of volunteers, specifically the tasks and motivations of citizens 2)To propose two types of networks - mobile and fixed - to explore the potential of innovative ICT tools

3)Evaluating the economic feasibility of implementing the framework

Think about the requirements of ICT tools used4)

Information technology and Geographic Information System (GIS) are two main mechanisms that have brought innovation to traditional curricula, which requires demonstrating how citizens are equipped to become more reliable data producers, and how to explore ICTs to increase citizen participation[10,12].The use of ICT to promote citizen participation in environmental monitoring may create opportunities in the education domain. Citizen education and awareness on environmental issues is one of the intangible benefits created by citizen participation in environmental monitoring.

The organization of ICT opportunities to support citizen participation is based on three building units[9]:

1)Volunteer citizens

Sensors, and2)

Background information infrastructure3)

The aim of this research is to design and develop a smart mobile application that facilitates public participation in the environmental monitoring process, named(**PPEM**) (Public Participation in Environmental Monitoring). This application takes the data collection and local content created by the volunteer users (citizens) and sends them to the central database to turn them into important information about the quality, quantity and location of environmental pollution, facilitate the decision-making process by the competent authorities for treatment as soon as possible, and increase public awareness.

Various tools and methods, have been integrated, such as GIS, mobile devices and multiple software to accomplish this task[13].

2- Case study:

The application(**PPEM**) will be implemented in Babylon governorate, and can be implemented anywhere else. A mobile application has been designed and programed that will take a data collection on environmental pollution from the volunteer users and send it to a database. The basic idea of the application is to send a report detailing this environmental pollution and sufficient information to help the competent authorities to address this pollution and to build a better environment and increase environmental awareness.

3-Design conceptual framework for smart application:

The application was built using Ionic, an open source development package for the development of hybrid applications for smart phone operating systems. A number of programming languages have been used, including Angular (commonly referred to as "Angular"), an open source web application framework that is reserved for Google, a community of individual and corporate developers, and PHP programming language Hypertext Preprocessor is an open source language that supports object oriented programming and its structural structure.

The project includes the use of MySQL databases and sometimes MySQL (MySQL) is a relational database management system that relies on SQL and it is an open source product.

3-1-Application details:

Practical application will be divided into two parts:

The part(1) will include the explanation of the form face and the method of filling the data.The part(2) will include the way in which this information is received and how it is read.

3-1-1-Part (1) :

Form Interfaces:

When you run the application you will see the form face and it includes a set of menus and options.

Components of the Form:

First: The first field is special in choosing the governorate name where it will be selected through a list containing all the Iraqi governorates as shown in Image (1).

Image (1) show the choice of governorate name

Second: The name of the Qadaa will be chosen. This list will be based mainly on the name of the governorate. The Qadaa differ from governorate to governorate in terms of numbers and names as shown in Image (2).

Image (2) show the choice of the name of the Qadaa

Third: The type of environmental pollution will be selected as shown in Image (3) [13].

Fourth: After determining the type of pollution, a new field will appear, entitled Pollution source. The contents of the pollution source fields vary in terms of number and names according to the type of pollution as shown in Image (4) [2].

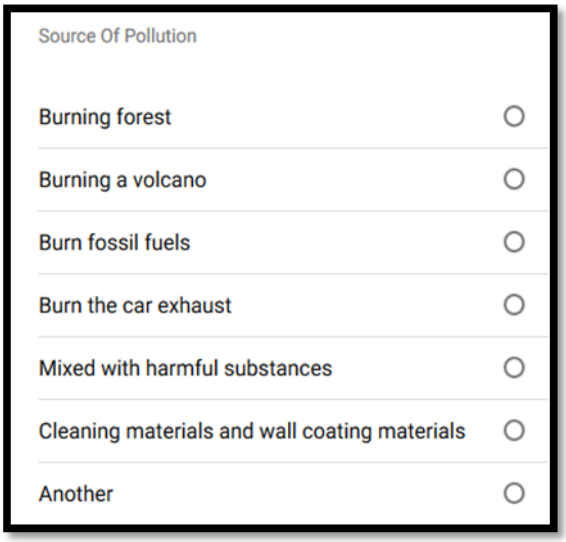
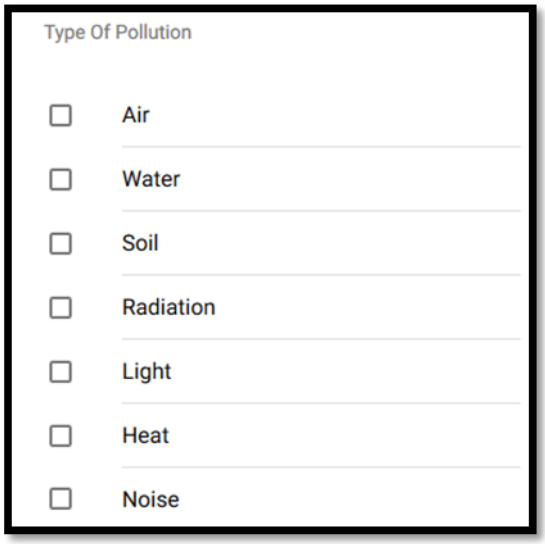


Image (4) show the selection of source of air pollution



Image(3)show the selection of the type of pollution

Fifth: Pollution rate will be chosen as the size or the special measurement to determine the pollutant estimate as shown in Image (5).

Sixth: Choose a picture from the mobile device and attach it with the form to document the situation as shown in Image (6).

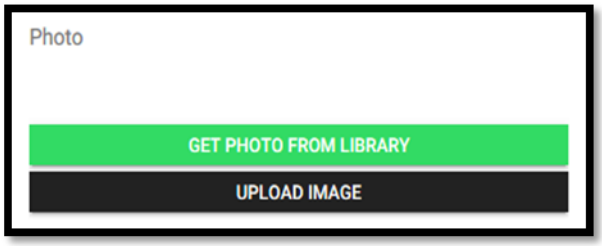


Image (6) show sending attachment picture

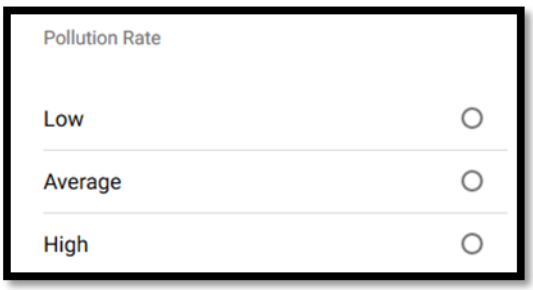


Image (5) show the selection of the pollution rate

Seventh: Activate the GPS to determine the geographical location with high accuracy, which includes latitude and longitude, as shown in Image (7).

Eight: Data will be sent when you press this button and the data will be stored in the database as shown in Image (8).

Image (8) show method of sending data

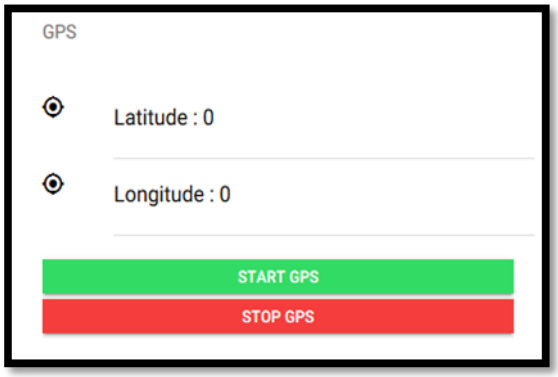


Image (7) show the coordinates of latitude and longitude

Using PPEM in case of Air pollution:

Step 1: The application can be run as shown in Image (9)

Step 2: After running the application ,the fields of the form, that have already been explained previously will be shown as in Image (10)

A report will be send on a specific site containing environmental pollution. The site of environmental pollution is in Babylon governorate in KifleQadaa. The type of pollution is air pollution. The fields of the form will be filled as shown in Image (10)

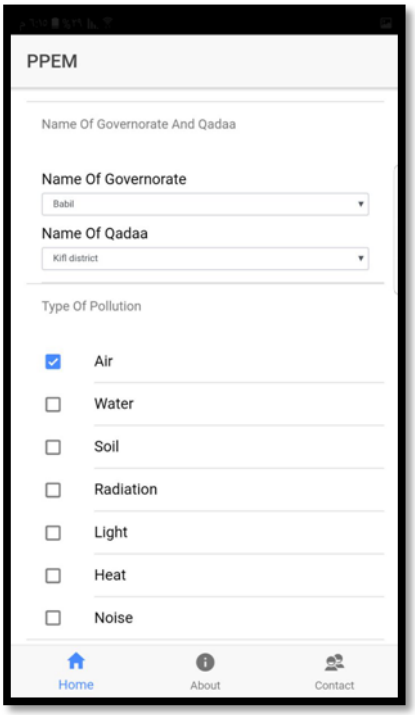


Image (10) show the fields of the form

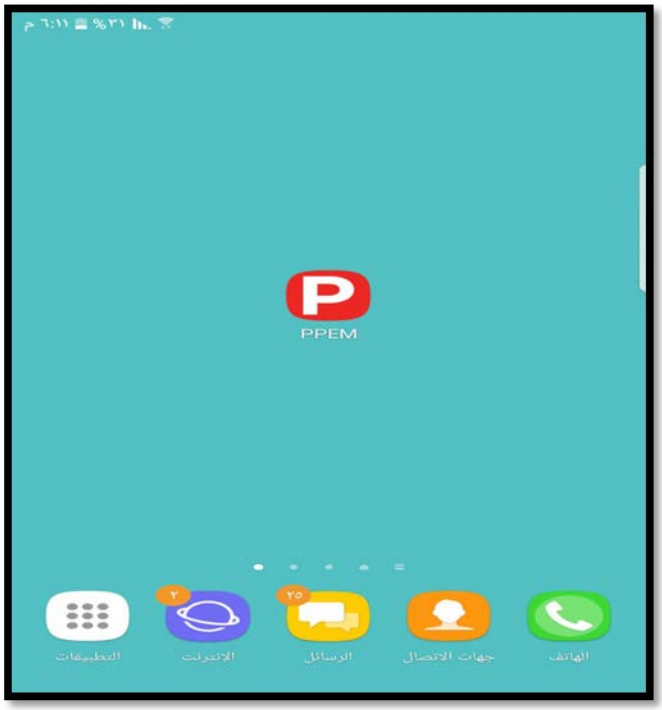


Image (9)show the name and picture of the phone application

Step 3: Identify the source of pollution that causes this environmental pollution. Here burn fossil fuels will be chosen , and the report requires information on the rate of pollution spread, the form will be fill out as shown in Image (11).

Step 4 : Attach the documented image of the pollution site, as well as the geographical coordinates of the pollution site, as shown in Image (12).

Image (12)show GPS of the air pollution site

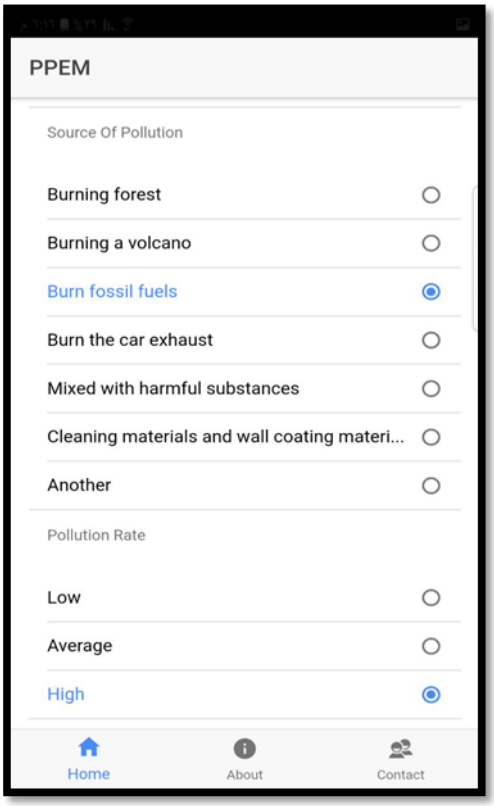


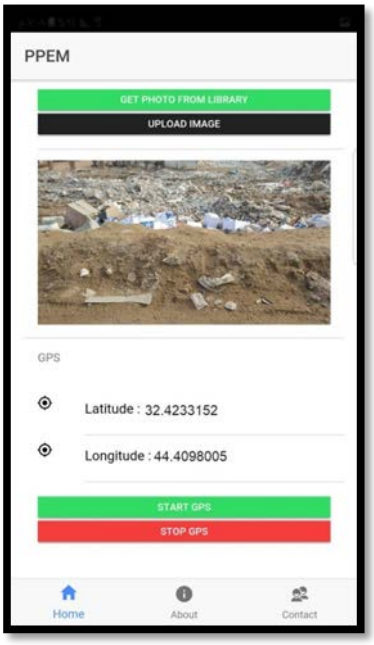
Image (11)show options source of air pollution

Step 5: This report can be send to the database by pressing send data, as shown in Image (13).

Image (13)show the field of sending data

Using PPEM in case of Soil pollution:

A report will be send on another case with the same steps, but with different information as shown in Image (14, 15 and 16) [2].



Image(16)show GPS of soil pollution source

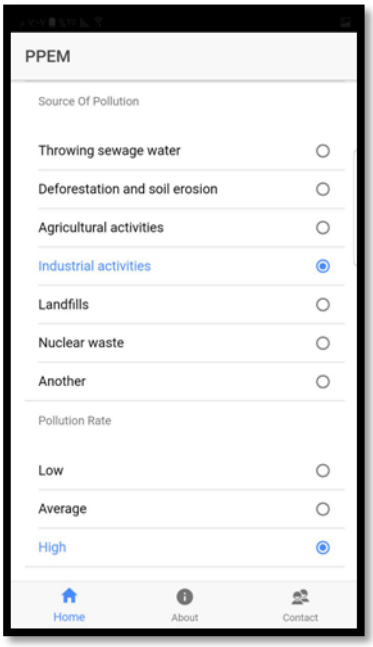
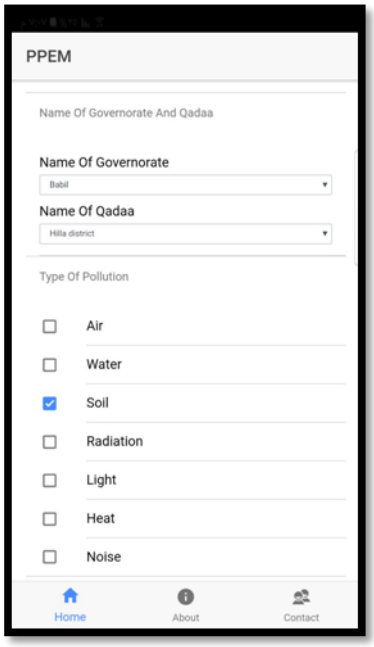


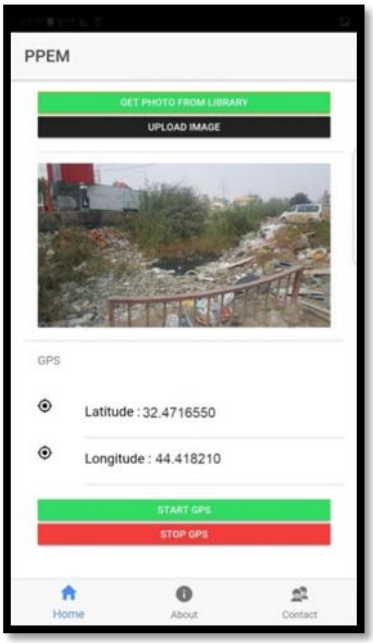
Image (15)select optionIndustrial Activities



Image(14)select the option of soil pollution

Using PPEM in case of Watr pollution:

Also, a report will be send on another case with the same steps, but with different information as shown in Image (17, 18 and 19).



Image(19)show GPS of water pollution source

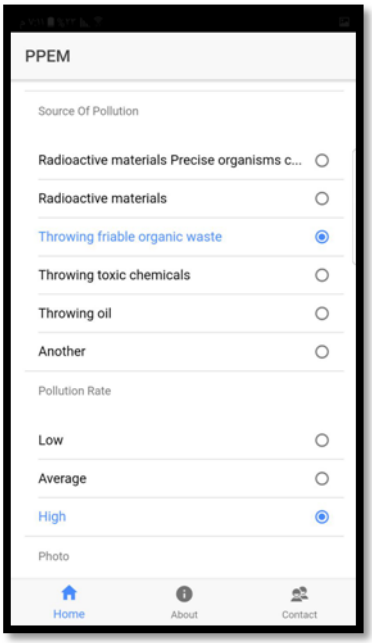
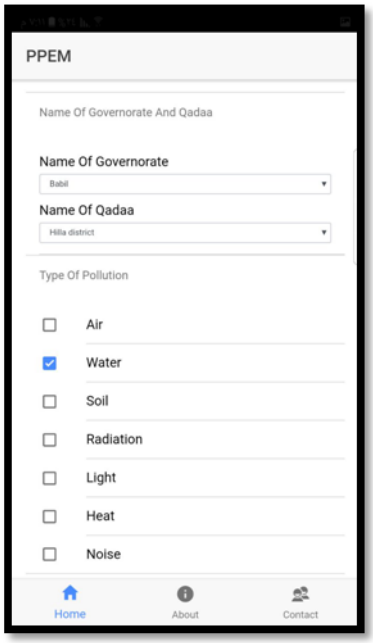


Image (18)select optionthrowing organic waste



Image(17)select the option of water pollution

3-1-2-Part (2) :

In this part of the application, how to receive data and display it on the website dedicated to it , will be shown , through which all new alerts and forms sent by mobile application, and in the form of environmental technical reports will be displayed.

Step 1: When completing a form and sending it from the mobile application, the site owner will be notified of the arrival of a new form as well as the number of newly received forms in the inbox as shown in Image (20).

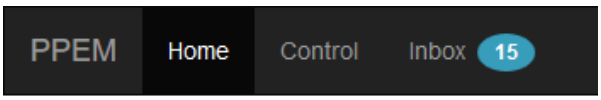


Image (20)display the update of alerts on the web page

Step 2: When the form arrives, it will be presented to the appropriate person for processing and to ensure the accuracy and integrity of the information. If properly confirmed, they will be added to the system menu. If the information is incorrect, the form will be deleted by the responsible officer. This form includes the name of the governorate , the name of the Qadaa , the sequence or number of the form, the type of pollution, the size of the pollution, the source of the pollution, the date of filling the form and as shown in image (21), with a documented image of the pollution as in image (22), the geographic location of longitude and latitude and the possibility of showing on the map clearly as in Image (23).

Name of governorate	Name of Qadaa	Image	GPS		Map	Setting
Babil	Hilla district		32.481135	44.439214		
State of number	Type of pollution	Pollution rate	Source of pollution	Date		
3	Water	High	Another	2018-10-09		

Image (21)show the structure of the presentation of data form

Image (23)Display a map of the pollution source

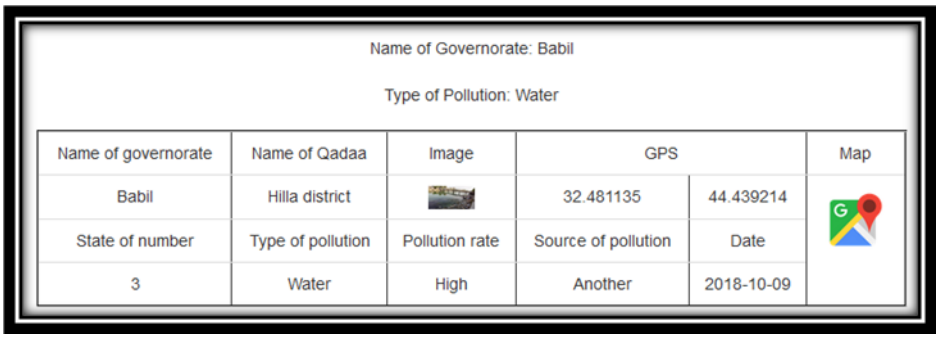
Image (22)show documented Picture of water pollution

Step 3: If the form is accepted, information will be sent in the form of an environmental technical report to the competent environmental authority to deal with the situation, whether it is responsible for air pollution or responsible for soil pollution or responsible for water pollution or other.

Website Features:

Other features of the website include the possibility of a detailed report that includes:

-Presentation of the forms received in a particular governorate, according to a specific type of pollution, for example, the presentation of all forms of pollution in water in Babylon governorate, as shown in image (24).



Name of Governorate: Babil

Type of Pollution: Water

Name of governorate	Name of Qadaa	Image	GPS		Map
Babil	Hilla district		32.481135	44.439214	
State of number	Type of pollution	Pollution rate	Source of pollution	Date	
3	Water	High	Another	2018-10-09	

Image (24)show the data of report of the water pollution in Babylon governorate

- The possibility of the work of a report, summarizes the statistical work in the numbers of forms received in all types of pollution, depending on the name of the province, for example, statistics pollution forms in Babylon governorate as shown in image (25).

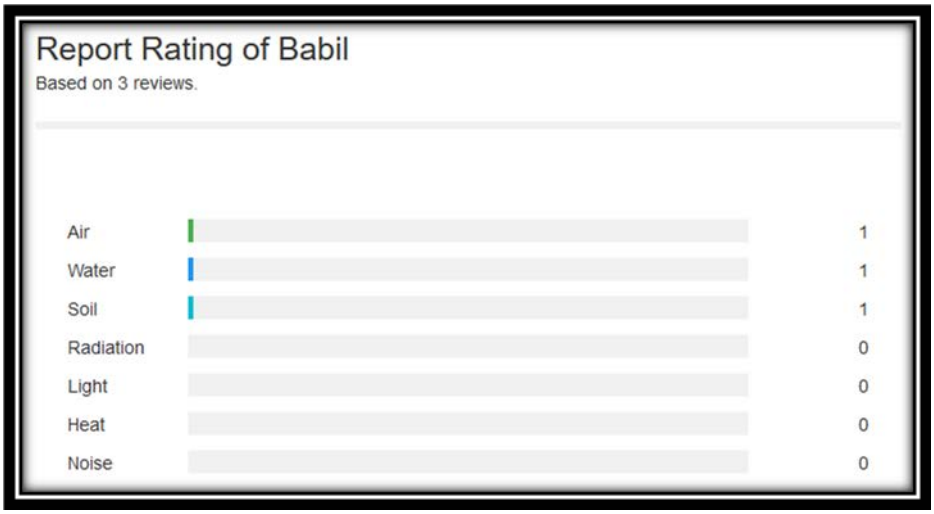
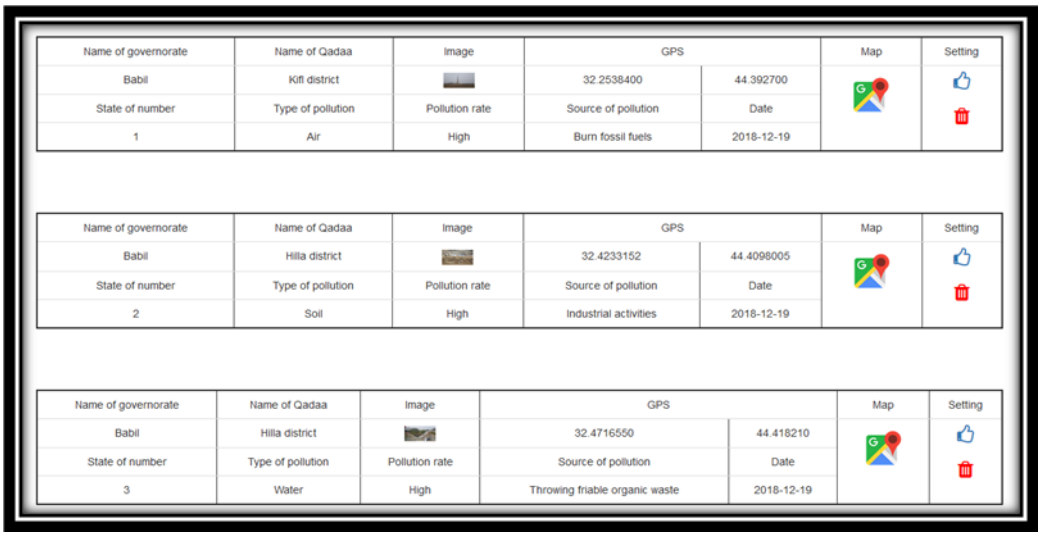


Image (25)show the rates and statistics of the types of pollution in Babylon governorate

- Display all newly received notifications in the form of environmental technical reports by going to the Inbox. The details of each report later will be seen , and note that there are three newly received reports as shown in image (26).



Name of governorate	Name of Qadaa	Image	GPS		Map	Setting
Babil	Kifl district		32.2538400	44.392700		
State of number	Type of pollution	Pollution rate	Source of pollution	Date		
1	Air	High	Burn fossil fuels	2018-12-19		

Name of governorate	Name of Qadaa	Image	GPS		Map	Setting
Babil	Hilla district		32.4233152	44.4098005		
State of number	Type of pollution	Pollution rate	Source of pollution	Date		
2	Soil	High	Industrial activities	2018-12-19		

Name of governorate	Name of Qadaa	Image	GPS		Map	Setting
Babil	Hilla district		32.4716550	44.418210		
State of number	Type of pollution	Pollution rate	Source of pollution	Date		
3	Water	High	Throwing friable organic waste	2018-12-19		

Image (26)show the details of three reports

Analysis of results 3-2-

First report:

The information of the first form can be noted, which includes pollution in Babylon governorate, KefalQadaa , and the number of the form of pollution is one, which is unique number is not repeated where each form is assigned a number, the type of pollution reported here is the air pollution, the pollution rate is high, and the source of pollution is burning fuel Fossil, as well as additional information such as the date of receipt of this report, was completed in 2018-12-19, the image on the form can be shown by clicking on the image and will appear as shown in image (27).There is also other information attached to the form, such as the geographical location of the pollution, which is represented by latitude and longitude through the GPS. These coordinates can be displayed by clicking on the image of the map, and will appear as shown in image (28)[2].

Image (28)show the location of pollution on the map

Image (27)show documented Picture of air pollution

Second report:

The second form information can be noted, it contains pollution in Babylon governorate, in HillaQadaa , the number of the form for this pollution is two, the type of pollution reported is soil pollution, pollution rate is high, pollution source is the pollution of industrial activities, the date of receipt of the form in 2018- 12-19, we can show the picture on the form by clicking the image and it will appear as shown image (29).

The geographical location of the latitude and longitude coordinates of this form is shown as shown in image (30).

Image (30) show location of soil pollution on the map

Image (29) show documented Picture of soil pollution

Third Report:

The information of the third form can be noted, that it contains pollution in Babylon governorate, in HillaQadaa ,pollution form number is the third, the type of pollution reported is water pollution, the pollution rate is high, the source of pollution is the dumping of organic waste, the date of receipt of the form in 2018-12-19, we can show the picture on the form by clicking on the image and will appear as shown in imaage (31).The geographic location of the latitude and longitude coordinates of this form is shown as shown in image (32).

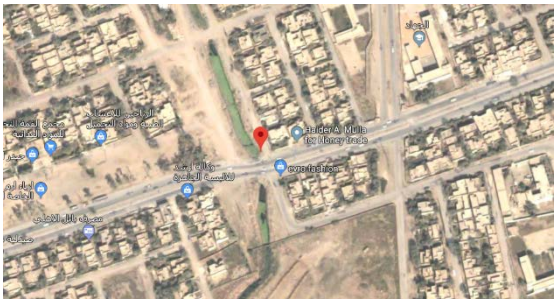


Image (32)show location of water pollution on the map

Image (31) show documented Picture of water pollution

Conclusions:

This research contributes to the establishment of a framework that explores the use of ICTs to enhance citizens 'participation in environmental monitoring in Babylon governorate by supporting citizens' activities, such as data collection and communications.‘

Furthermore :

-1-The smart application model (PPEM), designed and developed, provides a great opportunity to facilitate the participation of citizens in environmental monitoring, and integrates various tools and means such as GIS, mobile devices and multiple software .

-2-The conceptual framework and model design system is expandable to meet the needs of local governments and environmental institutions in the provinces of Iraq to promote public participation in environmental monitoring.

-3-The use of ICTs allows the collection and recording of non-traditional data types, from sensory data to personal exposure data. These types of new non-traditional data may offer opportunities for citizen participation in environmental monitoring because they represent more detailed and richer data.

4-Citizen education and awareness on environmental issues is one of the intangible benefits created by citizen participation in environmental monitoring. In addition to formulating a collective knowledge base on public participation in policy-making, promoting confidence and, ultimately, the development of a sustainable society.

Recommendations :

Further research is needed on how and levels to engage citizens in environmental monitoring, while working on:

1-Include in environmental legislation methods and levels of public participation of citizens and their various segments in environmental management, while guaranteeing their rights.

-2-Develop the potential of environmental frameworks more attractive to facilitate public participation in environmental monitoring.

- 3-Explore ICT tools to support educational activities in environmental education and awareness.

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