QATra Irrigation System

Market Needs Analysis

Texas A&M University at Qatar
ECEN 403: Electrical Design Lab I

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Date: 17 October 2019

Texas A&M at Qatar University, October 2019
"An aggie doesn't lie, cheat or steal, or tolerate those who do."

Table of Content:

1. Introduction

"QATra" is a smart irrigation system accompanied with a mobile application. In order to fabricate this product, there are certain inquires and concepts that needs to be clarified. This customer needs report aims to identify the needs of the customers (i.e. what would the future consumers like to see in such product), whether people accept this idea and are willing to have such products at their homes/farms/agricultural land, what constraints we might face as undergraduate students working in a field that is not ours (e.g. agricultural knowledge, creating the piping system for the irrigation), the feasibility of manufacturing such system. Responses to those matters can help us improve our initial design, incorporate the public's opinions (since they are the potential customers) and start promoting our product. This report will include the methods used for data collection, analysis of the results, importance and significance of those results and improvements we might consider if we were to do the surveys again.

2. Methods

The methodology that we considered was to gather information from different perspectives, opinions, areas and backgrounds. Therefore, we conducted an anonymous online survey for the general public in English and Arabic to examine their reactions and acceptance towards our proposed product and to observe if there is a demand for such product. The survey will allow respondents to express their ideas and views without questioning. Also, the survey charts were used to draw a conclusion from the answers received from the majority. On the other hand, we wanted to gain knowledge and feedback of specific technical information from experienced engineers of different fields and agricultural specialist. Interviews help us to gather information from an experts' experience in the field which will be a valuable input to our project.
The online survey was distributed among the general public through social media platforms such as WhatsApp and Twitter to get diverse responses. Moreover, we contacted four experts: an automation engineer from the Ministry of Municipality and Environment to investigate the current methods used in irrigation systems, two engineers from Kahramaa to explore the effect of our smart irrigation system on water wastages and an agricultural specialist to analyze the different factors affecting the soil measurements and to get some technical information regarding irrigation systems.

3. Customer Needs Analysis

3.1 - Survey 1: Specialist Interviews

While we were conducting our survey, we had an interview with Engineer Ahmad Shaker, an automation engineer at Public Parks Department at the Ministry of Municipality and Environment. The team asked Engineer Shaker about irrigation systems currently used. He replied that the

irrigation system used now is distributed water sprinklers among different cities and places and are controlled through a centralized software installed in one of the computers at Public Parks Department. The irrigation system waters the plant at an earlier scheduled time. Also, the user can shut down the whole irrigation system at a place such as Sheraton Park. However, one single sprinkler cannot be turned off independently. We asked about fault detection in the system, he responded that they can know if there is water leakage through comparing the normal flow rate of the water and the current flow rate of the water through a water sprinkler. But the user is not informed about it. Then we inquired about the cost of the system and the amount of water required to irrigate a land of km^2. However, he did not have any background about the cost, nor the amount of water required per km^2.

Then we explained our proposed irrigation system to Eng. Shaker. His feedback was positive about our project. Eng. Shaker confirmed that the usage of moisture sensor can decrease the amount of water needed to water the plants. We asked if the system needed other features, Mr. Shaker proposed that other sensors such as salinity and temperature sensors can be added to improve the system.

A second interview with two project engineers from Kahramaa (Qatar General Electricity and Water Corporation): Engineer Ayman Mashali and Engineer Mohamed Ben Aicha was conducted. In the interview, we discussed ways in order to effectively improve our design. Engineer Ayman highlighted the importance of taking into account the characteristics of each plant (e.g. their root types), the water content needed by each plant and the soil type used here in Qatar in order to elaborate the moisture sensor. Moreover, Engineer Mohamed suggested using drip irrigation rather than sprinkler irrigation, since it will reduce water wastage. The reason for that is due to the fact that when sprinklers are used, some of the water is evaporated or lost to the surroundings and therefore the irrigation system will not be efficient. Furthermore, he gave us another strategy for detecting a fault in the system. Instead of testing for faults at the end nodes, where (in the initial design) the sprinklers are located, we look out for faults in the pump of the system. When the group asked about the constraints we might face, the Engineers mentioned two significant ones. First, Engineer Ayman mentioned that social acceptance might be an issue, since people now are reluctant to try new products and that’s why we should try to promote and explain our project to people. Second, Engineer Mohamed mentioned that our system might face many technical problems, such as poor water flow rate, and therefore the system must be tested with different scenarios. Both of them emphasized that maintenance is an important aspect of our project, it should be considered when estimating the price of the product. Later, they mentioned how important it is to specify the price of the system per length or per area, since this product price will be dependent on the size of the farm/agricultural land. Finally, both of them showed great interest in our project. They both agreed that this project will contribute in reducing the amount of water being dispensed, especially that the agricultural sector consumes the most amount of water in Qatar.

A third interview was conducted with Mr. Osman Ahmed Abdalla, who is an agricultural affairs consultant and an agricultural specialist form the Ministry of Municipality and Environment. While conducting research for our proposed project, we came across many obstacles that should be taken into consideration in order to produce a more practical and well-functioning outcome. Many of these obstacles and constraints were related to agriculture. One of the most important questions that we asked Osman Abdalla to clarify the best place in the soil to place the sensors in which he said that its vital for the sensors to be placed in the root zone. He also mentioned that the root zone differs for different plant species, so it affects the level of soil depth for sensor placement. He brought up that some other constraints we might face is that each type of plant has different water level requirements, each phase of growth requires different water levels and the different seasons has an effect on water levels. Unfortunately he didn't have any data regarding water threshold level for different types of crops but he recommended to get these data from the Food and Agricultural Organization (FAO). Moreover, we asked if the type of soil used can affect the readings of soil moisture level. He explained that different types of soil such as sandy soil and silt soil has different water holding capacity. He added that in Qatar the most common type of soil used is sandy soil and the most common type of crops are vegetable crops and animal food. He advised us to use a mixture of sandy and clay soil for our prototype since this mixture is better for cultivation. We asked for his opinion on what type of water dispensing system is better to use in our irrigation system where he answered that using a drip irrigation is more beneficial than a sprinkler because water is used more efficiently as it goes straight into the soil and to the root zone. Furthermore, we asked how many times during the day should the sensor take soil moisture measurements and for how long should the irrigation system be on. He mentioned that taking the soil moisture level twice a day is enough preferably one in the early morning (best time for irrigation) and one in the afternoon or at night, he added that the irrigation system on time should be organized depending on the amount of water each crop needs to intake in one day where these data can be found from online research or the FAO. Lastly we asked some general questions regarding our project such as if there is a smart irrigation system currently in use, where he replied that this idea has not been implemented and that having a fault detection notification is better for monitoring rather than having to physically check the system every time.

3.2- Survey 2: Online Questionnaire

The online questionnaire was targeting general public. Total number of respondents was 202. The questions that were asked in the questionnaire were general and straight forward about our project. To begin with, we asked the respondents about their interest in a smart irrigation system. We obtained 202 responses were the majority (73.63%) were interested in a smart irrigation system as shown in **Figure 1** and **Figure 2**. 17.41% of respondents answered that they might be interested in such a product. 61.11% of the minority respondents who were not interested in such systems (8.96% of the total respondents) didn’t own a farm or garden. This analysis shows that there is demand and overall acceptance of such innovative irrigation system.

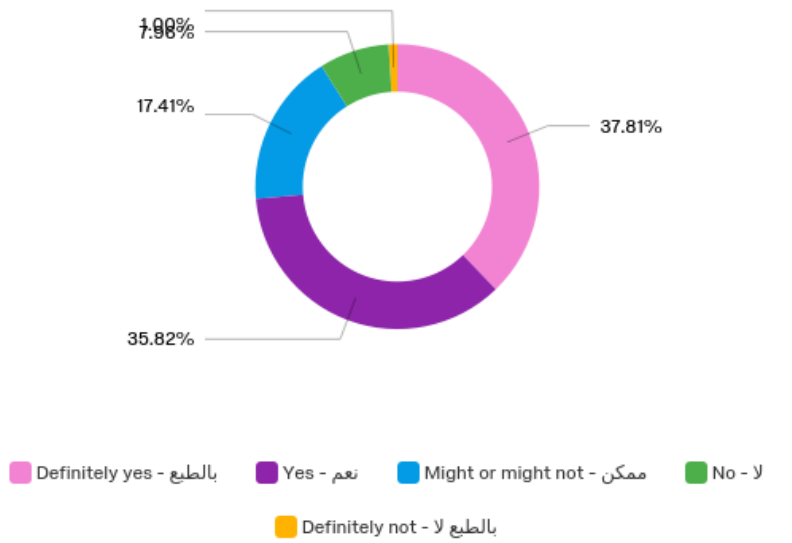


Figure 1: Respondents' answer to whether they are interested in a smart irrigation system shown as a pie chart.

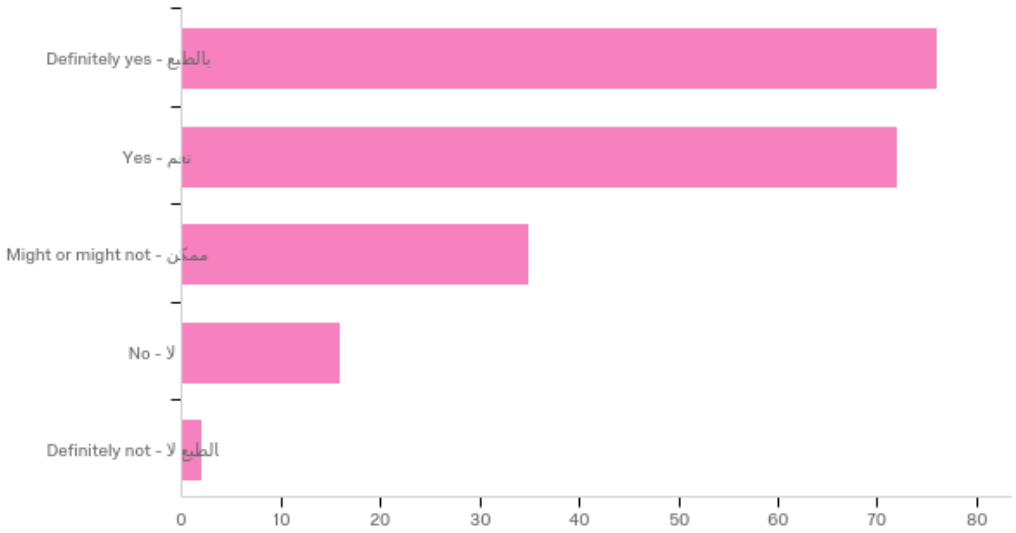


Figure 2: Respondents' answer to whether they are interested in a smart irrigation system shown as a bar chart.

Next we asked the respondents if they own farm or garden. 70.85% of respondents owned a farm/garden. Out of these, 47.86% were not familiar with such a project. This information proves that our idea is innovative and might encourage the usage of more eco-friendly smart systems.

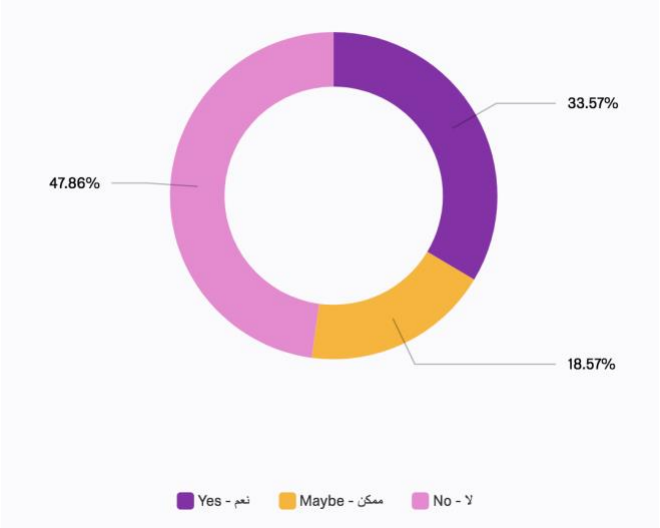


Figure 3: Respondents', who own a farm/garden, answers to if they are familiar with such system.

Furthermore, people were asked about the specifics of our proposed design which was regarding the application feature. Most of them, 65.67%, think that the application feature makes it more convenient to monitor and control the system as shown in **Figure 4**. This shows that people are willing to improve on the traditional methods of irrigation. On the other hand, 32.34% said "Maybe" and the remaining (1.99%) said that the application feature will not make the irrigation process convenient.

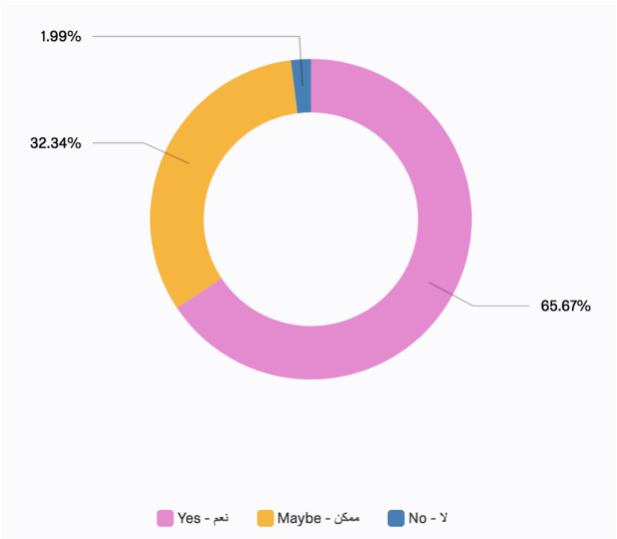


Figure 4: Respondents' answers to whether the application feature makes it more convenient for them to control and monitor the system.

Then we asked if our project helps in reducing water wastage and advocates environmental issues such as global warming. 78.61% of the respondents agreed that our project will reduce water consumption and raise awareness about environmental issues, as shown in **Figure 5**. 19.40% of them said that out project might help. However, the remaining respondents (1.99%) said that it will not help in reducing water consumption nor advocating environmental issues. This information supports our main idea that our product will reduce water consumption and raise awareness regarding environmental issues while advocating cultivation.

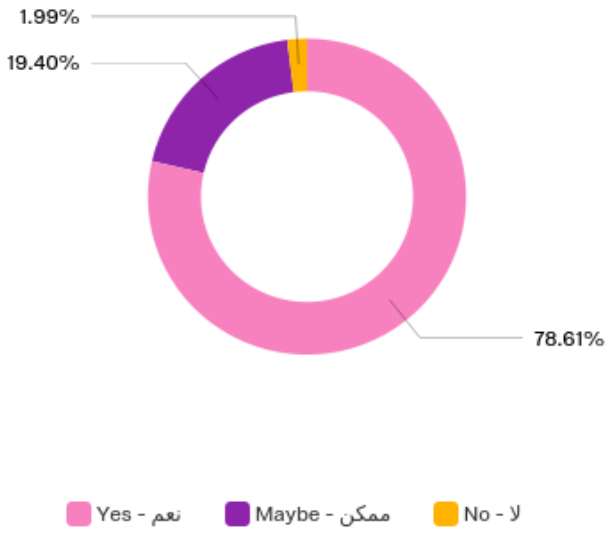


Figure 5: Respondents' answers to does our project helps in reducing water wastage and advocates environmental issues such as global warming

Moreover, we wanted people's opinion on a suitable price for our product. Our prototype costs around 1800 QR. Therefore, for the choices we gave ranges that are below, within the range and above the range of the prototype price. 57.29% voted for the lowest price range and 33.17% voted for the price range within the prototype's cost, as shown in **Figure 6**. Although this result is not desirable, it is important to note that the prototypes always costs more than the mass-produced products, therefore, the price of the product will definitely be lower. Also, this question was not very clear, since it didn't include the area that this price will cover (this point will be further discussed in the improvements section).

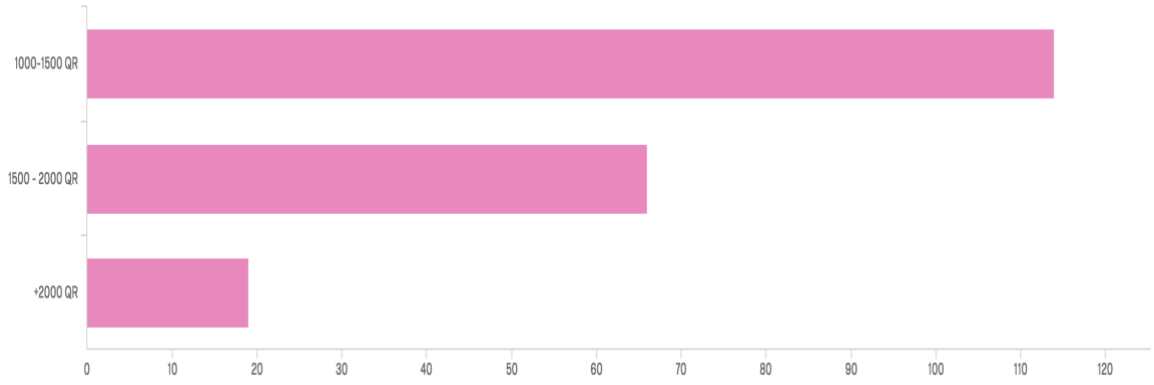


Figure 6: Respondents' answers to the suitable price range for our product.

Moreover, we asked about the age group and gender of the respondents. This question was asked in order to figure out the age group and gender that is mostly interested in our product and is willing to be involved in the development of our project. This can help us when we promote our product, to know which age group and gender we should focus on. Results show that the people who are mostly interested in our project are people that are above 35 years old and female. 148 voted that they are interested or definitely interested in a smart irrigation system, 79 of them were above 35 years old and 99 of them were female (53.38% and 66.9% as shown in **Figure 7** and **Figure 8,** respectively).

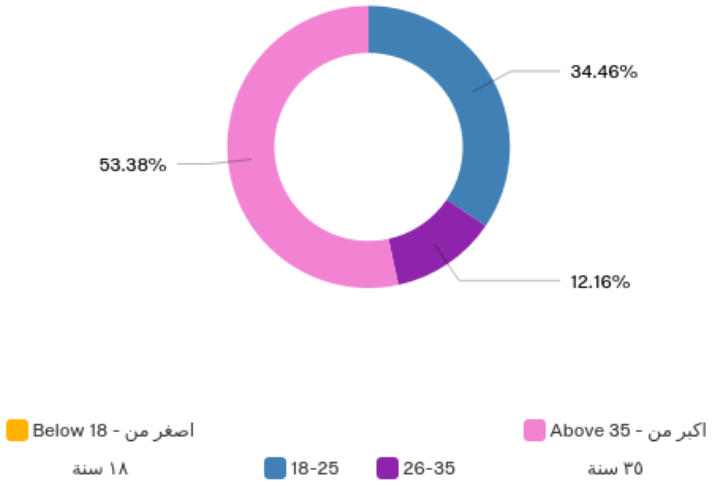


Figure 7: Respondents' age groups that are interested or definitely interested in a smart irrigation system.

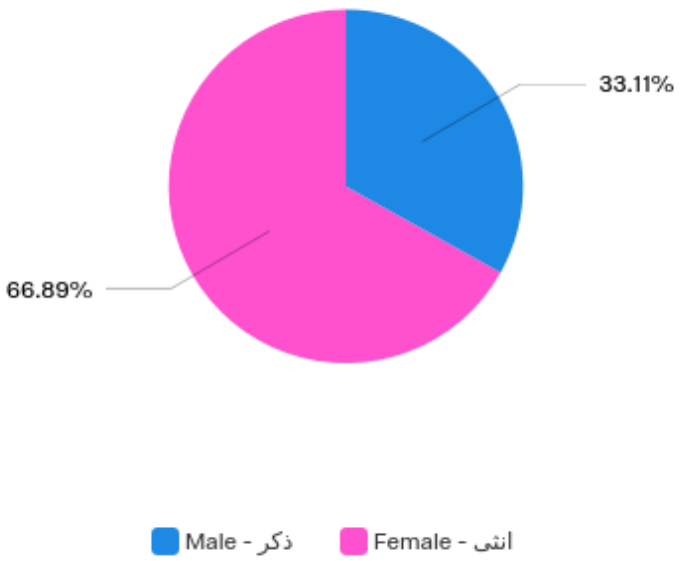


Figure 8: Respondents' gender that are interested or definitely interested in a smart irrigation system.

We asked the respondents if they have any additional suggestions or features that they would like to improve on our project. We received many opinions. In this section, we will highlight the most important suggestions. A suggestion that grabbed our attention was that this system will be implemented in gardens/farms outside buildings, and usually the Wi-Fi connection outside will have a low signal. Also, one respondent suggested to incorporate the effects of pest control and environmental factors on our system. Moreover, two respondents mentioned that they would like to see certain data in the app. The first wanted to view the daily, monthly and annual water consumption and the second wanted to know how much water was saved from this system in comparison to regular systems. Furthermore, a respondent advised using drip irrigation instead of using sprinklers. Finally, one of the respondents pointed out that we should consider the area of crops since it could be a factor affecting the price of the product. All those suggestions shall be taken into consideration and some can be implemented in our system.

3.3: Significance of Surveying Different Groups of Audience

The significance of surveying different groups of audience is that each group had different and important information to share. For instance, the general public gave us insight, comments and suggestions about our proposed design in general such as: the application features, the cost and whether there was demand for such product. On the other hand, discussing with engineers gave us a deeper understanding and awareness of the possible constraints that we might face and possible changes that could be made on the initial design. For example, it was brought to our attention that using a drip irrigation is much more beneficial than sprinklers. Lastly, consulting with an agricultural specialist provided us with all the factors that can affect the water threshold level in

the soil and how sensor readings can be affected. These might include the soil type, plant type and the growing phase of the plant. Overall, these suggestions and advice will help us to come up with a more practical and well functioning design.

3.4: Improvements For Future Surveys

After analyzing the surveys, both the specialist interviews and the online questionnaire, we noticed that there were some missing points that we should have taken into consideration when we did the surveys. First, in the online questionnaire, we needed to include a question asking about the profession or the background of the respondent. Another improvement could be to conduct different online questionnaires for people with different professions, e.g. one for farmers or agricultural specialist, one for engineers and one for the general public. That could've helped us in understanding the point of view of different sectors of the society, instead of just differentiating between them based on age or gender. Second, in the last question of the online questionnaire, we asked about a suitable price for our product and gave options. According to the comments received, we noticed that some people thought the prices were low and some thought that they were high, and others were confused about what did this price mean in terms of the system. Engineer Ayman and some respondents commented on this regard, that when prices are given for such a system, it should mention the area this price is going to cover. Moreover, a possible beneficial input to the needs analysis is to interview a large production company since they could be a potential customer. We contacted the production company: Al Sulaiteen Agricultural & Industrial Complex (SAIC) by email but didn't receive feedback from them.

4. Evaluation of Assignment

The questionnaire we conducted showed that the majority of respondents were not familiar with a smart irrigation system. Also, none of the experts we interviewed operated a smart irrigation system in their respective companies. This is very important since we can use the smart technology we are designing in something necessary and something we depend on (for agriculture and food production) like irrigation systems. Also, we aim to use this technology for a greater good: to help save our environment by consuming less water for sustainability. In both surveys, it was brought to our attention that there were many approaches for dispensing water in irrigation systems. The respondents from the questionnaire and the experts both suggested to use a drip irrigation system instead of sprinklers since it is more efficient as it dispenses water straight to the soil without any water wastage. The engineers from Kahramaa pointed out a suitable placement for fault detection process, we can do that by placing a pressure and flow meter at the water pump level instead of placing it at the end node. Since placing it at the end node might give us a non-accurate location of the fault. Thus, it is more efficient to check for fault detection at the source of the problem rather than checking only the end nodes.

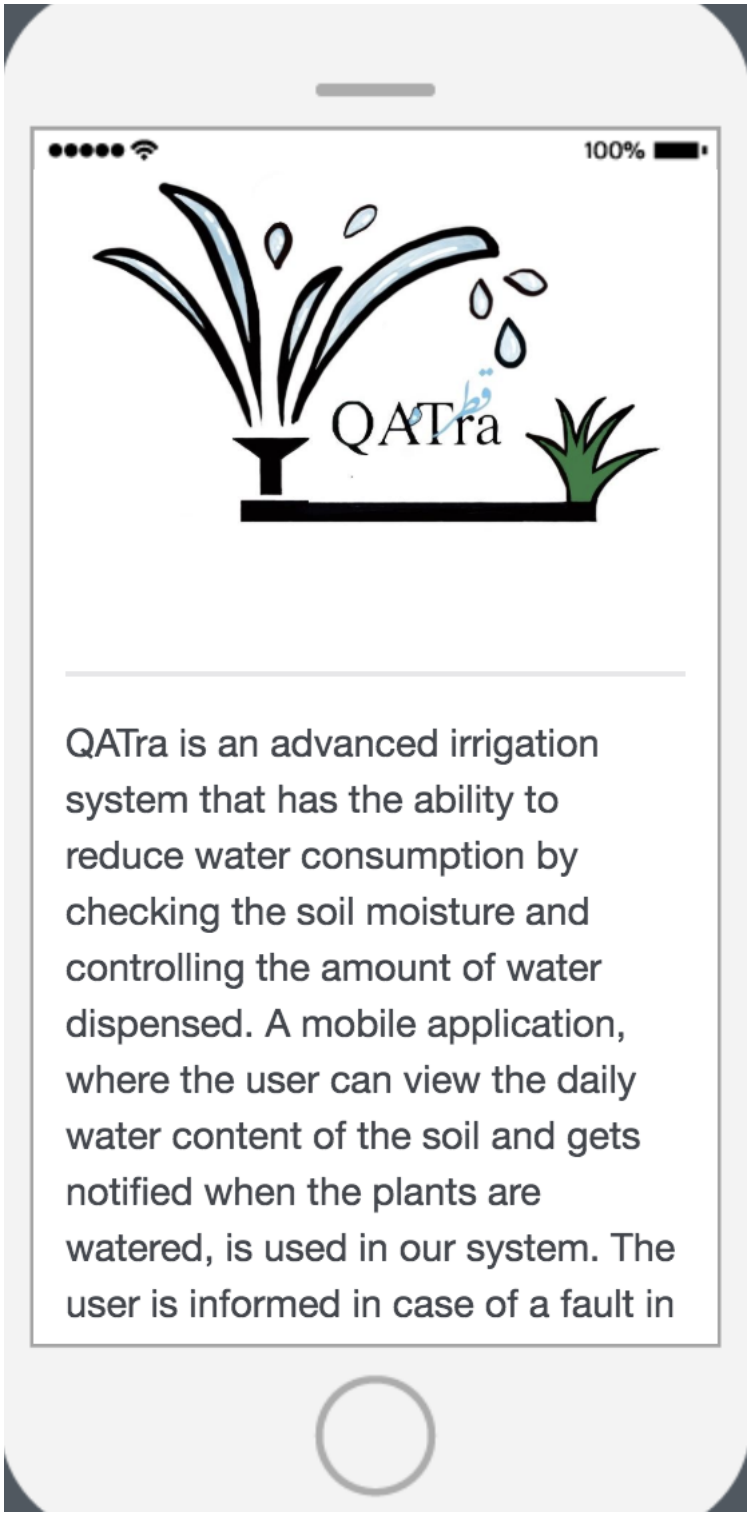
In our initial design we faced many constraints regarding agricultural technical information. Therefore, negotiation with an Agricultural Affairs Consultant from the Ministry of Municipality and Environment gave us a direction to focus on a single type of crop (vegetable crop), to use mixed soil (sandy and clay soil) as it is the most suitable soil type for agriculture and to gather data from the FAO on the water threshold levels and growth phases of the crop. Also, we were able to clarify that the root zone of each crop is the most optimal place for the sensors in the soil in order to obtain more accurate readings. We discussed with the specialists some constraints that we should take into consideration to help us develop a more desirable product. The interviewees said that we should focus on social acceptance towards such systems since it uses new technology, and adaptation to change is required from consumers. Therefore, raising awareness on advanced systems is vital. Additionally, Eng. Mohammed warned us on various technical problems that we might face during testing due to different environmental conditions. These constraints should be well studied in order to produce an overall well function prototype.

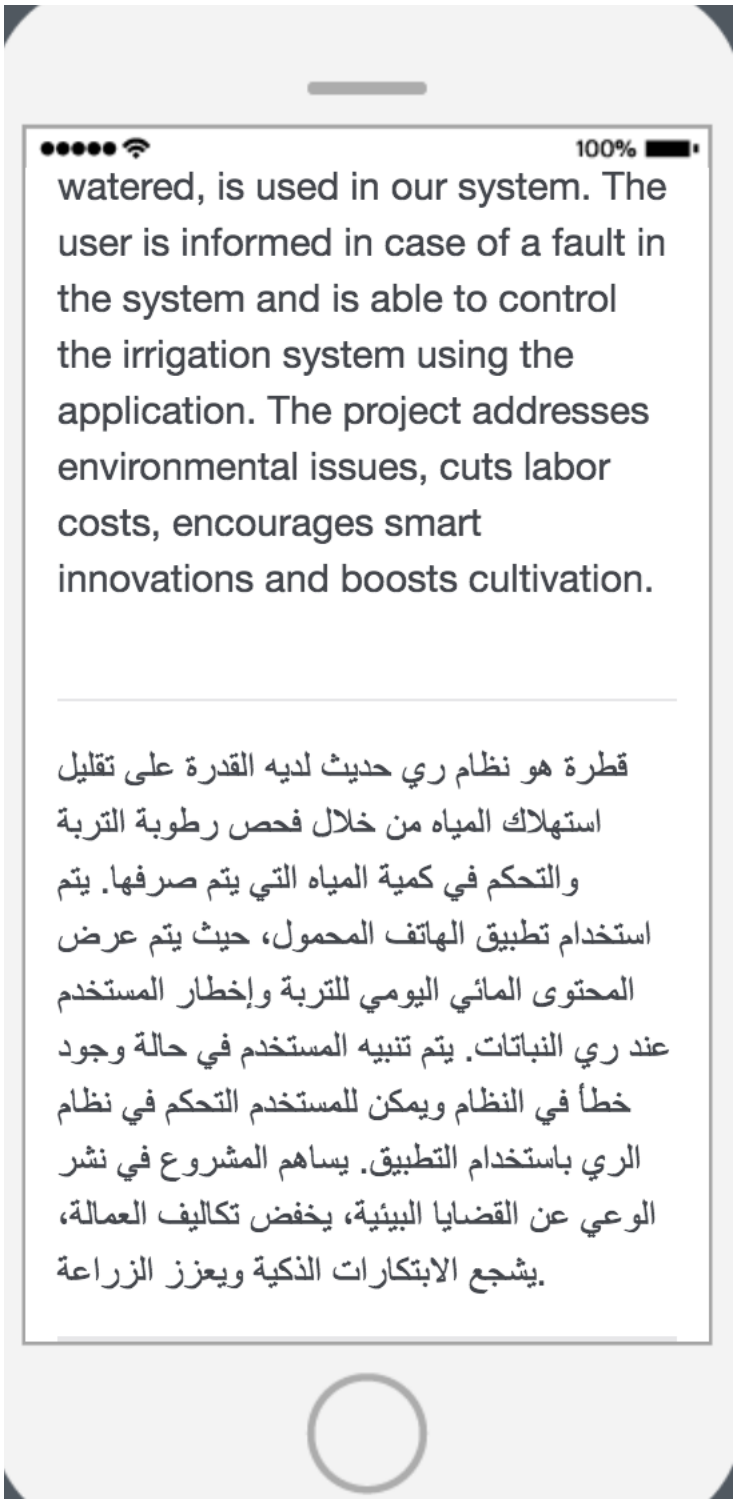
5. Conclusion

Conducting surveys for a wide range of audience helped us to uncover our proposed design from different angles. Obtaining the response from the general public assisted us to discover if there might be demand towards an advanced irrigation system and if consumers are willing to adapt to such technology. Moreover, expertise gave us insight on the overall constraints that we might face and have pointed out some issues that we initially did not think of such as fault detection and agricultural aspects. The responses we gathered from both surveys help us to meet our objective and hopefully be able to change our existing design for a more practical and effective design.

6. Appendix

6.1 - Survey 1: Questionnaire

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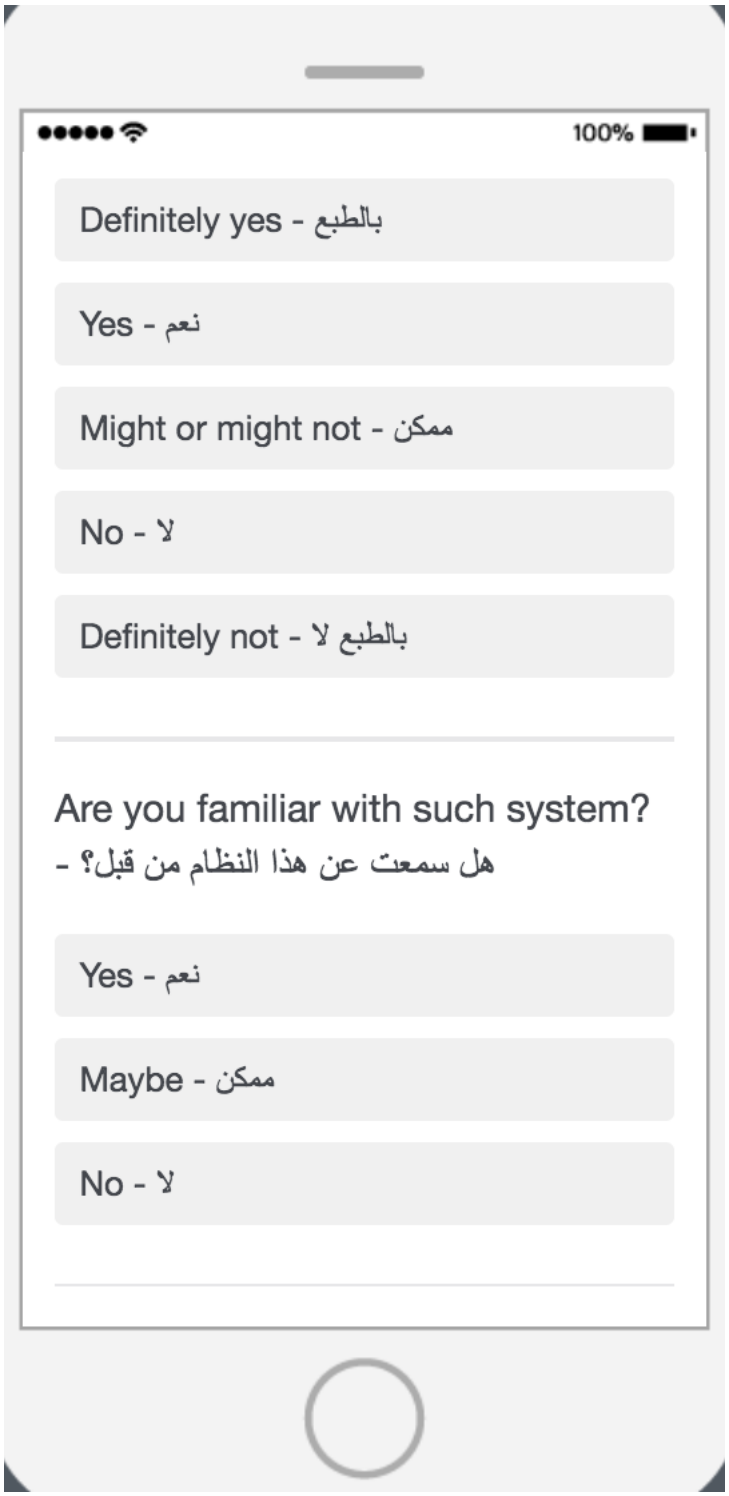
watered, is used in our system. The user is informed in case of a fault in the system and is able to control the irrigation system using the application. The project addresses environmental issues, cuts labor costs, encourages smart innovations and boosts cultivation.
قطرة هو نظام ري حديث لديه القدرة على تقليل استهلاك المياه من خلال فحص رطوبة التربة والتحكم في كمية المياه التي يتم صرفها. يتم استخدام تطبيق الهاتف المحمول، حيث يتم عرض المحتوى المائي اليومي للتربة وإخطار المستخدم عند ري النباتات. يتم تنبيه المستخدم في حالة وجود خطأ في النظام ويمكن للمستخدم التحكم في نظام الري باستخدام التطبيق. يساهم المشروع في نشر الوعي عن القضايا البيئية، يخفض تكاليف العمالة، يشجع الابتكارات الذكية ويعزز الزراعة.


100%
Age Range - الفئة العمرية
Below 18 - اصغر من ١٨ سنة
18-25
26-35
Above 35 - اكبر من ٣٥ سنة
Gender - الجنس
Male - ذكر
Female - انثى
Will you be interested in a Smart Irrigation System? - هل انت/ي مهتم/ة في نظام ري حديث؟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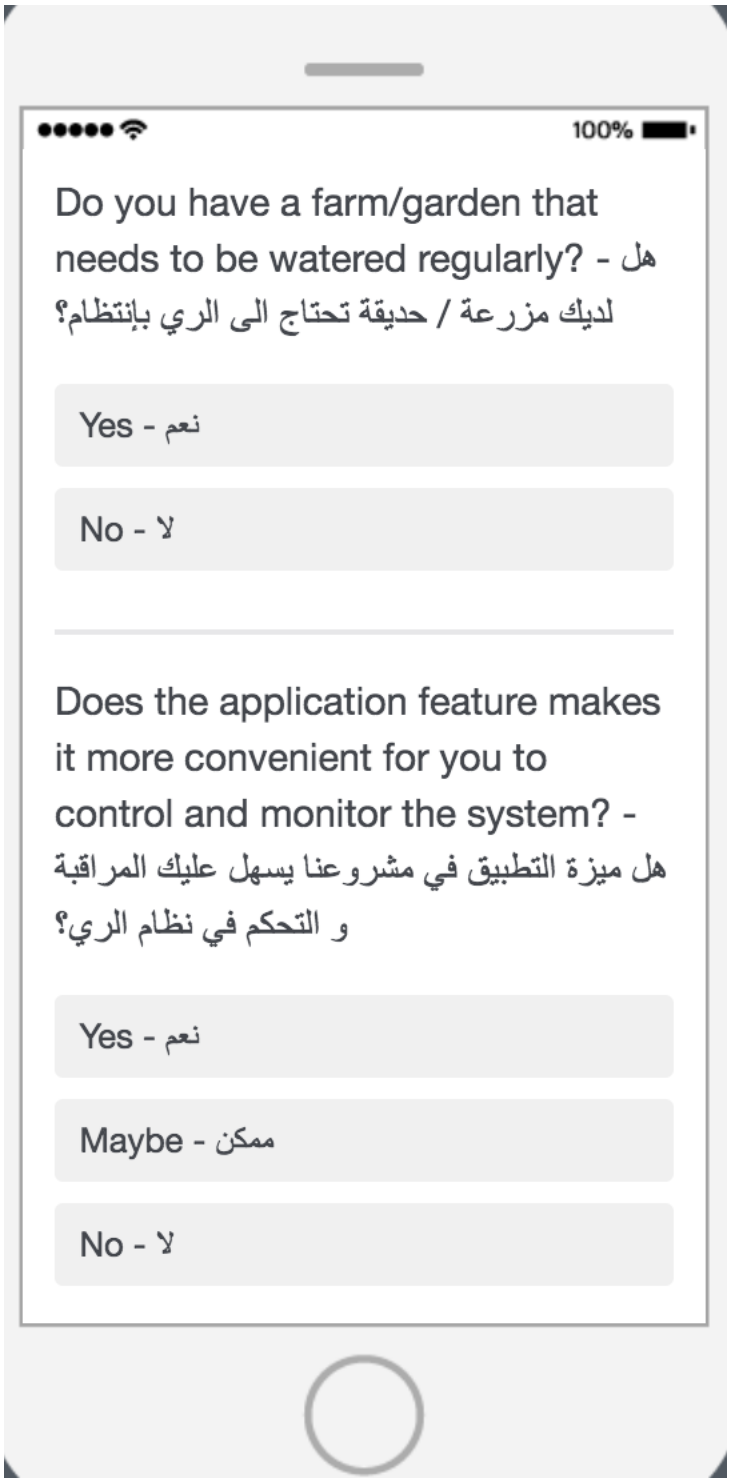
Definitely yes - بالطبع
Yes - نعم
Might or might not - ممكن
No - لا
Definitely not - بالطبع لا
Are you familiar with such system?
هل سمعت عن هذا النظام من قبل؟ -
Yes - نعم
Maybe - ممكن
No - لا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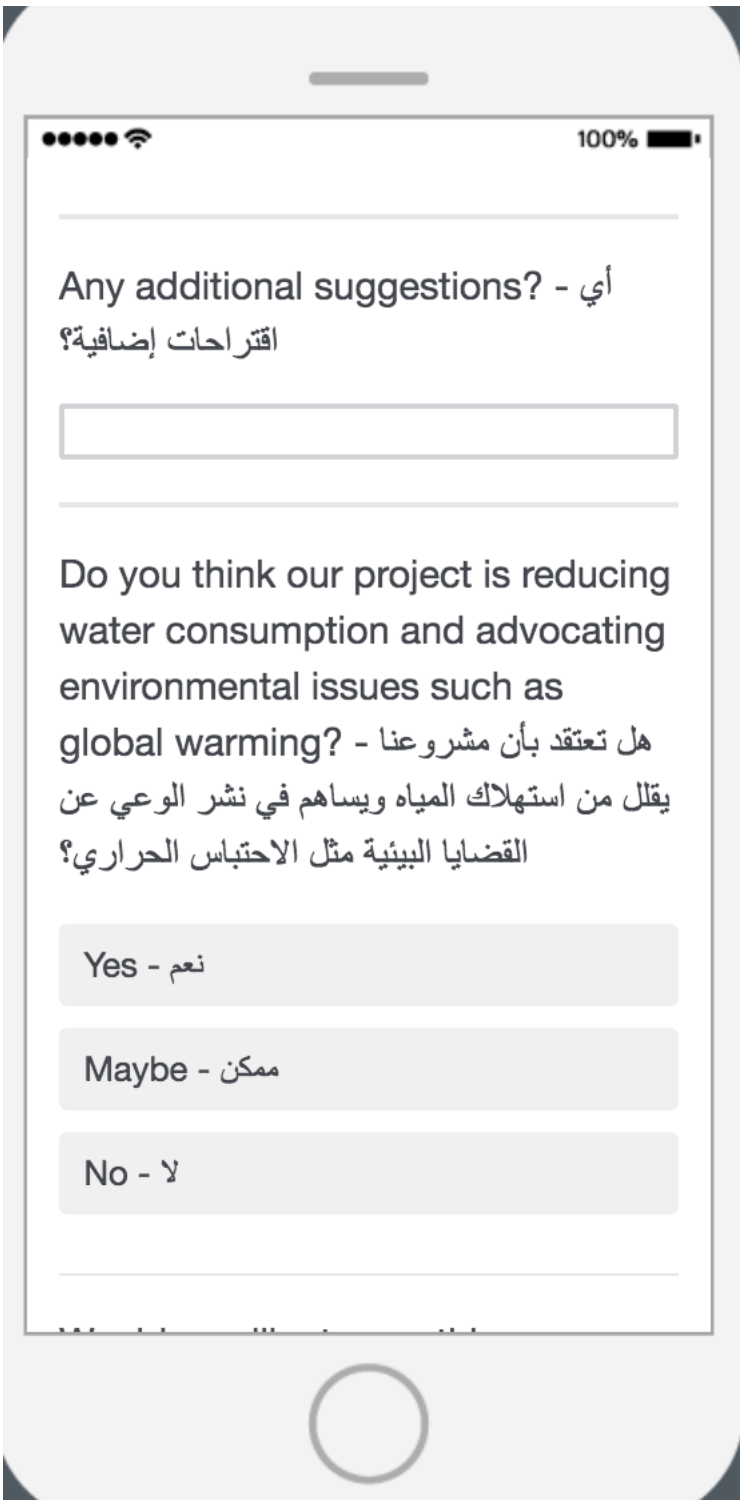
Do you have a farm/garden that needs to be watered regularly? - هل لديك مزرعة / حديقة تحتاج الى الري بإنتظام؟
Yes - نعم
No - لا
Does the application feature makes it more convenient for you to control and monitor the system? - هل ميزة التطبيق في مشروعنا يسهل عليك المراقبة و التحكم في نظام الري؟
Yes - نعم
Maybe - ممكن
No - لا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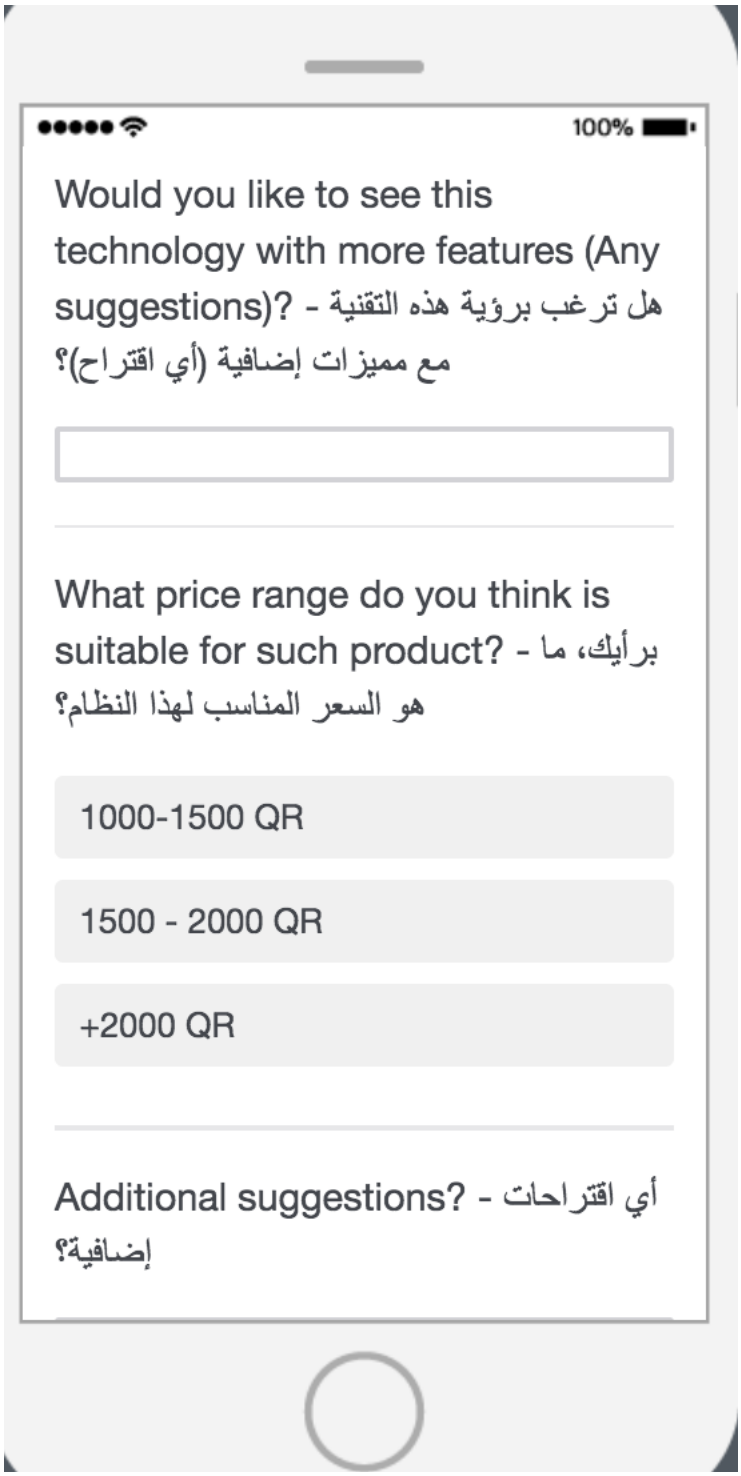
Any additional suggestions? - أي اقتراحات إضافية؟
Do you think our project is reducing water consumption and advocating environmental issues such as global warming? - هل تعتقد بأن مشروعنا يقلل من استهلاك المياه ويساهم في نشر الوعي عن القضايا البيئية مثل الاحتباس الحراري؟
Yes - نعم
Maybe - ممكن
No - لا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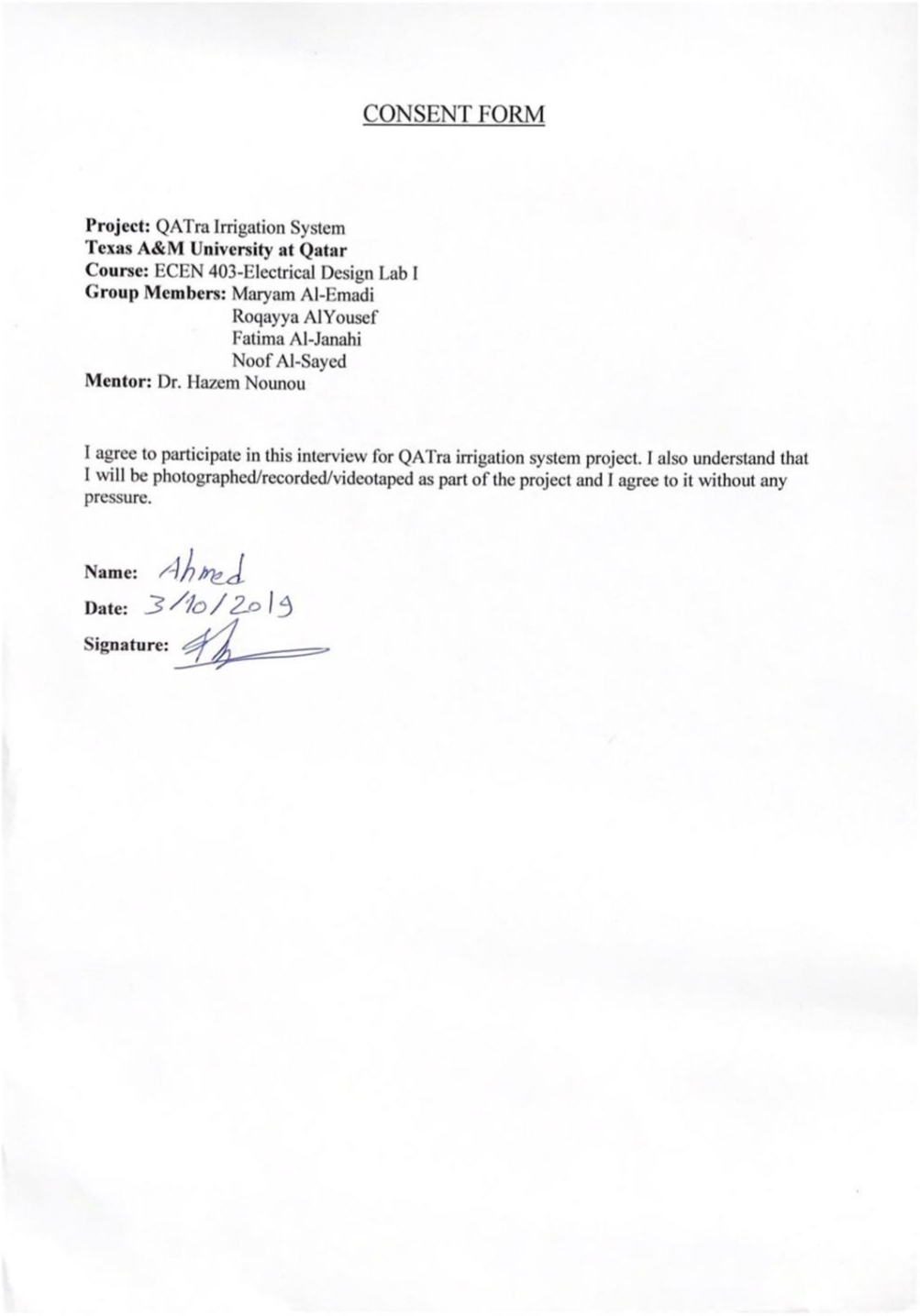
Would you like to see this technology with more features (Any suggestions)? - هل ترغب برؤية هذه التقنية مع مميزات إضافية (أي اقتراح)؟
What price range do you think is suitable for such product? - برأيك، ما هو السعر المناسب لهذا النظام؟
1000-1500 QR
1500 - 2000 QR
+2000 QR
Additional suggestions? - أي اقتراحات إضافية؟

6.2 - Consent Forms of Interviewees

Consent form of Eng. Ahmed Shaker:



CONSENT FORM

Project: QATra Irrigation System
Texas A&M University at Qatar
Course: ECEN 403-Electrical Design Lab I
Group Members: Maryam Al-Emadi
Roqayya AlYousef
Fatima Al-Janahi
Noof Al-Sayed
Mentor: Dr. Hazem Nounou

I agree to participate in this interview for QATra irrigation system project. I also understand that I will be photographed/recorded/videotaped as part of the project and I agree to it without any pressure.

Name: Ahmed
Date: 3/10/2019
Signature:

Consent form of Eng. Ayman Mashali:

CONSENT FORM

Project: QATra Irrigation System
Texas A&M University at Qatar
Course: ECEN 403-Electrical Design Lab I
Group Members: Maryam Al-Emadi
Roqayya AlYousef
Fatima Al-Janahi
Noof Al-Sayed
Mentor: Dr. Hazem Nounou

I agree to participate in this interview for QATra irrigation system project. I also understand that I will be photographed/recorded/videotaped as part of the project and aware that this material will be used for assignments like the market analysis study, ethnographic study video and any upcoming assignment that might need this material.

Name: Ayman Mashali

Date: 14-10-2019

Signature:

Consent form of Eng. Mohamed Ben Aicha:

CONSENT FORM

Project: QATra Irrigation System
Texas A&M University at Qatar
Course: ECEN 403-Electrical Design Lab I
Group Members: Maryam Al-Emadi
Roqayya AlYousef
Fatima Al-Janahi
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Name: Mohamed Sabah Ben Aicha // Project Engineer.

Date: 14/10 2019

Signature:

Consent form of Mr. Osman Ahmed Abdalla:

CONSENT FORM

Project: QATra Irrigation System
Texas A&M University at Qatar
Course: ECEN 403-Electrical Design Lab I
Group Members: Maryam Al-Emadi
Roqayya AlYousef
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Name: Osman Ahmed El Sharief Abdalla

Date: 14 OCT 2019

Signature: