Background Research &
Requirements Specifications

1. Background Research

1.1 Introduction

A lot of research has been done in the field of agriculture, most of the focus on sensors and signals of sensors [1]. This part mainly presents a literature survey in sensors, modules and solar panels. Today, the sun is the largest source of heat, light, and energy. ABAIS that is Arduino-based automated irrigation system take own energy directly from the sun with solar panel and movement system. It is clear that solar energy is not used in most research. The ABAIS is running the system with the energy obtained from the natural source of the sun and it keeps own energy in internal battery. This gives a noticeable advantage.

The main target is the irrigation efficiency. The water in the soil can be measured whatever happens [2]. As used in other projects, the soil moisture sensor takes on one of the most important roles in the project. Thus, when the soil needs water, the information is taken through the soil moisture sensor. Water should be checked frequently because water can be finished. Thanks to the water level sensor that we use in the ABAIS, this job is easily controlled with the help of the sensor without human need. Water saving is also an important feature. Therefore the water loss should be minimized and the efficiency of the water used should be increased. The water level sensor eliminates unnecessary following of the water supply and thanks to the soil moisture sensor, unnecessary use of water is eliminated [3]. Also, when the occupancy rate of the water tank is followed up and found insufficient, it informs the grower via SMS by other important sensors and modules that on ABAIS. As in the other projects, the irrigation system is operated systematically.

1.2 Various comparisons

Project 1 [2]

Projects / Features	Technology	Follow-up	Remote Cont.	Power	Moisture Control	Others
ABAIS	Arduino (Leonardo)	LCD	GSM (sms)	Solar Panel + Battery	Soil Moisture Sensor	Water Level Sensor
Project 1	Arduino (Mega)	LCD	GSM (gprs)	Power Adapter	Dielectric Soil Moisture	Data Logging Shield

The technology used by ABAIS and project 1 carries out the same tasks in the project. In the two technologies that do the same work, the cost of the project is cheaper than it is always preferred. Thanks to the technology that is used by ABAIS, it does the same job and uses less expensive technology. Another subject is the LCDs, which function by reflecting the read data to the screen. ABAIS uses an 16x2 character LCD. Project 1 uses a 64x128 graphic LCD. There are two materials that do the same work. That's why ABAIS' s technology is still cheap. As long as the read data is safely written to the screen, it does not add a burden to the project in terms of cost calculation. Thanks to the GSM module that on ABAIS, when the occupancy rate of the water tank is followed up and found insufficient, it informs the grower via SMS. The ABAIS has a built-in battery which possesses self-charging with solar panel. The solar panels in the ABAIS are used most efficiently during the day thanks to the ability to follow the sun. The solar tracking system and solar panels used add to the environment-friendly feature. It is a feature that can not be ignored today. ABAIS's use of electricity produced from the sun instead of the electricity grid is one of the biggest advantages. Project 1 used an electronic adapter connected to the electric grid. For open field application, the power supply can be provided through a common lead-acid battery and the environmental sensors are powered directly by a high-efficiency digital switch, by passing the onboard linear converter [2]. Dielectric soil moisture sensors detect the soil moisture by measuring the dielectric constant of the soil, an electrical property that is highly dependent on the moisture content. The used sensor in the ABAIS, soil moisture sensor has low cost, very accurate, continuous measurement at the same location and direct water reading for irrigation but there are disadvantages that are destructive, time-consuming, slow response to changes in soil water content.

Project 2 [3]

Projects / Features	Technology	Follow-up	Remote Cont.	Power	Water Control	Others
ABAIS	Arduino (Leonardo)	LCD	GSM (sms)	Solar Panel + Battery	Water Level S. + Pump	-
Project 2	Logic Circuit (NE555)	Level Display	-	Power Adapter	Geotextile + Valve	Data Logging

The main purpose of automation systems is to improve plant growth, to increase efficiency and to monitor it [3]. ABAIS targets the system to be suitable for a home user. At the same time, project 2 has set out for this purpose. Project 2 has logic circuit for soil measurement and follow input values. ABAIS uses Arduino that has a more advanced design. The absorption rate of the plants depends on many factors [3]. The important value in irrigation projects is to control these factors. In ABAIS, these factors are controlled by various sensors. Project 2 uses geotextile [3] that is reduce the water consumption by limiting the evaporation of excess water and dripline for absorption control. One of the main differences between the two projects is the water control. Project 2 has valve driver, the driver is the circuit that activates the valve on the Flow Control signal from the Logic Circuit. In contrast, the ABAIS controls the water flow with the water pump. The data logging is presented to future developments in Project 2 [3].

Project 3 [4]

Projects/Features	Technology	Follow-up	Remote Cont.	Power
ABAIS	Arduino (Leonardo)	LCD	GSM (sms)	Solar Panel + Battery
Project 3	Arduino (Mega)	Mobile App	Wi-Fi	Battery

Project 3 is a Clearwater Industries project and the aim of the project is to ensure efficient growth by monitoring irrigation. Project 3 has a smartphone application based human machine interface. This permits users to optimize watering. These provide to users by microcontroller for processing data, moisture sensors to detect saturation levels, and solenoids connected to drip lines for water distribution [4]. All this works in the same way as ABAIS, but Project 3 provides the energy needs with batteries that need to be changed. GSM

module is used in ABAIS, which is more convenient than Wi-Fi. And there is no drawback to Wi-Fi as performance. It is even easier to use than Wi-Fi, for instance no mobile application is required.

Project 4 [5]

Projects/Features	Technology	Follow-up	Remote Cont.	Power	Others
ABAIS	Arduino (Leonardo)	LCD	GSM (sms)	Solar Panel + Battery	Water Control
Project 4	Raspberry Pi + Arduino (Nano)	Mobile App	Bluetooth	Battery	Data Logging

The biggest difference of Project 4 is that this is a monitoring application instead of automated irrigation system. Soil moisture monitoring is a common fact for both projects. The main aim of Project 4 is to provide low-cost and wireless soil moisture monitoring and help farmers determine their exact irrigation needs [5]. This tracking is made possible by the base station and the sensor nodes communicating with each other. Farmers can monitor data with their mobile devices via Bluetooth. The Bluetooth technology is unnecessary for ABAIS that has GSM module, because SMS is a more effective solution for data tracking and control than bluetooth plus mobile app. For communicate via Bluetooth, the base station, sensor nodes and the mobile phone which application installed must be within a certain range [6]. However, there is no such limitation in GSM. If the user is near ABAIS, datas can be monitored via the built-in LCD. Also, there is a solar panel in ABAIS, so it can produce its own energy but Project 4 has only batteries that need charging. As a result, both projects considers users to save on irrigation costs, provide better efficiency and reduce overall water use. While the Project 4 is only monitoring system, the ABAIS provides automatic watering.

Project 5 [8]

Projects/Features	Technology	Follow-up	Remote Cont.	Power	Others
ABAIS	Arduino (Leonardo)	LCD	GSM (sms)	Solar Panel + Battery	Water Control
Project 5	ZigBee	over the internet	GSM (sms)	Solar Panel + Battery	Database Connection

In general, the two projects seems very close to each other. But there are many technological differences. The two projects have multiple advantages and disadvantages. Looking at ABAIS in general, there are more detailed explanations and resources on the irrigation system, and in the Project 5, works on multiple platforms and may access to past data via database. There is an information that in Project 5, it has been saved up to 90% water in natural environments [8]. This statistic shows that the system has proven itself. Since ABAIS is the project that not implemented yet, so it is not right to compare two projects in this branch. Both projects have battery and solar panels. Both projects have almost the same technology about these branch. In terms of communicating with the customers, Project 5 has a GPRS module, provides internet connectivity with this module and allows users to access information over the internet. It also allows users to influence the system over the internet. ABAIS has a GSM module, this module communicates information to users via sms method and enables users to access the system via sms method in the same way. The biggest difference is that in Project 5, users have access to old data and can be informed about changes over time.

Project 6 [9]

Projects/Features	Technology	Follow-up	Remote Cont.	Power
ABAIS	Arduino (Leonardo)	LCD	GSM (sms)	Solar Panel + Battery
Project 6	AT89S52 (8051 Microcontroller)	LCD	-	Solar Panel + Battery

In general, looking at the two systems, the Project 6 is in the sector, but does not seem a bit professional. But there are many good comments about this project. In the Project 6, the system operates the irrigation pump with the energy it receives from solar energy [9]. ABAIS has almost the same technology. There are solar panel and the battery and the whole system uses only these energy suppliers. Both projects have a humidity sensor, and when there is not enough moisture in the soil, they are both working. There is a water level sensor in ABAIS and informed by the message coming from the system when the water in our source is low. Project 6 does not provide any information about the source.

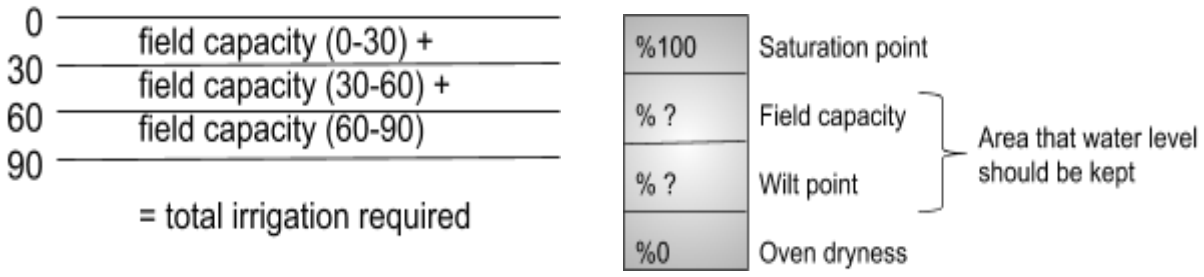
1.3 Comparison Chart

Project / Features	Technology	Follow-up	Remote Control	Water Control	Power
ABAIS	Arduino (Leonardo)	LCD	GSM (sms)	Water level s. + pump	Solar Panel + Battery
Project 1	Arduino (Mega)	LCD	GSM (gprs)	Pump	Power Adapter
Project 2	Logic Circuit (NE555)	Level Disp.	-	Geotextile + Valve	Power Adapter
Project 3	Arduino (Mega)	Mobile App.	Wi-Fi	Valve	Battery
Project 4	Raspberry Pi + Arduino (Nano)	Mobile App.	Bluetooth	-	Battery
Project 5	ZigBee	Over the Internet	GSM (gprs)	Valve + pump	Solar Panel + Battery
Project 6	AT89S52 (8051)	LCD	-	Pump	Solar Panel + Battery

1.4 Ideas of Specialists

Specialists who are from Ege University were interviewed, for the corrections of the project. As a result of the interviews, ideas were developed to develop the project. According to the information about the watering hours, if the watering is done in the summertime, the most efficient watering time is before the sun rises. Evening watering time is after sunset. If watering is done in the winter time, the sun does not irrigate because the soil holds moisture. In addition to the watering hours, the reaction of the soil to water is also important. Since the targeted irrigation pots and horticultural crops are used, irrigation is done using average soil calculations. The important point here is the quality of the sensors used. This situation greatly affects the irrigation efficiency. As stated below, the soil depth must be taken into account when watering. In pots this account is ignored. In the gardens, extra irrigation should be done according to the increasing depth and the layers should be irrigated equally. For irrigation efficiency, the amount of water in the soil must remain between "wilt point" and "field capacity". On the advice of specialists, the system to be created should not have a complex structure and the system should have advanced data logging. In addition, if more than one

point is to be irrigated, the system must contain a valve. The interview stated in the reference source A made a major contribution to the development of the project.



(Figures and details are given in Appendix A)

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