THE DEVELOPMENT OF AN AGRO-METEOROLOGICAL MONITORING APPLICATION USING GEO-SPATIAL TECHNIQUES FOR PRECISION FARMING

(CASE OF STUDY OF MAPS, ATMOSPHERIC PRESSURE AND RAINFALL)

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ABSTRACT

This work focuses on the use of geospatial technologies in precision farming. To achieve this, the focus is on how geospatial data is collected, analyzed and used in the decision making process to maximize on yields. An application of this nature can be developed to help bring a new face to the technology of agriculture with the use of an open weather map with the purpose of visualizing its real-time on android smartphone using the device's inbuilt GPs to track current location. This application was developed to get current weather information basically (Maps, Atmospheric Pressure and Rainfall) based on the user's current location. The application was tested in Federal Polytechnic Ado-Ekiti, Ekiti State. Statistical tools used to analyze the data were ANOVA and charts which show the results were at variance and this may be due to the location of the Automatic weather station because some were sited around river, hill, snow, farm land e.t.c. The use of this application developed enables the farmer or the user of the application to have the knowledge and idea in order to make wise decision on which crop to plant on the farm from the data obtained from the app developed for atmospheric pressure and rainfall.

With the use of the application, more job opportunity will be created for youth because it will give them freedom to farm anywhere at any time and it will increase the farming system of the nation in every side.

Key-Words: - Agro-meteorological, Atmospheric pressure, Geo-spatial, Map, Precision

farming, Rainfall

INTRODUCTION

1.1 Background of the Study

It was discovered that not only the old do farming business again but farming business has gone wide that both the young and old are now into farming due to the economy advancement in our technology. During the search about this topic it was brought to our understanding that both the young and old farmers lack the understanding of using precision farming and geo-spatial technique in Nigeria. It was discovered that computer now play a great role in the agricultural sector, the use of computer has goes wider. Computer is one of the electronic devices which have simplified the world by its usefulness to the people. Computer is used in various fields such as education, agriculture, business organization, scientific research etc.

As a modern electronic device, computer has not only have made changes in modern occupation but it has also made changes in traditional occupation sector like Agriculture. Computer help agriculture through computer software, computer internet etc. Through computer application animal are individually track so, no mistakes will take place but if it is done by a person sometimes mistakenly error can happen. Information such as health of the animal, milk production, reproductive information can be got through precision agriculture; these types of information are known as herd recording (Chen and wingfield, 2012). This herd recording is stored in computer, through forum and social networking, site farmers can get connected with other experts and exchange their views and other details. Farmers can get

a lot of information on variety of agriculture topics by surfing. Farmers can get connected to foreign customers who can help to improve their products and increase their production capacity. Farmer can get information regarding price, weather, temperature etc. Keeping financial record, production records, online banking, buy required resources through internet etc. The amount of water sprinkled in a balanced quantity is also computerized. The production capacity in farming and animal husbandry has increase due to use of computer in agriculture field. There are less losses due to work been monitored by computer; by using computer in traditional field like agricultural field, productivity can be increased and minimize the error happen.

The technology devices has also come in a very mobile way through our android phone, agriculture can be put to performer. The android device is not only use to make call, or send sms but it can be to great advantage of many industries. The android device is now placed on very high rates which make it assessable by everyone at any time in any place.

The world is facing interesting challenges in the years to come: a growing population that needs to be fed, combined with labour scarcity in agriculture, limited natural resources (e.g. oil, fresh water, fertilizers) and a growing concern about the environment (from large scale resource use). Precision farming addresses these challenges by supporting or automating precise dosage, timing, and allocation of inputs (e.g. fertilizers in arable farming or time varying temperature control in greenhouses). During the past 15 years, the Farm Technology group has built up an extensive and unique portfolio in precision farming ranging from optimal climate control in greenhouses, to precision weed control in arable farming, and to individual health status prediction in livestock farming (Bohn, 2012). The principles of systems and control theory offer solutions with significant impact to a wide range of challenges in precision farming.

This project collects geospatial data via reputable weather recourse api's (open weather maps) with the purpose of visualizing its real-time on android smartphone using the device's inbuilt GPs to track current location. The application developed will get current weather information basically (Maps, Atmospheric Pressure and Rainfall) based on the user's current location. The implemented package will be tested on the available mobile devices and analyze how mobile application can be used to enhance precision farming, assist farmers and subsequently increase crop yield.

2. METHODOLOGY

This work started on the premise of the previous work done in 2016 by Akerele *et al.*, (2016). These authors have successfully developed Gumbel Mathematical model for predicting meteorological data in agriculture. Below are the details of how the project was carried out and the flowchart is shown in Appendix 1.

2.1 Java Programming Language

A powerful, general-purpose, platform-independent, object-oriented programming language.

Java is a set of technologies (programming language and computing platform) for creating and running software. However, Java is often used to refer Java programming language for simplicity. In order to be able to run java programming on windows (up 7, 8 and 10) we need; Java runtime environment and Java development kit.

2.1.1 Java runtime environment (JRE)

JRE contains JVM (java virtual machine), supporting libraries, and other components to run a Java program. However, it does not contain a compiler or a debugger but have a lot of java libraries (already packaged files) and modules.

2.1.2 Java development kit (JDK)

JDK (Java Development Kit) contains JRE and tools such as compilers and debuggers for developing Java application; it contains a lot of java libraries. Plate 2 below is the java SE development kit which was downloaded for the development of the application.

Java SE Development Kit 8u131

You must accept the Oracle Binary Code License Agreement for Java SE to download this software.

Accept License Agreement Decline License Agreement

Product / File Description	File Size	Download
Linux ARM 32 Hard Float ABI	77.87 MB	jdk-8u131-linux-arm32-vfp-hflt.tar.gz
Linux ARM 64 Hard Float ABI	74.81 MB	jdk-8u131-linux-arm64-vfp-hflt.tar.gz
Linux x86	164.66 MB	jdk-8u131-linux-i586.rpm
Linux x86	179.39 MB	jdk-8u131-linux-i586.tar.gz
Linux x64	162.11 MB	jdk-8u131-linux-x64.rpm
Linux x64	176.95 MB	jdk-8u131-linux-x64.tar.gz
Mac OS X	226.57 MB	jdk-8u131-macosx-x64.dmg
Solaris SPARC 64-bit	139.79 MB	jdk-8u131-solaris-sparcv9.tar.Z
Solaris SPARC 64-bit	99.13 MB	jdk-8u131-solaris-sparcv9.tar.gz
Solaris x64	140.51 MB	jdk-8u131-solaris-x64.tar.Z
Solaris x64	96.96 MB	jdk-8u131-solaris-x64.tar.gz
Windows x86	191.22 MB	jdk-8u131-windows-i586.exe
Windows x64	198.03 MB	jdk-8u131-windows-x64.exe

Plate 1 below is the java SE development kit which was downloaded for the development of the application.

Plate 1: Java Standard Edition Development Kit

2.3 Development Of An Android Software Application

This is the process by which new applications are created for devices running the Android operating system. Apps can be written using Java, C++ or Kotlin using the Android software development kit (SDK). But in this case, java programming is adopted using the Android software development kit (SDK). The Android software development kit (SDK) includes a comprehensive set of development tools. These include a debugger, libraries, documentation, sample code, and tutorials. The officially supported integrated development environment (IDE) was Eclipse using the Android Development Tools (ADT) Plugin, though IntelliJ IDEA IDE (all editions) fully supports Android development out of the box, and Net Beans IDE also supports Android development via a plugin. As of 2015, Android Studio, made by Google and powered by IntelliJ, is the official IDE; however, developers are free to use others, but Google made it clear that ADT was officially depreciated since the end of 2015 to focus on Android Studio as the official Android IDE.

Android Studio is Google's officially supported IDE for developing Android apps. Based on IntelliJ IDEA, Android Studio is freely available under License. The most recent stable version, 2.1.1, includes the following features:

a. A unified environment where you can develop for all Android devices.

b. Support for building Android TV apps and Android Wear apps.

c. Android applications are packaged in apk format.

d. Gradle-based build support.

e. C++ and NDK support.

f. Plugin architecture for extending Android Studio via plugins.

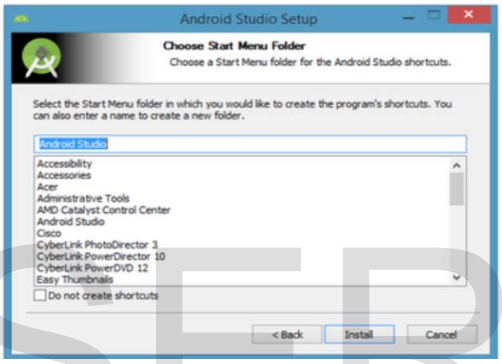
g. Gradle-based build support.

When installing android studio, one must be very careful and also to understand each process of its installation, because installation comes with setup, before downloading Android Studio, make sure that the computer meets one of the following requirements:

a. Microsoft Windows 7/8/10 (32-bit or 64-bit).

b. 2 GB RAM minimum, 8 GB RAM recommended.

c. 2 GB of available disk space minimum, 4 GB Recommended (500 MB for IDE + 1.5 GB for Android SDK and emulator system image).



d. 1280 x 800 minimum screen resolution.

e. JDK 8.

For accelerated emulator: 64-bit operating system and Intel processor with support for Intel VT-x, Intel EM64T (Intel 64), and Execute Disable (XD) Bit functionality

Once you've ensured your operating system is compatible with Android Studio 2.1.1, download the appropriate Android Studio distribution file, The Android Studio download page will auto-detect the kind of running operating system of the computer and android-studio-bundle-windows.exe should be download because it includes an installer and the Android SDK as shown in plate 2a and b.

Plate 2a: Android Studio Setup **Plate 2b:** Android Studio Set up

Clicking the show details button will let you view detailed information about the installation progress. The dialog box shown in plate 3 will inform you when installation has finished. To complete the installation, leave the Start Android Studio box.

Plate 3: Android Studio Setup SDK

2.4 The Development Step Using Android Studio

In order to complete the development action for the app, the followings were considered:

(i) a weather API key was gotten from the open weathermap which is an online service that provides weather data, including current weather data. After This API key was gotten, it was parse into the java programming used.

(ii) in order for the android device debugging, this was done; enabling USB debugging in the developer options was done by enabling the developer options:

Note: A developer mode in Android phones that allows newly programmed apps to be copied via USB to the device for testing. A gps enabled phone/with internet permission, the following activities were developed in the android studio which each has enabling functions;

1. Get location: this shows the latitude and longitude of exactly where the user is with the help of the enabled GPS on the device alongside as shown in Appendix 2 and 3 with the java programme language.

2. Weather information: this also shows the weather information of the location of where the user is, which works together with latitude and longitude, and also with the help of the registered agriculture API gotten from the openweathermap as shown in Appendix 3 and 4.

The java language programmed weather information is atmospheric pressure and rainfall.

3. Map: this shows the exact map of the location where the user is as shown in Appendix 5.

On android studio, the Google map activity was chosen, this activity enables to be able to view real time map on our device alongside the user location. The map activity code was written as well.

2.5 Layout

A new android project was chosen in the android studio where application name was changed to "ABE one", Company Domain: "example.com", preferred Android version was chose like API: 16 Android 4.1(Jelly Bean), while maximum and minimum SDK was chosen. Make sure the minimum SDK is below your phone's operating system level. An empty activity was selected after the above has been done, the default value was left and the activity was configured.

This is the main activity (the entry point for the app where the buttons are located). It should be built and run the app, the system launches an instance of this activity and loads its layout on the android device connected to it via USB debugging function with the help of ADB driver installed on the system. After the above has been done, the information files will be in;

app > res > layout > activity_main.xml

This XML file defines the layout for the activity's UI. It contains a text field element; Get location, weather information, and map. After completing this, you have an app that shows an activity (a single screen) with a text field and a button. A background and a header were added to the single screens which consist of the button and a text field by; clicking on the draw able on the top left corner on the screen which under res, and choose the show in Explorer, it was clicked on and the draw able folder opens, the image used was copy from the system and was pasted on the draw able folder and automatically enabled the image.

The background image code was written, and it was save Run and the preferred used android device was selected and deployed on the android device. Same was done also to insert the header image to the layout background; the summary of the layout is shown in Appendix 6.

3 RESULTS AND DISCUSSIONS

3.1 Results

The application was developed to work in an android mobile device, in which the data gotten from the application developed gives the average weather information (Map, Atmospheric pressure and rainfall) for the case study area. The developed application was connected with an automatic weather station (AWS) which is the openweathermap station, with the help of the registered agriculture application programming interface (API) key gotten from the

openweathermap station; the application developed has the access to the weather information on the station. With the android mobile device global positioning system (GPS) turned on, the average weather information for the location which is Ado – Ekiti will be gotten on the application developed.

After developing the application, some data were obtained which were tabulated; the data's were taken for two months from (August to September) as shown in Appendix 7. Data's were also obtained from other sources as shown in Appendix 8 and 9, so as to validate the data's obtained from the application developed. The data's obtained was from Yandex and Worldweather which was used to compare the data's from each other to see how perfect the application developed is to other data's obtained. Appendix 7 is the data obtained from the application developed while Appendix 8 is the data's obtain from Yandex and Appendix 9 is the data obtained from World weather.

Furthermore the data were divided in the two months and average of each week was used to plot the graphs below in Figure 2 and 3 which are for August and September. It was observes that World weather recorded the highest atmospheric pressure in the two months, followed by Yandex, while ABE recorded the least. This variation may be due to the sensitivity or type of equipment used or the location of the Automatic weather station.

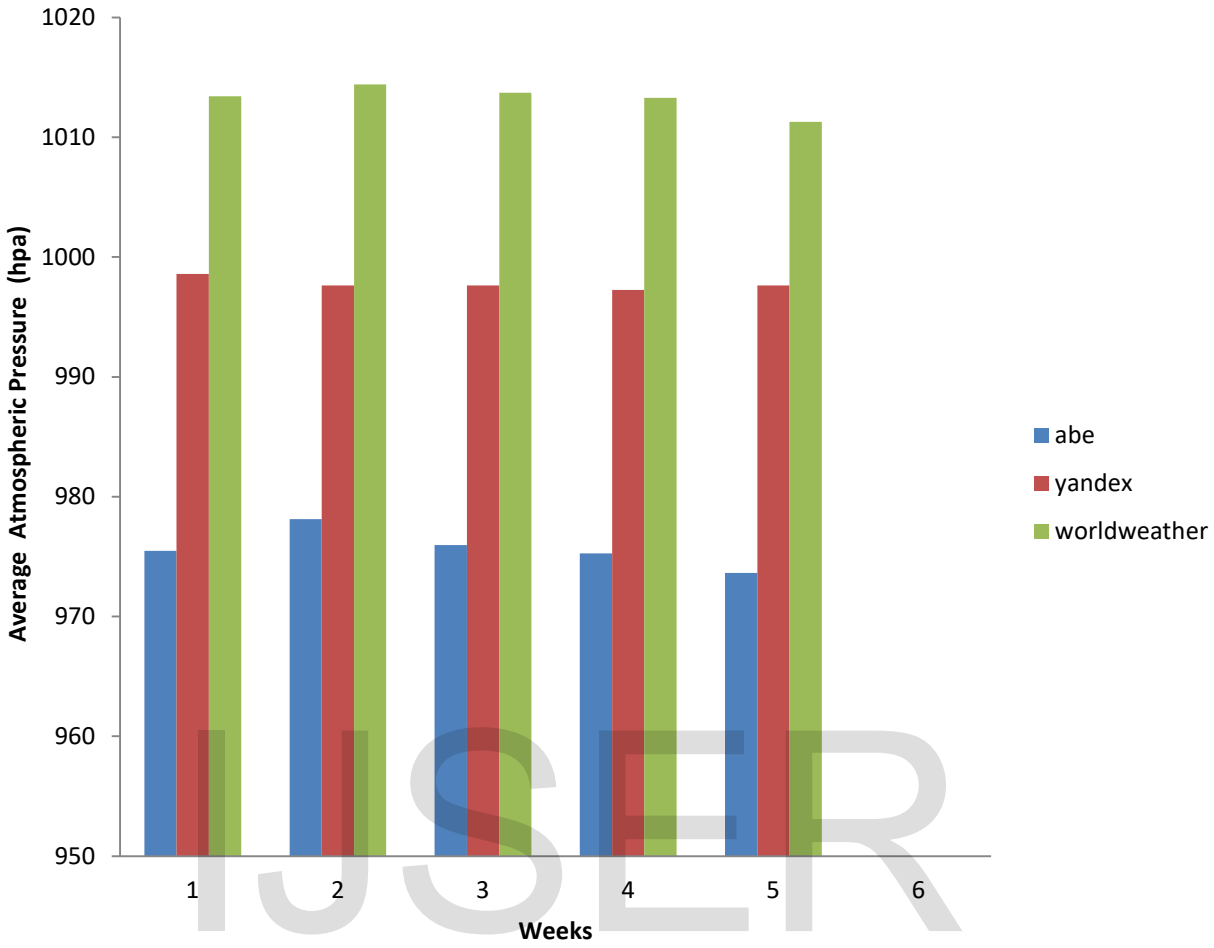


Figure 2: Average Atmospheric Pressure (hpa) For The Month Of August

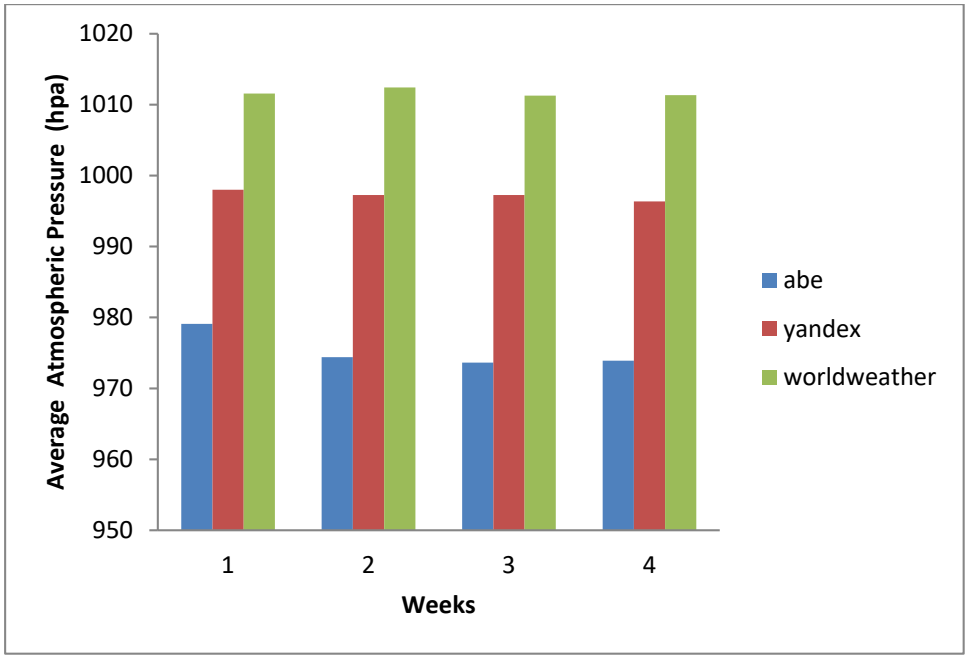


Figure 3: Average Atmospheric Pressure (hpa) For The Month Of September

3.1.1 Rainfall Data

The following results were obtained from the application on rainfall as shown in Table 3. The data obtained was compared with another data from world weather for the period of two months which was August and September. It was observed that there is similarity in the result ranging from light rainfall, moderate and scattered cloud on some days.

Table 3: Data Obtained from the Application and One other Source on Rainfall

Date	Abe	World weather
1/8/2018	few Rain	light rain
2/8/2018	broken cloud	thundery
3/8/2018	broken cloud	outbreak
4/8/2018	light rain	light rain
5/8/2018	light rain	light rain
6/8/2018	overcast clouds	light rain
7/8/2018	few clouds	moderate rain
8/8/2018	light rain	light rain
9/8/2018	light rain	light rain
10/8/2018	light rain	moderate rain
11/8/2018	scattered clouds	light rain
12/8/2018	moderate rain	scattered clouds
13/8/2018	light rain	light rain
14/8/2018	overcast clouds	light rain
15/8/2018	scattered clouds	overcast clouds
16/8/2018	moderate rain	moderate rain
17/8/2018	light rain	light rain
18/8/2018	overcast clouds	light rain
19/8/2018	light rain	moderate rain
20/8/2018	light rain	light rain
21/8/2018	moderate rain	heavy rain
22/8/2018	overcast clouds	light rain

23/8/2018	**moderate rain**	**heavy rain**
24/8/2018	**broken cloud**	**moderate rain**
25/8/2018	**light rain**	**light rain**
26/8/2018	**light rain**	**light rain**
27/8/2018	**broken cloud**	**moderate rain**
28/8/2018	**few clouds**	**broken clouds**
29/8/2018	**broken cloud**	**torrential rain**
30/8/2018	**light rain**	**moderate rain**
31/8/2018	**light rain**	**light rain**
1/9/2018	**broken cloud**	**light rain**
2/9/2018	**light rain**	**moderate rain**
3/9/2018	**moderate rain**	**moderate rain**
4/9/2018	**light rain**	**torrential rain**
5/9/2018	**light rain**	**torrential rain**
6/9/2018	**light rain**	**moderate rain**
7/9/2018	**light rain**	**light rain**
8/9/2018	**scattered clouds**	**torrential rain**
9/9/2018	**light rain**	**light rain**
10/9/2018	**light rain**	**moderate rain**
11/9/2018	**broken cloud**	**torrential rain**
12/9/2018	**moderate rain**	**light rain**
13/9/2018	**scattered clouds**	**moderate rain**
14/9/2018	**light rain**	**scattered clouds**
15/9/2018	**scattered clouds**	**moderate rain**
16/9/2018	**scattered clouds**	**broken clouds**

17/9/2018	**scattered clouds**	**scattered clouds**
18/9/2018	**moderate rain**	**scattered clouds**
19/9/2018	**clear sky**	**moderate rain**
20/9/2018	**light rain**	**light rain**
21/9/2018	**broken cloud**	**light rain**
22/9/2018	**overcast clouds**	**moderate rain**
23/9/2018	**light rain**	**moderate rain**
24/9/2018	**light rain**	**light rain**
25/9/2018	**heavy intensity rain**	**light rain**
26/9/2018	**moderate rain**	**thundery**
27/9/2018	**light rain**	**outbreak**
28/9/2018	**light rain**	**moderate rain**
29/9/2018	**moderate rain**	**light rain**
30/9/2018	**heavy intensity rain**	**moderate rain**

3.2 Discussion

Appendices 7, 8 and 9 are the data Atmospheric data obtained from the developed application and other two sources (yandex, worldweather). Furthermore the data's was divided into month which is August and September and was later divided into weeks, 5 weeks for August and 4 weeks for September.

Appendix 10 shows the average weather information for the month of August on atmospheric pressure, the data obtained from the application developed is at variance with other data from other sources which may be as a result of the location of the automatic weather station bit lower than other obtained due to the different source.

Also the data obtained from Yandex is a bit close to the data obtained from the application developed with that, it was shown that the Yandex data is close to the data collected from the application developed

The rainfall data obtained from the application developed and World weather for the month of august and September has a close relationship with each other as seen in the Table 3 above. The different in the results is not much from each other, with that the application can be said to be well developed because the data's obtained from each source is very close. An ANOVA calculation was done as shown in Appendix 12 which shows significant difference in all the results obtained. From the value of R obtained as shown in Appendix 13, there is a positive relationship/correlation between the variables.

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4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Data was collected using reputable weather recourse api's (open weather maps) which give its real-time on android smartphone with the device's inbuilt GPs to track current weather information of Federal Polytechnic Ado Ekiti, Ekiti State Nigeria.

The development of the application was done in other to get the average current weather information basically (Maps, Atmospheric Pressure and Rainfall) based on the user's current location. The application was tested on available mobile devices and all information was provided in the application which makes one known that he application is effective.

This application was developed bearing in mind cloud computing techniques which enhance precision farming, for farm management approach through information technology. This provides actual information that plant and crop needs for their optimum productivity and for healthy yield. However, the application developed will helps the farmer to make a wise decision on what to do on the farm because it is a decision support tool and gives opportunity for smart farming.

This research will serve as a basis for which agricultural methods and practices can be enhanced using mobile devices which is a common, efficient and flexible machine relatively useful in agriculture and other meteorological related fields as well as geo-spatial techniques which is widely becoming a very useful tool in every developing sector.

4.2 Recommendations

This application is recommended to every farmer both young and old to help because is cloud computing that serves as a decision support system.

The application will make youth find agriculture interesting because on their mobile phone, they can control some activities on the farm.

Through the agricultural extension agent, the illiterate farmers can also be helped to benefit from this new innovation.

Since the school does not have AWS and is not well structured, this application can assist the department to get average weather information of Ado Ekiti by standing in any of the location in the Google map in Appendix 5 and not just anywhere in the campus and the reading can be taken.

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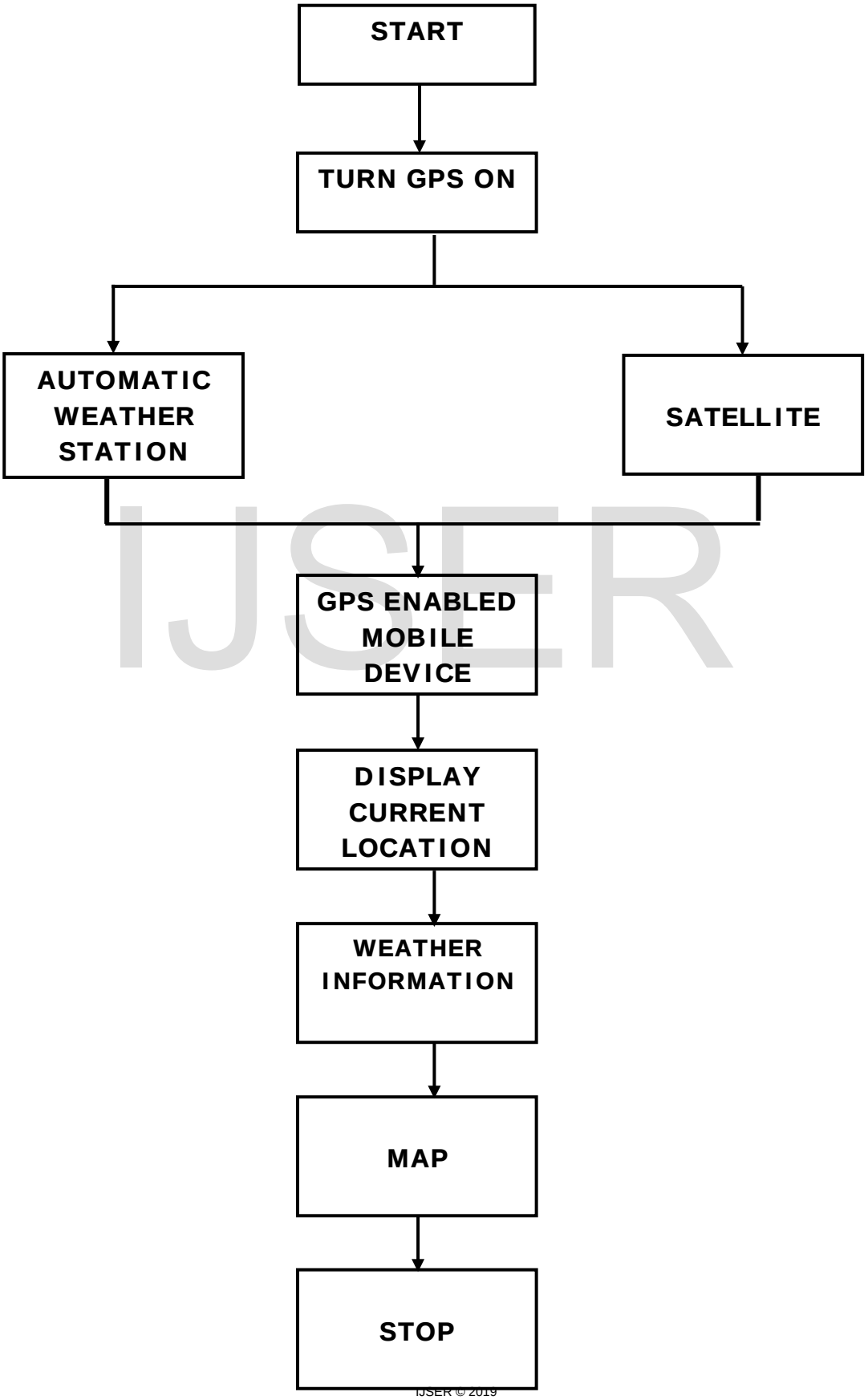
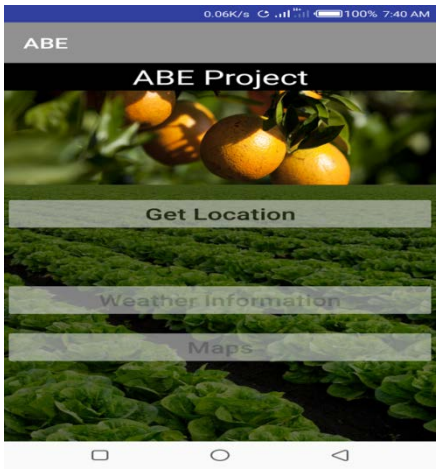
APPENDICES

APPENDIX 1: Flowchart

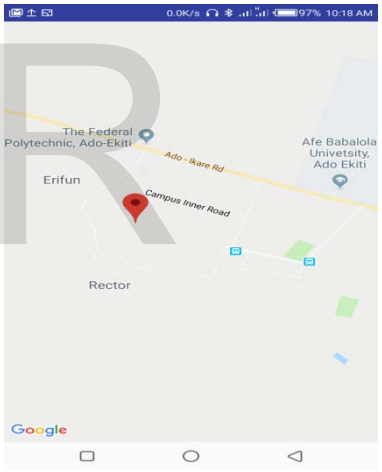


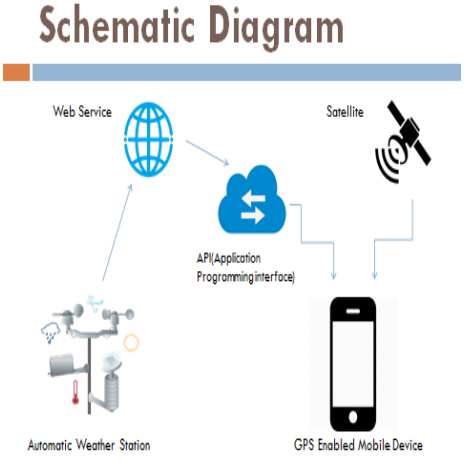
APPENDIX 2: Screenshot of the Environment APPENDIX 3: Location Coordinates



APPENDIX 4: Average Weather Information

APPENDIX 5: Google Map of the Case Study Area





APPENDIX 6: Schematic Diagram of the Application Programming Interface

APPENDIX 7: Atmospheric Pressure Data Obtained from the Application Developed

Date	Atmospheric Pressure (Hpa)
1/8/2018	975.16
2/8/2018	975.38
3/8/2018	974.23
4/8/2018	976.97
5/8/2018	975.16
6/8/2018	975.08
7/8/2018	976.37
8/8/2018	975.27
9/8/2018	976.36
10/8/2018	974.62
11/8/2018	994.33
12/8/2018	974.41
13/8/2018	975.71
14/8/2018	976.21
15/8/2018	977.01
16/8/2018	975.19
17/8/2018	975.35
18/8/2018	976.65
19/8/2018	976.33
20/8/2018	975.73
21/8/2018	975.55

22/8/2018	**976.43**
23/8/2018	**974.86**
24/8/2018	**974.75**
25/8/2018	**975.4**
26/8/2018	**976.65**
27/8/2018	**973.47**
28/8/2018	**975.29**
29/8/2018	**974.44**
30/8/2018	**972.11**
31/8/2018	**974.15**
1/9/2018	**973.74**
2/9/2018	**974.53**
3/9/2018	**973.82**
4/9/2018	**972.73**
5/9/2018	**975.14**
6/9/2018	**991.05**
7/9/2018	**992.62**
8/9/2018	**975.07**
9/9/2018	**973.91**
10/9/2018	**975.3**
11/9/2018	**974.02**
12/9/2018	**975.12**
13/9/2018	**972.57**
14/9/2018	**974.89**
15/9/2018	**975.16**

16/9/2018	**974.6**
17/9/2018	**974.62**
18/9/2018	**972.82**
19/9/2018	**973.96**
20/9/2018	**972.64**
21/9/2018	**971.68**
22/9/2018	**973.86**
23/9/2018	**974.09**
24/9/2018	**974.18**
25/9/2018	**974.67**
26/9/2018	**972.82**
27/9/2018	**973.47**
28/9/2018	**974.44**
29/9/2018	**973.11**
30/9/2018	**974.53**

Other data was also collected for yandex and world weather so as to validate the data collected from the application

APPENDIX 8: Atmospheric Pressure Data Collected From Yandex

Dates	Yandex Data
1/8/2018	998.58
2/8/2018	998.58
3/8/2018	998.58
4/8/2018	998.58
5/8/2018	998.58
6/8/2018	998.58
7/8/2018	998.58
8/8/2018	998.58
9/8/2018	998.58
10/8/2018	997.25
11/8/2018	997.25
12/8/2018	997.25
13/8/2018	997.25
14/8/2018	997.25
15/8/2018	997.25
16/8/2018	997.25
17/8/2018	997.25
18/8/2018	997.25
19/8/2018	997.25
20/8/2018	997.25
21/8/2018	997.25
22/8/2018	997.25

23/8/2018	**997.25**
24/8/2018	**997.25**
25/8/2018	**997.25**
26/8/2018	**997.25**
27/8/2018	**997.25**
28/8/2018	**997.25**
29/8/2018	**997.25**
30/8/2018	**997.25**
31/8/2018	**997.25**
1/9/2018	**998.58**
2/9/2018	**997.25**
3/9/2018	**997.25**
4/9/2018	**998.58**
5/9/2018	**998.58**
6/9/2018	**998.58**
7/9/2018	**997.25**
8/9/2018	**997.25**
9/9/2018	**997.25**
10/9/2018	**997.25**
11/9/2018	**997.25**
12/9/2018	**997.25**
13/9/2018	**997.25**
14/9/2018	**997.25**
15/9/2018	**997.25**
16/9/2018	**997.25**

17/9/2018	**997.25**
18/9/2018	**997.25**
19/9/2018	**997.25**
20/9/2018	**997.25**
21/9/2018	**997.25**
22/9/2018	**997.25**
23/9/2018	**997.25**
24/9/2018	**997.25**
25/9/2018	**995.92**
26/9/2018	**995.92**
27/9/2018	**995.92**
28/9/2018	**995.92**
29/9/2018	**995.92**
30/9/2018	**995.92**

APPENDIX 9: Atmospheric Pressure Data collected from Worldweather

Dates	Worldweatheronline.com
1/8/2018	1013
2/8/2018	1012
3/8/2018	1013
4/8/2018	1014
5/8/2018	1014
6/8/2018	1014
7/8/2018	1014
8/8/2018	1014
9/8/2018	1014
10/8/2018	1015
11/8/2018	1015
12/8/2018	1014
13/8/2018	1014
14/8/2018	1015
15/8/2018	1014
16/8/2018	1014
17/8/2018	1013
18/8/2018	1013
19/8/2018	1014
20/8/2018	1014
21/8/2018	1014
22/8/2018	1014

23/8/2018	**1013**
24/8/2018	**1013**
25/8/2018	**1013**
26/8/2018	**1014**
27/8/2018	**1013**
28/8/2018	**1013**
29/8/2018	**1012**
30/8/2018	**1011**
31/8/2018	**1011**
1/9/2018	**1012**
2/9/2018	**1012**
3/9/2018	**1011**
4/9/2018	**1011**
5/9/2018	**1012**
6/9/2018	**1011**
7/9/2018	**1012**
8/9/2018	**1012**
9/9/2018	**1013**
10/9/2018	**1014**
11/9/2018	**1013**
12/9/2018	**1012**
13/9/2018	**1011**
14/9/2018	**1012**
15/9/2018	**1013**
16/9/2018	**1012**

17/9/2018	**1010**
18/9/2018	**1012**
19/9/2018	**1011**
20/9/2018	**1010**
21/9/2018	**1011**
22/9/2018	**1012**
23/9/2018	**1012**
24/9/2018	**1011**
25/9/2018	**1012**
26/9/2018	**1011**
27/9/2018	**1011**
28/9/2018	**1011**
29/9/2018	**1011**
30/9/2018	**1011**

APPENDIX 10: Average Weekly Atmospheric Pressure Data's for the month of August

Weeks	Abe	Yandex	Worldweather
week 1	**975.48**	**998.58**	**1013.43**
Week 2	**978.13**	**997.63**	**1014.43**
Week 3	**975.97**	**997.63**	**1013.71**
Week 4	**975.26**	**997.25**	**1013.28**
Week 5	**973.65**	**997.63**	**1011.28**

APPENDIX 11: Data's collected for the month of September

Weeks	Abe	Yandex	Worldweather
Week 1	**979.09**	**998.01**	**1011.57**
Week 2	**974.41**	**997.25**	**1012.42**
Week 3	**973.64**	**997.25**	**1011.28**
Week 4	**973.9**	**996.36**	**1011.33**

APPENDIX 12: Calculation Using Anova And Correlation To Validate The Reading

From The Data With Other Data From Other Source

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	61	60841.56	997.4026	0.53647
Column 2	61	59518.98	975.721	16.24554

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	14337.85	1	14337.85	1708.717	7.91E-73	3.920124
Within Groups	1006.921	120	8.391004			
Total	15344.77	121				

APPENDIX 13: Correlation

ABE Values

∑ = 60841.56

Mean = 997.403

∑(X - Mx)2 = SSx = 32.188

Yandex Values

∑ = 59518.98

Mean = 975.721

∑(Y - My)2 = SSy = 974.732

X and Y Combined

N = 61

∑(X - Mx)(Y - My) = 23.199

R Calculation

r = ∑((X - My)(Y - Mx)) / √((SSx)(SSy))

r = 23.199 / √((32.188)(974.732)) = 0.131

Meta Numerics (cross-check)

r = 0.131 Key

X: X Values

Y: Y Values

Mx: Mean of X Values

My: Mean of Y Values

X - Mx & Y - My: Deviation scores

(X - Mx)2 & (Y - My)2: Deviation Squared

(X - Mx)(Y - My): Product of Deviation Scores

The value of R is 0.131. Although technically a positive correlation, the relationship between your variables is weak

The value of R2, the coefficient of determination, is 0.0172.