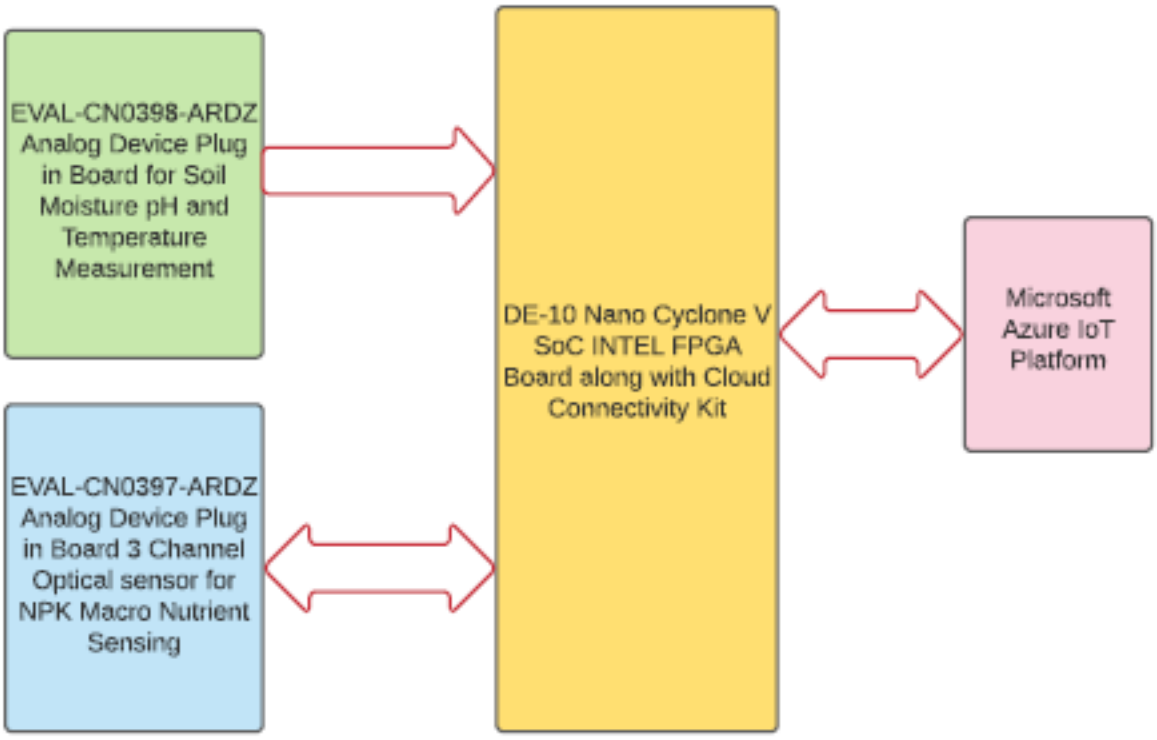
This research project develops a system that senses the real time soil health (measures the macro-nutrients in the soil) using embedded system and IoT. The macro-nutrients Nitrogen (N),Phosphorous (P) and Potassium (K) commonly known as the NPK trio are the most important nutrients for plant growth and are also the main ingredients in any fertilizer. To increase crop yield fertilizers containing predominantly nitrate (N), phosphate (P), and potassium (K) are essential. Improper use of fertilizers in turn results into poor quality in fruits, vegetable lagging in color, size, test and even quantity. In China over-application of fertilizers has caused low fertilizer usage efficiency (~35% in average) resulting in low agricultural product quality, serious environmental pollution, etc. Quantity of NPK is dependent on crop type and on plant growth status. How much quantity of fertilizer to be used is further dependent on present contents of NPK nutrients in the soil. Researchers in agriculture are looking for ways to optimize plant yield while minimizing the consumption of fertilizer. Since these macro-nutrients vary even on a small scale throughout a cultivated field, numerous researchers have attempted to develop the sensors to map these nutrient contents. Integrated crop management systems have been designed to study spatial and temporal behavior of NPK . Continuous monitoring of these along with humidity and pH of soil is leading to an automation in agricultural areas to improve crop productivity. The present study deals with the actual detection of NPK values of the soil using multimode plastic fiber optic sensor. Aqueous solution of soil under test is illuminated by different light colors. Light gets reflected from solution depending upon its absorbent coefficient of soil. Reflected light is received by another optic fiber which is converted into electrical signal. Further using threshold values stored in database of microcontroller one can determine NPK levels. This helps in detecting the deficient component of the soil. Thus undesired dispensing of the

fertilizers can be controlled which in turn reduces deterioration of soil.A lot of attention has been focused in this area in the recent years, particularly in the area of precision agriculture and site specific management procedures for obtaining localized on the go measurement of NPK in any soil.



The Agricultural Device for Evaluation of Soil Parameters consists of pH Sensors, moisture sensors, temperature sensors, NPK sensors and ESP NODE-MCU, soil sample, LCD display and PC.

Here the pH sensors used to measure hydrogen-ion activity (acidity or alkalinity) in soil. Fundamentally, a pH meter consists of a voltmeter attached to a pH-responsive electrode and a reference (unvarying) electrode. PH probes measure pH by measuring the voltage or potential difference of the soil,

whereas the LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature and at the soil moisture sensor used is capacitive type. The sensor gives analog output of zero volts when there is 100% moisture and 5V for 0% moisture and the DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like ESP8266 NODE-MCU, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability. The DHT11 Humidity and Temperature Sensor consist of 3 main components. A resistive type humidity sensor, an NTC (negative temperature coefficient) thermistor (to measure the temperature) and an 8-bit microcontroller, which converts the analog signals from both the sensors and sends out single digital signal. This digital signal can be read by any microcontroller or microprocessor for further analysis.

6.2 WORKING PRINCIPLE

Here the NODE MCU gets the input from pH Level Sensors, Temperature sensors, Moisture sensors and NPK Sensors.

It sends the data to both display device and Wi-Fi module. The data processed in the microcontroller is sent to the Cloud through WIFI

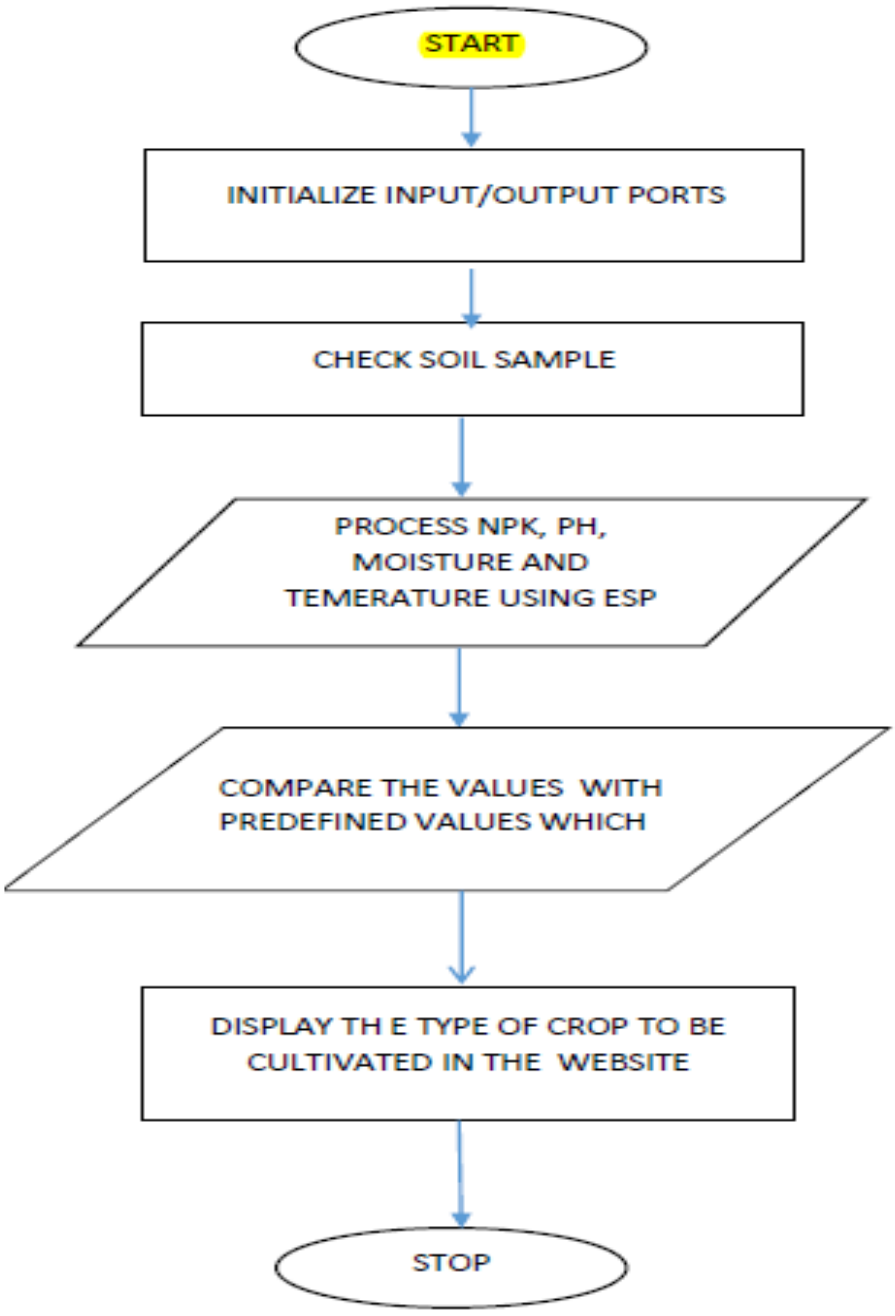

START
INITIALIZE INPUT/OUTPUT PORTS
CHECK SOIL SAMPLE
PROCESS NPK, PH,
MOISTURE AND
TEMERATURE USING ESP
COMPARE THE VALUES WITH
PREDEFINED VALUES WHICH
DISPLAY TH E TYPE OF CROP TO BE
CULTIVATED IN THE WEBSITE
STOP

FIG 6.2 FLOW CHART FOR THE BASIC OPERATION OF THE SYSTEM

Modem using internet connection. The data are stored in the IOT cloud. The data are compared with the existing predefined data in the database. This database is collected from conducting various soils testing on various soil using chemicals in the local laboratories. After comparing the data processed by and predefined values the website displays the suggested crops can cultivate in the soil and accurae amount of fertilizers can use in the soil.