DEV

Soil Fertility Detection and Automatic Fertilization Robot

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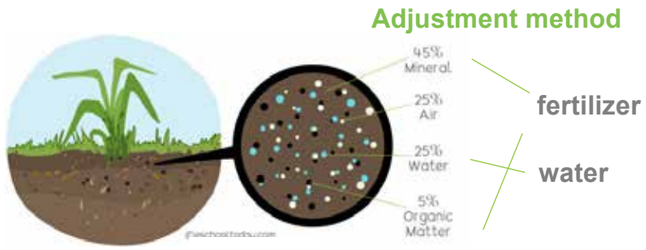
INSPIRATION

We have plants in the dormitory and water them on time, the plants are getting worse and worse



It is related to the lack of nutrients and fertilizers in the soil. Different types of plants require different soil conditions and have different requirements for PH, humidity, hardness and fertilizer

ISSUE

Pollution of Fertilizer

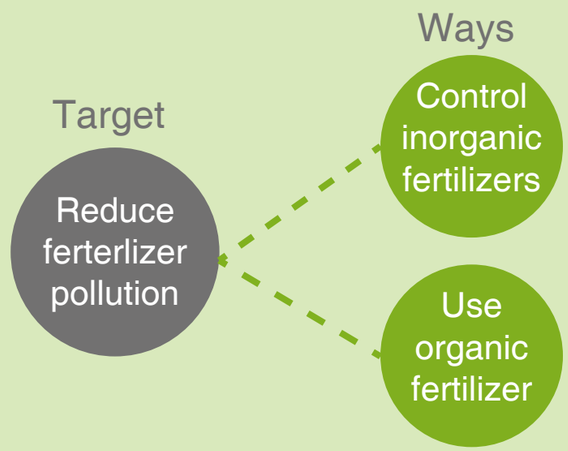
In permanent agricultural land, the soil will gradually become depleted of nutrients. Therefore, producers fertilize the soil, control pests, irrigate and other agricultural activities to improve soil efficiency. Fertilizing during these activities is always a priority.[1]For the next 30 years, more fertilizer will be used to obtain more products. Excessive use of chemical fertilizers in agriculture, resulting in a large number of environmental problems [2]

Chemical fertilizer used per hectare in Turkey (N P K) are determined as 100.4. These values are 665.5 in the Netherlands; 624.8 in Egypt; 373.2 in Japan; 301.5 in China; 287.5 in Britain; 205.4 in Germany; 180.1 in France; 160.8 in the USA; 126.4 in Italy; 121.4 in India; 115.4 in Greece and 106.9 in Indonesia kg

Effect

- soil salinity
- accumulation of nitrate
- soil compaction
- water eutrophication
- soil secondary salinization
- heavy metal accumulation
- air pollution of gases
- soil acidification
- greenhouse effect

Why



Ways to reduce land pollution from fertilizers

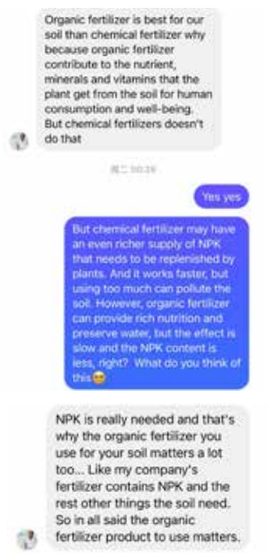
- Control the use of fertilizers
- Encourage people to use organic fertilizers
- Plant perennial crops to reduce crop waste

RESEARCH

● INTERVIEW

commercial farm

fertilizer seller



farmers

Name	Chunlei Hu
Age	53
Gender	Male
Location	Central Plains
Crop Type	bean wheat corn
Fertilizer Type	Urea Brassin Trace Elements (Zinc Molybdenum Boron) Nitrogen Fertilizer Ammonium Bicarbonate Potash Fertilizer Phosphate Fertilizer Compound Fertilizer
Work Process	Apply basal fertilizer first, fertilize according to the growth of seedlings use drone to spray foliar fertilizer manual or use small machinery for soil fertilizer
Work Feature	Semi-automated work

Name	Fangyun Jia
Age	50
Gender	Female
Location	Southern Mountains with large temperature difference
Crop Type	Green tea
Fertilizer Type	Organic fertilizers
Work Process	It is planted from November to December every year to March of the second year. The first 1-3 years are manually weeded with a hoe, and the fourth year is mined. Do not fertilize the first year, start fertilizing in the second year, and then fertilize every October every year, and apply a little more every year
Soil Feature	Loess soil, the soil is acidic, the light intensity is strong for half a day, the humidity is generally soft, the soil is soft, and the content of nutrients is unknown.
Work Feature	Artificial Work according to experience

Name	Huangtao Xie
Age	35
Gender	Male
Location	southern hills
Crop Type	Potatoes Cabbage Eggplant Bayberry
Fertilizer Type	Calcium Phosphate Ammonium Bicarbonate Urea Ammonium Pentachlorate etc. Compound Fertilizer
Work Process	When planting, apply less fertilizer, and add fertilizer according to the growth. Soil fertilizer should not be poured on the seedlings. The soil is too wet, too little, too hard and rocks cannot be planted, and there are requirements for light, humidity and soil hardness The bayberry tree and the picked tree should not be too high and will be pruned
Work Feature	Artificial Work according to experience

Name	Wang
Age	53
Gender	Female
Location	northern mountains
Crop Type	Corn Sorghum Soybean Millet
Fertilizer Type	long-acting compound fertilizer
Work Process	tossing the soil to loosen it filling the soil sowing the soil fertilizing Use herbicides to weed before emergence and after sowing Using the Planter put both the seeds and fertilizer in the planter's storage compartment and plant them Fertilizer can not be excessive, need to adjust Because it is located in mountains and hills, using a simple semi-automatic seeder requires manual Manually cut with a scythe when harvested.
Soil Feature	loess soil is acidic
Work Feature	Artificial Relying on experience

Name	Williams
Age	45
Gender	Male
Location	Lenzie, Glasgow, Scotland
Crop Type	Wheat
Fertilizer Type	fertilizer and organic fertilizer
Work Process	Use tractor to tow various agricultural machinery to work such as seeders, fertilizer spreaders, etc. Doesn't know the soil situation, and will ask Scotish Agronomy's staff to conduct sampling tests and listen to their suggestions.
Soil Feature	Acidic soil.
Work Feature	Automated and Semi-automated

- Collect messages and data from
  famers commercial farm fertilizer seller
- Compare problems
- Choose the main issues about fertilizer
- Rethink the solves and meaning of them

- size — small farm (less than 1 hectare) — big farm (more than 1 hectare)
- terrian — hill — mountain — plain
- work feature — artificial — semi automated — automated
- fertilizer — chemical fertilizer — organic fertilizer — compound fertilizer

Target

Control the amount of fertilizer applied according to the needs of the crops， Reduce the pollution of the land from overuse of fertilizers and, for farmers, reduce their spending.

DEFINE

When

When it is necessary to fertilize crops. Improve soil conditions by testing soil before planting crops. Fertilize crops at all stages of their growth.

Where

Small farms in various terrains. for small farms and special areas such as mountains and hills, large equipment has high cost and is not suitable for terrain.

Large machines such as tractors are not allowed in such complex terrain

What

A product that can effectively test soil conditions and control the amount of chemical fertilizers

How

A Product with soil detection module for soil detection and analysis, and fertilization according to the needs of crops.

Why

Issues

USER

- The user cannot clearly know the soil condition
- It is difficult to remember the requirements of different crops
- The amount of fertilizer used depends on experience which lead to over fertilization.

FERTERLIZER

- Overuse of different chemical fertilizers can have bad effects on land and crops.
- Organic fertilizer is troublesome to make, smells disgusting, and is prone to insects.

TOOL

- Large machines cannot be used in mountainous and hilly areas
- Many automated tools are too heavy or expensive for individual use

Who

User

- Location
- Terrian
- Feild Feature
- Crop Type
- Ferterlizer Type
- User characteristics

Small farm holder

No limit

Mountain Hills Plain Basin Plateau

Small farm

Common Crops

Inorganic and organic fertilizers

- Do not understand soil conditions
- Use more traditional farming methods
- Operating small farmland
- Use chemical and organic fertilizers
- Middle income and below

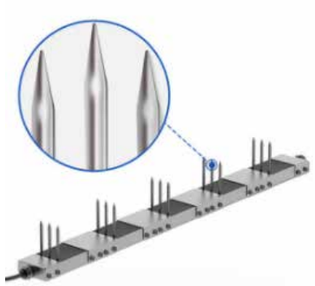
Spend 7000 yuan(750 pounds)/year

for 10mu(6660m²) 350yuan/mu 2season

PERSONA

Current Technology

Sensor

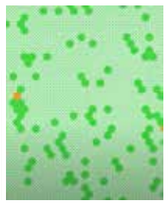


suitable for detecting the content of NPK in the soil
facilitating the systematic evaluation of the soil condition
fast and accurate
easy to use

Sampler

more accurate much data is mea-	manual troublesome takes longer costs more

Robot



advanced and accurate fast and efficient multifunction scientific analysis	too large in size heavy in weight high in cost professional requirements not suitable for small farm

Tool

easy to use cheap	single function inefficient

Concept Design

Small Farm Users

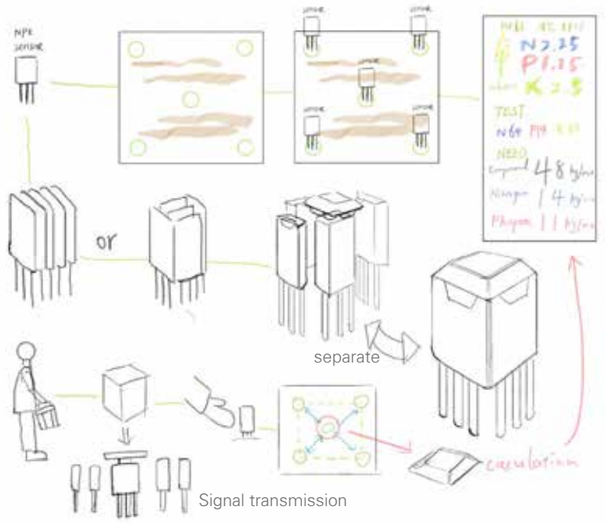
- Not knowing the nutrient content of the soil
- Not sure how much fertilizer your crop needs
- Not knowing how much fertilizer to apply, often relying on experience
- Unable to control the amount of fertilizer
- Manual fertilization with organic fertilizers is inconvenient
- Want to know about soil nutrients
- Looking to reduce fertilizer use and costs

Fertilization method

Concept 1

Tell farmers the needs of different crops and how much fertilizer to apply per square meter

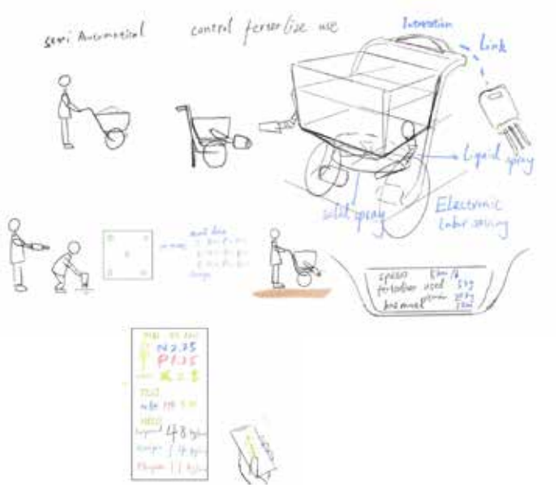
Five-point detection method



- Advantage
  - Help farmers more intuitively understand soil conditions and crop needs
  - The amount of fertilizer needed can be calculated
  - Simple operation and high reliability
- Disadvantage
  - Inability to precisely control fertilization
    Detect range limitation for every sensor

Concept 2

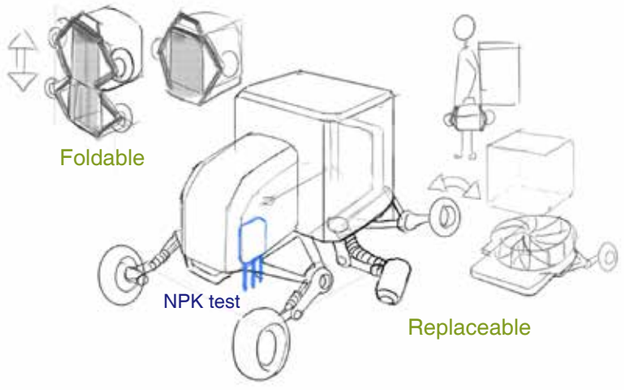
Semi-automatic and precise fertilization, cart power assist helps users reduce the burden



- Advantage
  - Help farmers more intuitively understand soil conditions and crop needs
  - Calculate the amount of fertilizer needed
- Disadvantage
  - Still need manpower
    (Or use the principle of motor and balance car to design automatic mode)
  - Size limitation

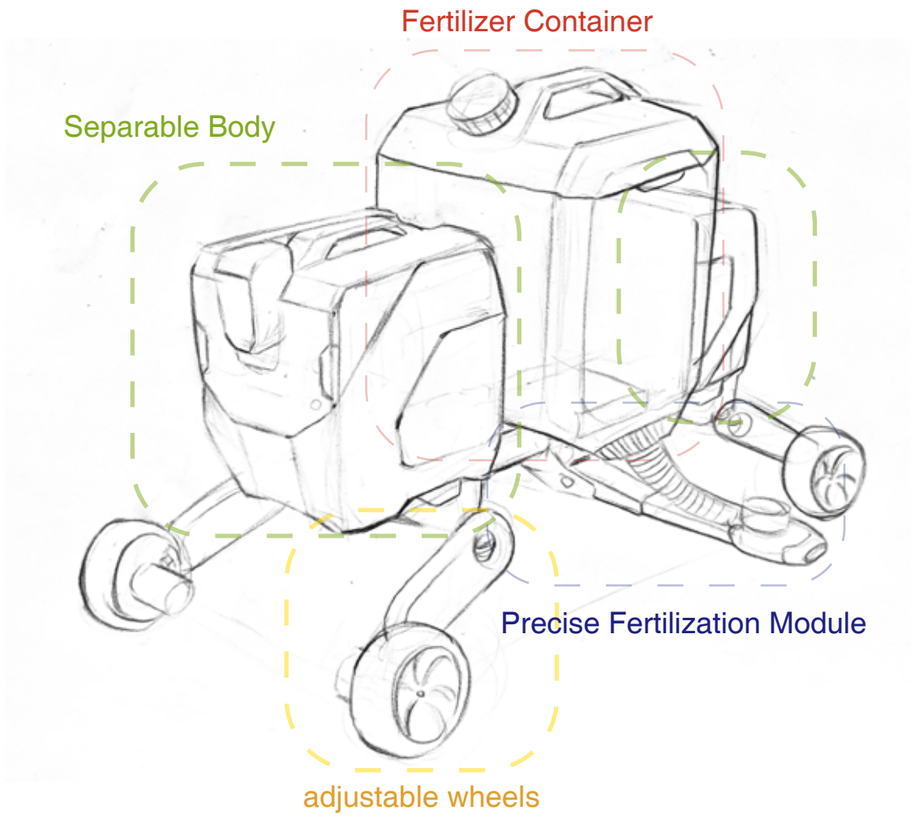
Concept 3

Use the robot to test the soil, tell the user the soil condition and the needs of different crops, calculate the amount of fertilization, and automatically control the fertilization.



- Advantage
  - Help farmers more intuitively understand soil conditions and crop needs
  - Can accurately calculate the amount of fertilizer needed
  - Precise control of fertilization
  - Can meet the use of different fertilizers
- Disadvantage
  - Operation requires learning and understanding

Function Design

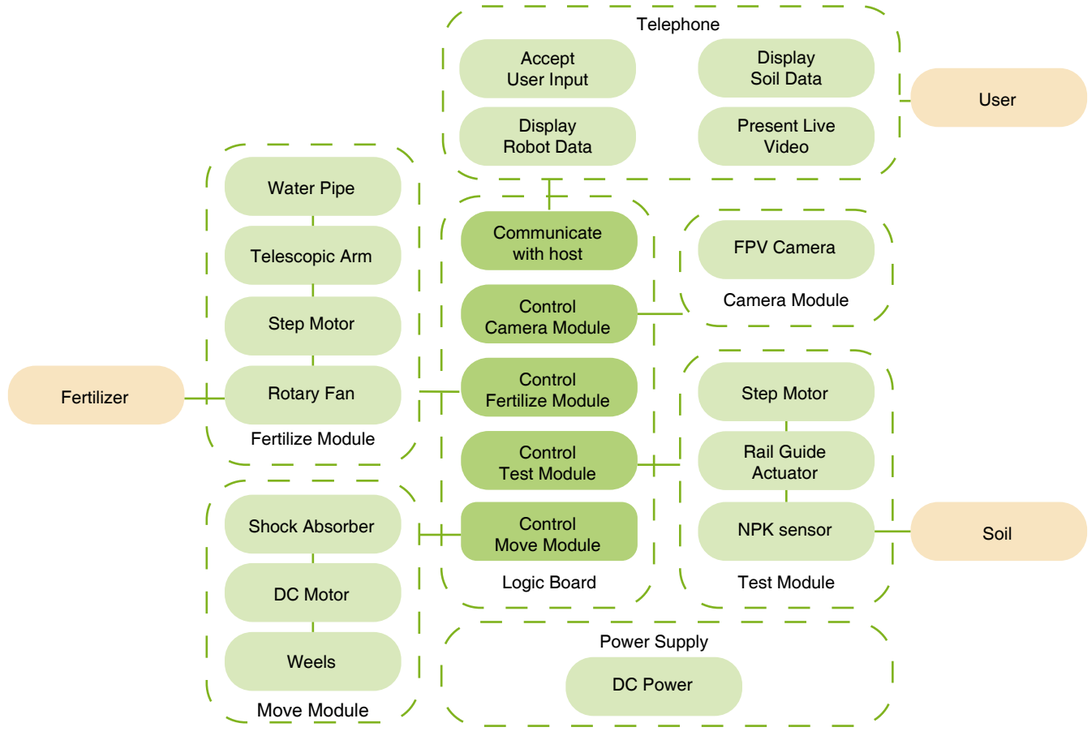


To refine the concept, the size of the robot should be smaller than the row spacing of the crops, and the fertilization distance can be adjusted to carry 25kg of fertilizer, which is the weight that the user can carry. The functions of each module are designed as follows.

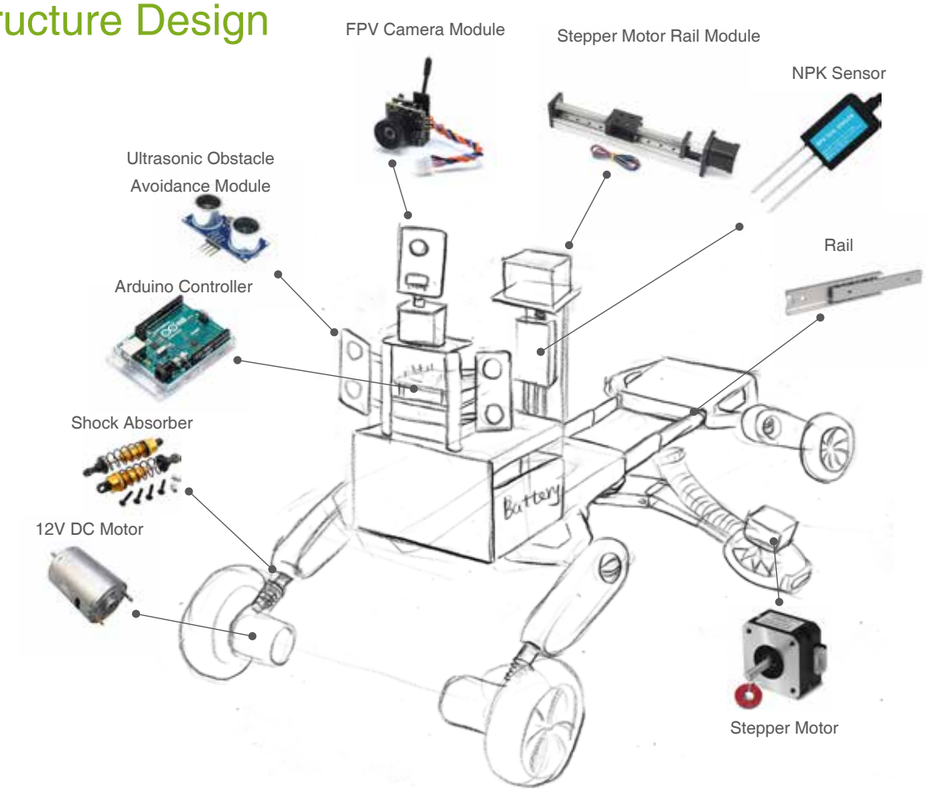
- The body can be stretched, and the soil detection mode and automatic fertilization mode can be switched. After stretching, the guide rails use the elastic force to fix the fertilizer box
- Fertilizer bins can be used to store solid, organic and liquid fertilizers
- The precise fertilization module can control the start, stop and flow of fertilizers, and adjust the fertilization spacing according to the row spacing of the crops. Most crops are planted at a spacing of 30–60cm. The total width of the robot is 30cm, and the fertilizing arms at both ends can be extended by 15cm.
- The adjustable wheel frame has a shock absorption function, and the height of the body can also be adjusted by rotating the knob at the connection, which is conve–nient for fertilizing the newly grown seedlings.

Product Architecture

Design product architecture and structure design from the definition of product function.



Structure Design



3D Model

Soil Detection Mode
Length 50cm
Width 30cm

Automatic Fertilization Mode
Length 75cm
Width 30cm

Fertilizer Bucket
Length 30cm Width 25cm
Height 35cm
Capacity about 25L

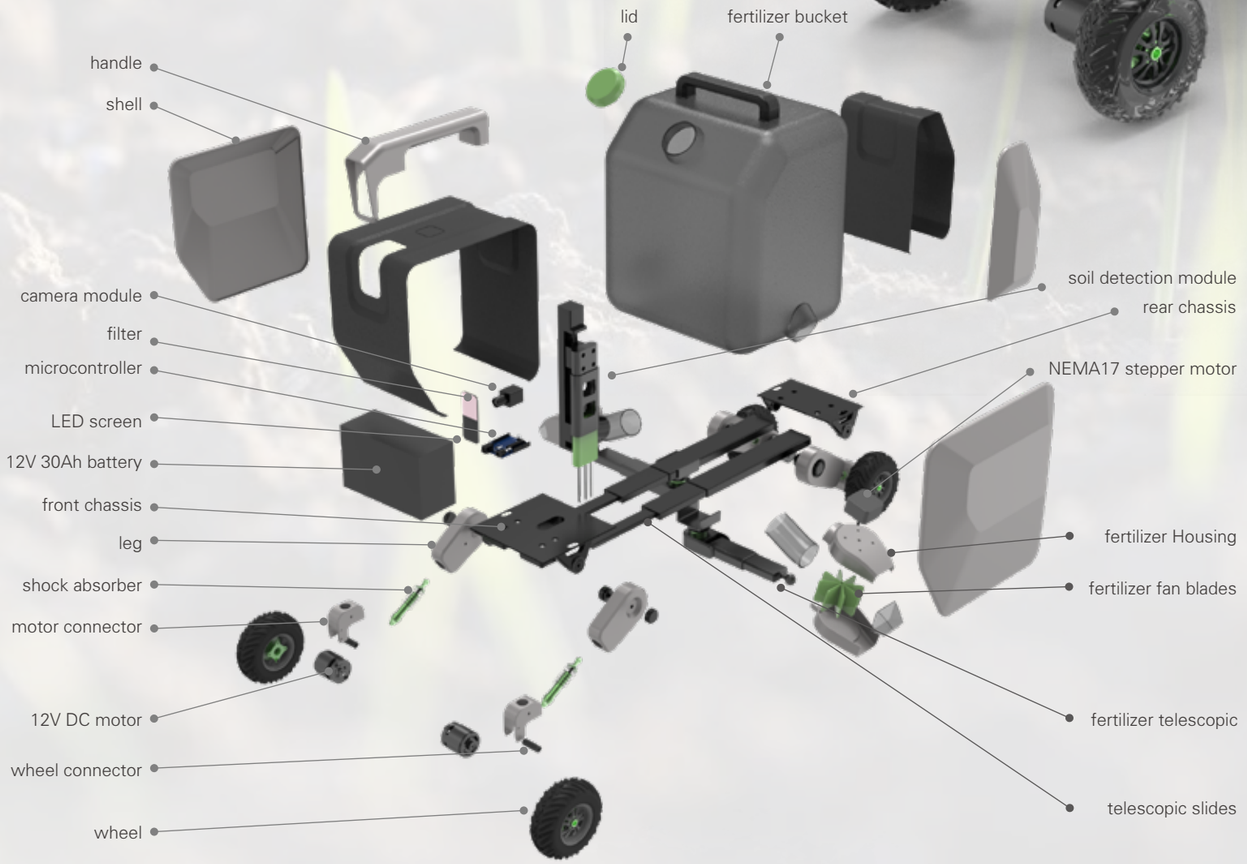
Soil Detection Module

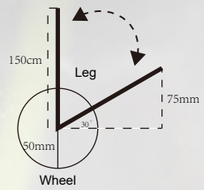
It is composed of NEMA17 stepper motor guide rail, soil NPK sensor and connector. The step–per motor can control the sensor to move up and down, so that the probe can be inserted into the soil for detection.

Automatic Fertilizer Module

It is composed of NEMA17 stepper motor, fan blade and 0–15cm telescop–ic rod. Controlling the speed of the stepper motor can control the rate of fertilization, and can apply solid granular fertilizer and liquid fertilizer.

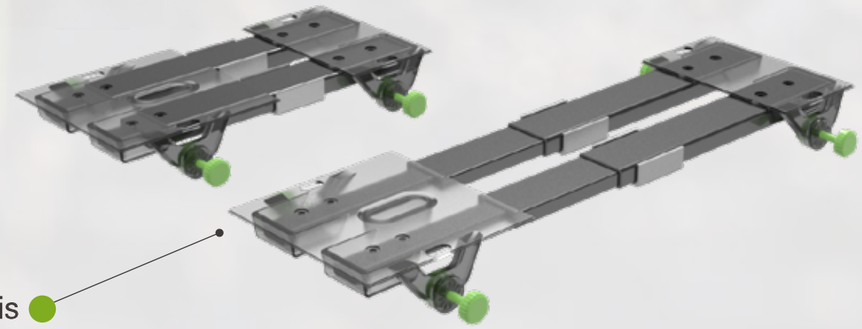
Structural Explosion Diagram





Adjustable Motion

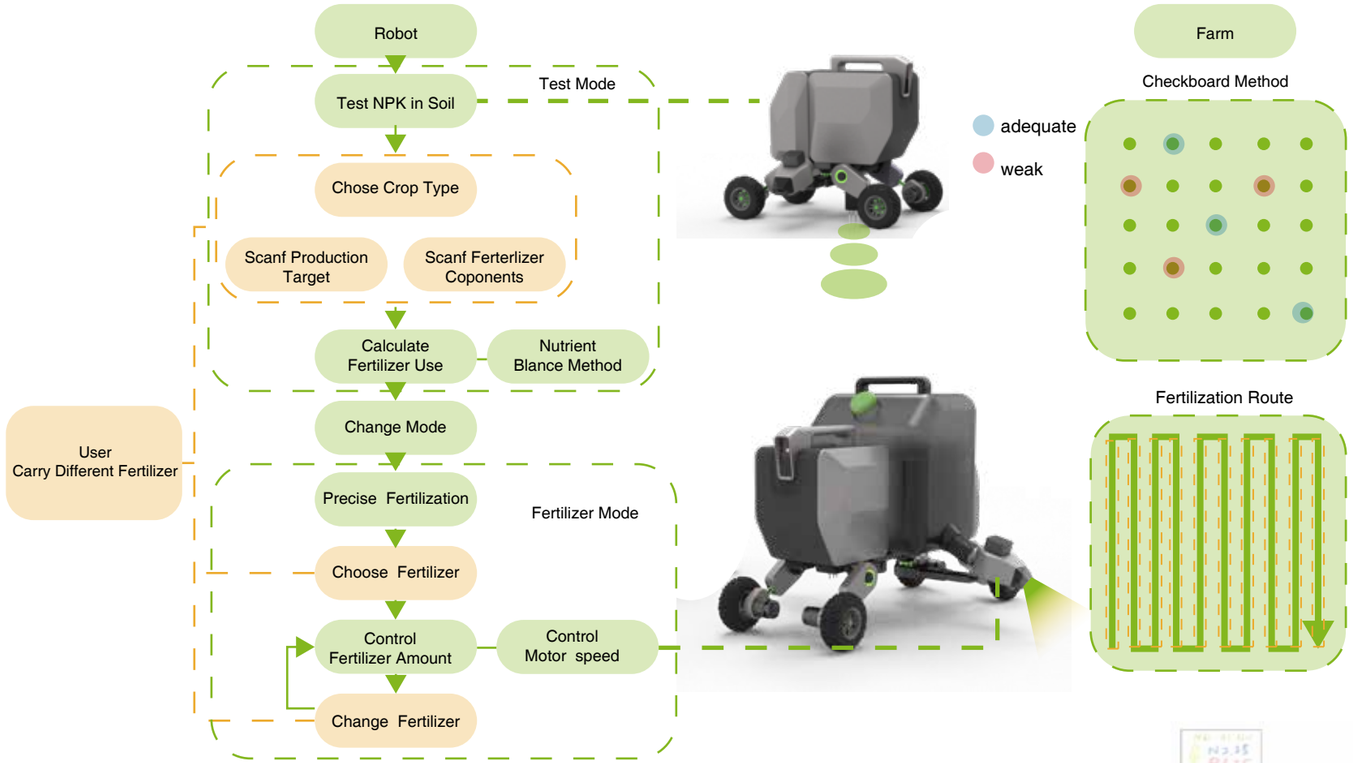
The angle can be adjusted by rotating the knob to adjust the height of the robot chassis, and an 8cm shock absorber is installed inside to relieve the impact of the soil ground.

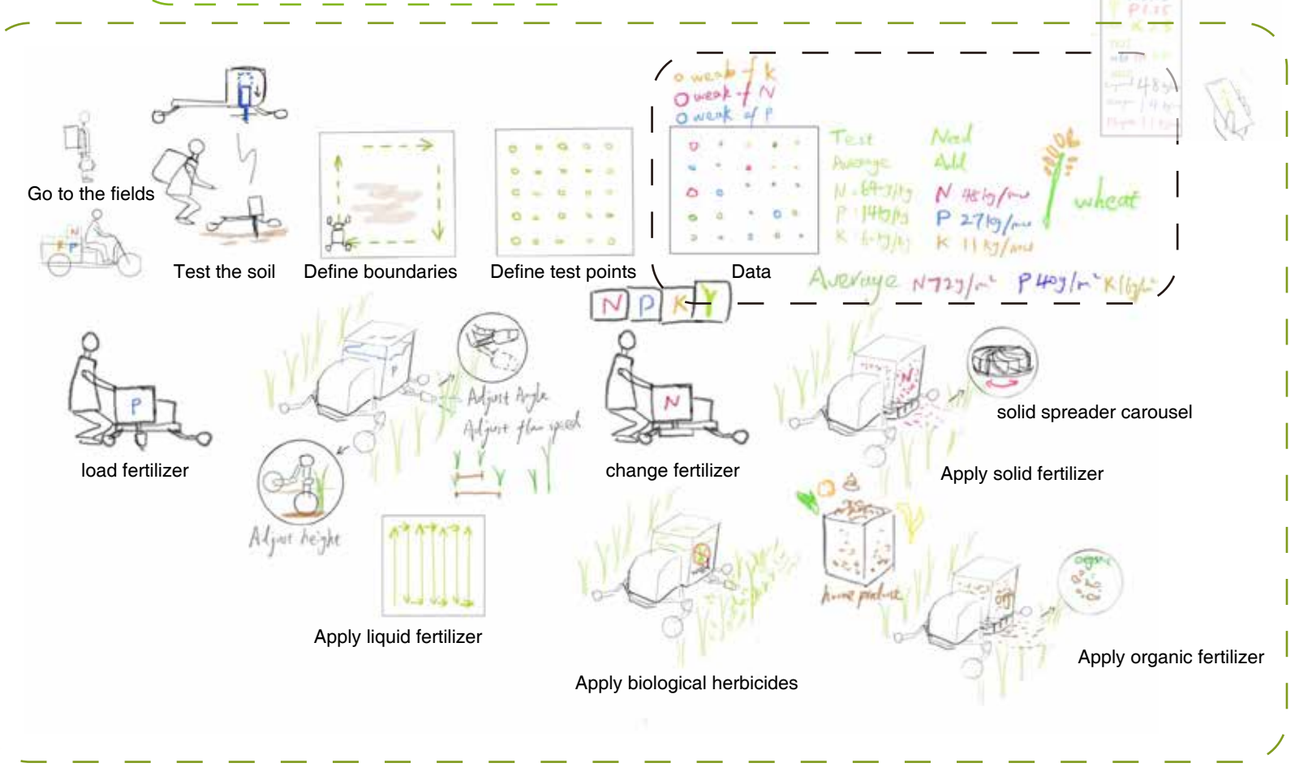


Retractable Chassis

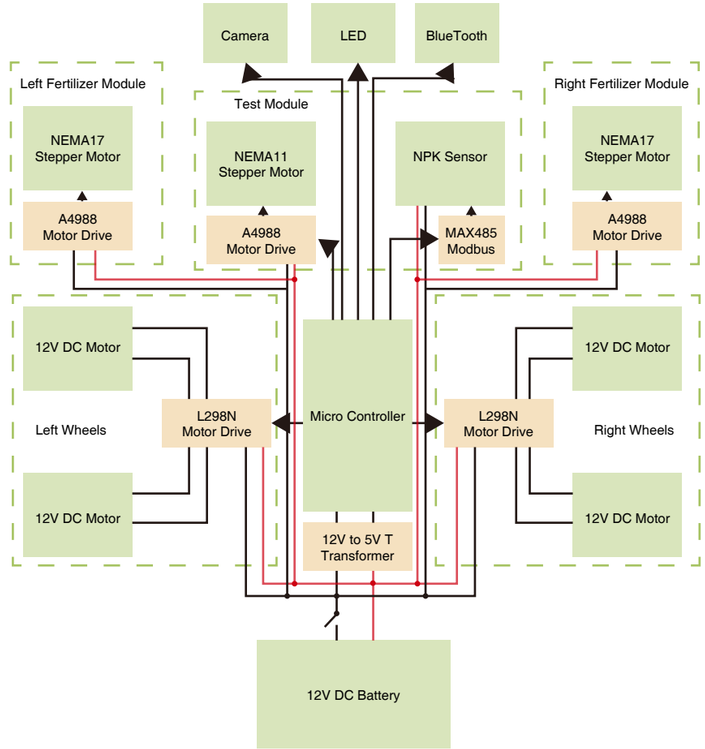
A guide rail with a lead of 25cm is installed, which can be used to adjust the working mode of the robot. The hole in the center of the front chassis can be passed through by the soil detection sensor

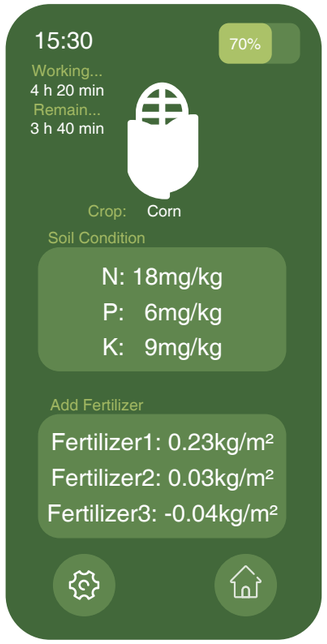
Worrking Princi-





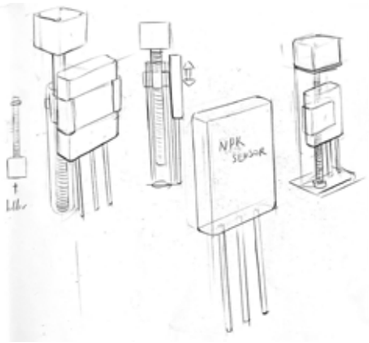
Circuit Design





Interface Design

Soil Detection Module



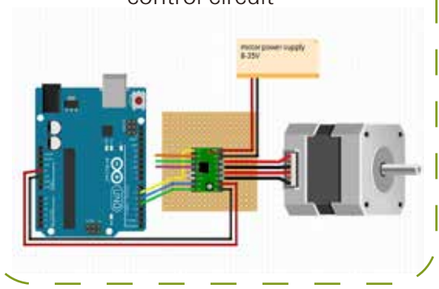
- Use the stepper motor rail module to connect the NPKsensor, and the step–per motor rotates the slider of the control rail module to control the up and down movement of the NPKsensor

NEMA17 stepper motor rail

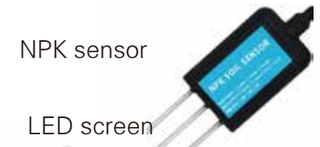
A4988 motor drive

12V Battery

control circuit



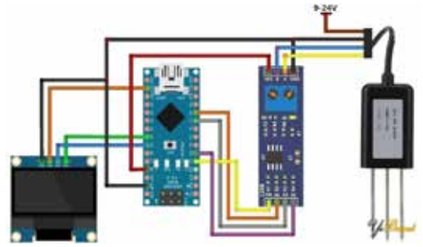
NPK sensor



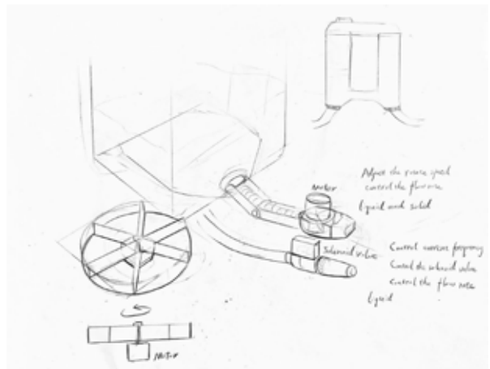
LED screen

MAX485 Modbus

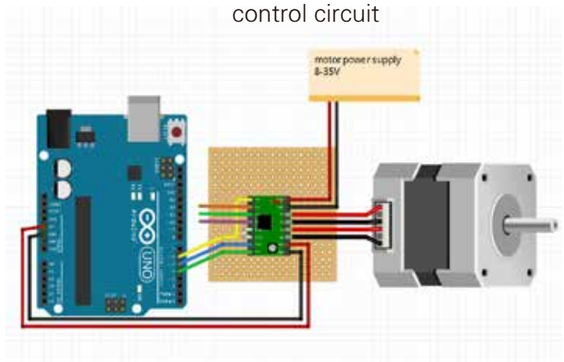
control circuit



Automatic Fertilizer Module



control circuit



Universal telescopic rod

water pipe

NEMA17 stepper motor

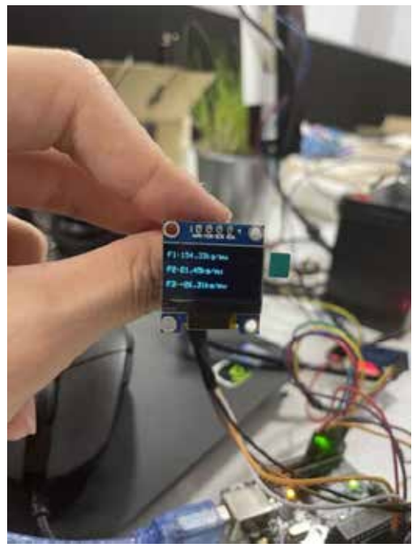
turntable

- Use the motor to control the over–flow of liquid or solid from the small turntable, and the motor speed can control the flow

Function Test

```
void loop()
{
   digitalWrite(dirPin,HIGH); // Set Dir high
   for(x = 0; x < STEPS_PER_REV*100; x++) // Loop 100 turns
   {
      digitalWrite(stepPin,HIGH); // Output high
      delayMicroseconds(800); // Wait 1/2 a ms
      digitalWrite(stepPin,LOW); // Output low
      delayMicroseconds(800); // Wait 1/2 a ms
   }
  delay(3000); // pause 3 second
  digitalWrite(dirPin,LOW); // Set Dir low
  for(x = 0; x < STEPS_PER_REV*100; x++) // Loop 100 turns
  {
      digitalWrite(stepPin,HIGH); // Output high
      delayMicroseconds(800); // Wait 1/2 a ms
      digitalWrite(stepPin,LOW); // Output low
      delayMicroseconds(800); // Wait 1/2 a ms
   }
   delay(3000); // pause 3 second
}
```

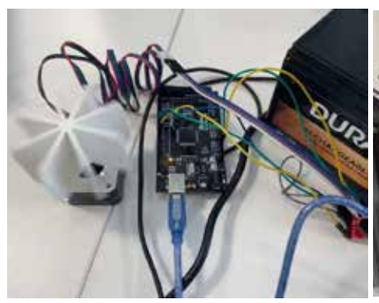
- Stepper motor rail control Test

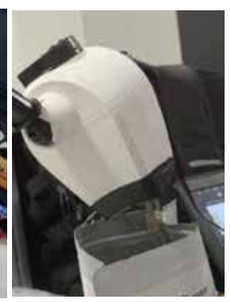


```
COM12
Add Fertilizer 1: 154.33 kg/mu
Add Fertilizer 2: 21.45 kg/mu
Add Fertilizer 3: -26.31 kg/mu
1320123849
132063846
132097842
Nitrogen: 18 mg/kg
Phosphorous: 6 mg/kg
Potassium: 9 mg/kg
Add Fertilizer 1: 154.33 kg/mu
Add Fertilizer 2: 21.45 kg/mu
Add Fertilizer 3: -26.31 kg/mu
1320123849
132063846
132097842
Nitrogen: 18 mg/kg
Phosphorous: 6 mg/kg
Potassium: 9 mg/kg
```

- Soil NPK sensor detection and fertilizer calculation test

Taking corn as an example and use its data to verify,the screen shows how much fertilizer is need.



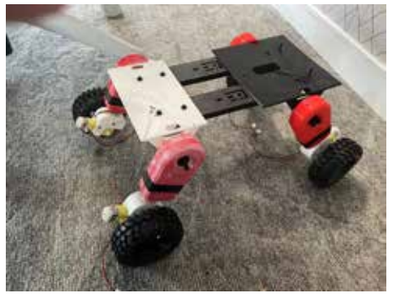


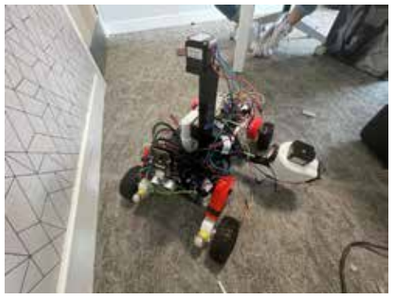
```
void loop()
{
   n=1000/(200*0.3);//Turn 0.3 circl
   digitalWrite(dirPin,HIGH); // Set
   for(x = 0; x < 2000; x++) // Loop
   {
      digitalWrite(stepPin,HIGH); //
      delay(n); // Wait 1/2 a ms
      digitalWrite(stepPin,LOW); // C
      delay(n); // Wait 1/2 a ms
   }
}
```

- Automatic fertilization module speed control and fertilization test

Model and Test





Soil Test





Move to Detection Point

Insert Sensor

Read Data

Fertilize



Change Mode

Load Fertilizer

Fertilize

Result

After I made the model through 3D printing, I verified the function of the robot. After field verification, I found that the hardness of the ground does have a big impact on the measurement. For softer farmland, the robotic arm of the robot can transmit force into the soil for normal detection and calculation of fertilization. However, for the hard and uncultivated land in the park, it is difficult for the robot arm to insert into the soil, which brings difficulties to the detection.

Conclusion

The purpose of this project is to help farmers and users of small farms understand the fertilization needs of different crops and automatically control fertilization to effectively control the pollution of chemical fertilizers to the land. The feasibility of its main functions has been proved by calculation and circuit experiments, but its complete circuit design and realization of complete functions still need to be further developed. It can help users reduce the use of chemical fertilizers and save costs, which brings obvious benefits to farmers.

Reflection

TIn the selection of the plan for this project, I combined the actual situation and the trend of agricultural modernization, and chose agricultural robots as the direction to solve the problem. I considered the process of using the robot from beginning to end, and designed many structural and functional modules to meet the actual situation. Farmers work environment conditions, optimize the experience of farmers using robots. Users can adjust the robot's detection and fertilization work modes, adjust the height to cope with the height changes of crops, adjust the fertilization row spacing, and control the fertilization amount. In this process, my overall system design and functional realization of the robot benefited from my undergraduate study of robotics expertise, but this project allowed me to learn more and expand. There are also many imperfections in the verification stage of the project. For example, the design of the leg structure of the robot is unstable due to the flexibility of the shock absorber. Due to the urgency of time, the adaptability of the detection module to the ground hardness still lacks a lot of experiments. Experience testing can still do more. But overall, the conceptual design, functional design and implementation of this project are successful.

Future Work

The feasibility of its main functions has been proved by calculation and circuit experiments, but its complete circuit design and realization of complete functions still need to be further developed.

In the future design and development, It can also endow the robot with other functions related to agricultural production, such as installing harmless weeding, insecticide modules, etc., to improve its utilization rate. For the price that farmers care about, the robot can be rented for farmers to use, reducing farmers' usage costs and maintenance costs.

Conclusion

[1]Savci, S. (2012). Investigation of Effect of Chemical Fertilizers on Environment. APCBEE Procedia, 1. https://doi.org/10.1016/j.apcbee.2012.03.047

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Appendix

Fertilizer amount caculation

Fertilizer application amount (kg/mu) = (nutrient uptake per unit of crop yield × target yield - soil measurement value × 0.16) / (fertilizer nutrient content × fertilizer utilization rate)

crop	harvest	The amount of nutrients absorbed to form 100kg of economic output (kg)			target yield	soil content			Fertilizer nutrient content (input according to fertilizer information)			Fertilizer utilization			Demand			Usage (demand/utilization)		
		Nitrogen (N)	Phosphorus Pentoxide (P2O5)	Potassium oxide (K2O)	kg/mu	N(mg/kg)	P(mg/kg)	K(mg/kg)	Compound fertilizer N15% P15% K15% (based on potash fertilizer)	Nitrogen fertilizer (urea) Contains N47%	Phosphate fertilizer (Superphosphate) Contains P61%	N(20-40%)	P(10-25%	K(30-50%)	N	P	K	N	P	K
rice	grain	2.25	1.1	2.7	500	64	14	60	65	13.93617021	10.73770492	30%	20%	40%	1.01	3.26	3.9	3.36667	16.3	9.75
winter wheat	grain	3	1.25	2.5	500	64	14	60	48.33333333	27.23404255	20.98360656	30%	20%	40%	4.76	4.01	2.9	15.8667	20.05	7.25
spring wheat	grain	3	1	2.5	500	64	14	60	48.33333333	13.93617021	10.73770492	30%	20%	40%	4.76	2.76	2.9	15.8667	13.8	7.25
barley	grain	2.7	0.9	2.2	500	64	14	60	23.33333333	16.59574468	12.78688525	30%	20%	40%	3.26	2.26	1.4	10.8667	11.3	3.5
corn	grain	2.57	0.86	2.14	500	64	14	60	18.33333333	16.06382979	12.37704918	30%	20%	40%	2.61	2.06	1.1	8.7	10.3	2.75
Valley	grain	2.5	1.25	1.75	500	64	14	60	-14.16666667	47.18085106	36.35245902	30%	20%	40%	2.26	4.01	-0.85	7.53333	20.05	-2.125
Sorghum	grain	2.6	1.3	1.3	500	64	14	60	-51.66666667	61.80851064	47.62295082	30%	20%	40%	2.76	4.26	-3.1	9.2	21.3	-7.75
sweet potato	fresh tubers	0.35	0.18	0.55	500	64	14	60	-114.1666667	22.18085106	17.09016393	30%	20%	40%	-8.49	-1.34	-6.85	-28.3	-6.7	-17.125
potato	fresh tubers	0.5	0.2	1.06	500	64	14	60	-71.66666667	9.680851064	7.459016393	30%	20%	40%	-7.74	-1.24	-4.3	-25.8	-6.2	-10.75
soybean	Beans	7.2	1.8	4	500	64	14	60	173.3333333	16.59574468	12.78688525	30%	20%	40%	25.76	6.76	10.4	85.8667	33.8	26
pea	Beans	3.09	0.86	2.86	500	64	14	60	78.33333333	-3.085106383	-2.37704918	30%	20%	40%	5.21	2.06	4.7	17.3667	10.3	11.75
peanut	pods	6.8	1.3	3.8	500	64	14	60	156.6666667	-4.680851064	-3.606557377	30%	20%	40%	23.76	4.26	9.4	79.2	21.3	23.5
cotton	seed cotton	5	1.8	4	500	64	14	60	173.3333333	16.59574468	12.78688525	30%	20%	40%	14.76	6.76	10.4	49.2	33.8	26
rape	rapeseed	5.8	2.5	4.3	500	64	14	60	198.3333333	45.85106383	35.32786885	30%	20%	40%	18.76	10.26	11.9	62.5333	51.3	29.75
Sesame	grain	8.23	2.07	4.41	500	64	14	60	207.5	20.05319149	15.45081967	30%	20%	40%	30.91	8.11	12.45	103.033	40.55	31.125
cucumber	fruit	0.4	0.35	0.55	500	64	14	60	-114.1666667	31.22340426	24.05737705	30%	20%	40%	-8.24	-0.49	-6.85	-27.467	-2.45	-17.125
eggplant	fruit	0.3	0.1	0.4	500	64	14	60	-126.6666667	21.91489362	16.8852459	30%	20%	40%	-8.74	-1.74	-7.6	-29.133	-8.7	-19
tomato	fruit	0.45	0.5	0.5	500	64	14	60	-118.3333333	40.53191489	31.2295082	30%	20%	40%	-7.99	0.26	-7.1	-26.633	1.3	-17.75
carrot	root	0.31	0.1	0.5	500	64	14	60	-118.3333333	19.25531915	14.83606557	30%	20%	40%	-8.69	-1.74	-7.1	-28.967	-8.7	-17.75
radish	root	0.6	0.31	0.5	500	64	14	60	-118.3333333	30.42553191	23.44262295	30%	20%	40%	-7.24	-0.69	-7.1	-24.133	-3.45	-17.75
onion	onion	0.27	0.12	0.23	500	64	14	60	-140.8333333	27.5	21.18852459	30%	20%	40%	-8.89	-1.64	-8.45	-29.633	-8.2	-21.125
cabbage	leaf	0.41	0.05	0.38	500	64	14	60	-128.3333333	19.78723404	15.24590164	30%	20%	40%	-8.19	-1.99	-7.7	-27.3	-9.95	-19.25
celery	Whole plant	0.27	0.12	0.23	500	64	14	60	-140.8333333	27.5	21.18852459	30%	20%	40%	-8.89	-1.64	-8.45	-29.633	-8.2	-21.125
green onions	Whole plant	0.3	0.12	0.4	500	64	14	60	-126.6666667	22.9787234	17.70491803	30%	20%	40%	-8.74	-1.64	-7.6	-29.133	-8.2	-19
Tangerine	fruit	0.6	0.11	0.4	500	64	14	60	-126.6666667	22.44680851	17.29508197	30%	20%	40%	-7.24	-1.69	-7.6	-24.133	-8.45	-19
apple	fruit	0.3	0.08	0.32	500	64	14	60	-133.3333333	22.9787234	17.70491803	30%	20%	40%	-8.74	-1.84	-8	-29.133	-9.2	-20
pear	fruit	0.47	0.23	0.48	500	64	14	60	-120	26.70212766	20.57377049	30%	20%	40%	-7.89	-1.09	-7.2	-26.3	-5.45	-18
Grape	fruit	0.6	0.3	0.72	500	64	14	60	-100	24.04255319	18.52459016	30%	20%	40%	-7.24	-0.74	-6	-24.133	-3.7	-15
Peach	fruit	0.48	0.2	0.76	500	64	14	60	-96.66666667	17.65957447	13.60655738	30%	20%	40%	-7.84	-1.24	-5.8	-26.133	-6.2	-14.5
									Fertilizer application amount (kg/mu)											

Spacing of different kinds of crops

	spacing	row spacing
Beetroot:	10-15cm	30cm
Broccoli:	45cm	60cm
Beans:	5-7.5 cm	60cm
Cabbage:	45-60 cm	60-90 cm
Carrots:	5cm	25cm
Cauliflower:	30-45cm	60cm
Celery:	15-25 cm	60 cm
Corn: spacing	10-15 cm	75-90 cm
Cucumbers:	30-45 cm	90 cm
Eggplant:	45-60 cm	75 cm
Garlic:	12.5-15cm	20cm
Kale:	25cm	45-60cm
Kohlrabi:	15 cm	30 cm
Leeks:	15 cm	30 cm
Lettuce:	10-20 cm	30-45 cm
Onions:	10 cm	25-30 cm
Peanuts:	15-20 cm	60-90 cm
Peppers:	25-45 cm	45 cm
Potatoes:	30 cm	90 cm
Spinach:	7.5-12.5 cm	20-25 cm
Swiss chard:	20-25 cm	45-60 cm
Tomatoes:	45-60 cm	60-90 cm
Zucchini:	30-37.5 cm	60-90 cm

Cost of Product

ITEM	AMOUNT	UNIT PRICE/GBP	PRICE/GBP	UNIT WEIGHT/kg	WEIGHT/kg
Electronic Device					
Arduino Mega2560 Micro controller	1	15	15	0.036	0.036
12V DC Motor	4	10	40	0.3	1.2
L298N DC Motor Drive	2	4	8	0.03	0.06
NEMA17 Stepper Motor	2	12	24	0.13	0.26
Linear Actuator with NEMA11 Stepper Motor	1	40	40	0.38	0.38
A4988 Stepper Motor Drive	3	2	6	0.004	0.008
12V 30Ah Battery	1	50	50	5.7	5.7
NPK Sensor	1	60	60	0.2	0.2
MAX485/RS485 Modbus Module	1	1	1	0.006	0.018
Camera	1	5	5	0.06	0.06
Blutooth Module	1	5	5	0.004	0.004
Wire	1	5	5	0.05	0.05
12to5V Converter	1	7	7	0.03	0.03
Button	1	2	2	0.005	0.005
Structure(Purchase)					
Wheel	4	2.5	10	0.05	0.2
Shock Absorber	4	3	12	0.015	0.06
Rail	2	3	6	0.15	0.3
Screw	-	-	3	-	0.03
Structure(Manufacture)					
Chassis	2	10	20	0.3	0.6
Plastic Shell	1	8	8	0.3	0.3
Fertilizer Arm	2	3	6	0.15	0.3
Fertilizer Container	3	5	15	0.5	0.5
TOTAL COST			348		
TOTAL WEIGHT					10.301