Optimum Sunlight Coverage Environmental Growth Regulation System Solar Powered Hydroponics IOT Linked

A Scientific Investigatory Project

(Science and Innovation Expo)

Leon V. Orong III
Ericca Jane J. Paylaga
Erreana Lei C. Mariquit
Researchers

Grade 12 – STEM A

ANTONIO N. LEGASPI PhD
Research Adviser

Iligan City East National High School
Sta. Filomena, Iligan City

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APPROVAL SHEET

This research entitled: "**Optimum Sunlight Coverage Environmental Growth Regulation System Solar Powered Hydroponics IOT Linked",** prepared and submitted by Leon V. Orong III, Ericca Jane J. Paylaga, and Erreana Lei C. Mariquit in fulfilment of the subject Practical Research II of STEM strand, has been examined and approved.

ANTONIO N. LEGASPI PhD

Research Adviser

PANEL OF EXAMINERS

Approved by the committee on Oral Presentation,

ENGR. VINCENT L. BALTAZAR
Member

ENGR. MARVEN A. YUSON
Member

ANTONIO N. LEGASPI PhD
Adviser

Approved and accepted in fulfilment of the requirement for the subject Practical Research II of STEM strand.

JOSEPHINE G. REGIS
Secondary School Principal I

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THE RESEARCHERS

Orong III, V, Paylaga, E, .and Mariquit, E.
Iligan City East National High School-Sta. Filomena

ABSTRACT

Philippines is one of the agricultural countries in east Asia with decreasing turnover rate in terms of farmer's profession resulting to increase of imports from neighboring countries to fill the gap in food production. Traditional planting is time, effort and money consuming due to time spent in the field and materials like fertilizers and pesticides to protect crop's growth. In comparison to hydroponics, soil culture is mostly based on land which is why there are a tangible amount of factors that influences its growth. Hydroponics is used widely but mostly not on rural areas where farming is a way of living and solely rely on the traditional way of growing plants. Plants grown on land are most susceptible to diseases and pest. Unpredictable weather is also an influential factor in plants that could present the surrounding conditions with extreme heat that evaporates moisture or extreme rainfall that drowns plants. The purpose of the study is to create an automated hydroponics equipment structure capable of sustaining plant growth through calibrating the surrounding conditions while isolating the crops from external factors such as diseases and pest. Equipped with sensors that serves as foot stool for regulating environmental factors, it also ensures transmission and recording of data via IOT in websites for further analysis. The utilization of an oscillator enables the optimization of sunlight coverage for the plants. Solving the energy issue of hydroponics leads to its clean green energy that makes use of the full coverage of the sun collected by solar panels and stored in generators. The study creates a fine line between soil culture and hydroponically grown crops. Crops grown in hydroponics are more resilient to pests and diseases compared to those in soil medium while height of the plants grown are shown to increase more in hydroponics than soil culture. Products grown from hydroponics have great quality with the features it offers allowing more harvest and products sold to consumers.

Keywords: Optimim Sunlight, Environmental Growth, Solar Power, Hydroponics, IOT Linked.

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CHAPTER I

THE PROBLEM

Even before the Spanish government, the Philippines, as one of Asia's agricultural countries, produced and supplied raw materials for their industries, significantly influencing the Philippines' agricultural history. Beginning with hand planting and tilling the field with carabaos, the agricultural business has grown to include the use of tractors and a variety of sophisticated machinery to improve harvest and lessen time spent on the process of planting crops. With the population expanding by 108.1 million and farmers employing approximately 30% of the population, there will be less supply and more demand for harvested products and raw resources, resulting in more challenges and hassles along the route.

Numerous issues develop as a result of elements relating to the country's expansion, which is unduly reliant on agriculture, increasing the difficulty of food and raw material production. These variables are influenced significantly by production rates, the overall number of farmers in the Philippines, machinery costs, pest control materials, soil profile, weather, climate, and environmental growth parameters for plant crops, among others. To address the issue, the government dropped the prices of goods sold by farmers in an attempt to stabilize the country's economy, oblivious to the new problems it created for farmers, such as decreased financial earnings from their agricultural profits related to agribusiness operations. Different strata of Filipino farmers were overlooked, which highlights the fact that some farmers do not own land, while others are employed and are disproportionately affected by the reduced income. Additional challenges associated with agricultural production include climate change, soil quality, and pest control, all of which have a significant impact on the growth parameters of plants.

To address these issues, it is possible to consider hydroponics as a solution that does not require soil. By filtering and transporting the minerals and nutrients required by plants solely through water, pest control is made simple because the ground and entire production area are isolated, while environmental factors such as humidity, sunlight, and moisture are monitored and controlled in accordance with climate and weather influences.

The study will be undertaken in agricultural sectors with the goal of improving farming methods and techniques while increasing the effectiveness of crop production plants. In terms of events that have a significant impact on the growth of crops in agricultural sectors, examples include climate change, which inhibits plant growth by modifying various parameters such as soil condition and water availability in the plant's environment. Reduced price ceilings on farmers' and agribusiness crops set by the government to meet the economy's dramatic increase in demand and shortage of supply as a result of the Covid19 regulations' ramifications, resulting in extreme income losses and sometimes survival on scraps.

Climate change, a recent global occurrence, exacerbates such issues, notably disproportionate sunshine heat, which results in soil draught and decreased soil humidity and wetness, creating tough conditions for plants. Abnormal La Niña and El Niño both contribute to the creation of an unfavorable environment for plant crops by resulting in excessive and insufficient water availability, resulting in inferior quality, or destroyed crops. To compensate for the decreased food supply, additional land is converted to farming to serve the rising population while gradually degrading the soil condition with pesticides and fertilizers. Utilizing solutions to meet rising demand, the administration expanded the country's imports, bringing in additional supplies of goods and foods despite the country's lower GDP. Time and money should be invested in developing an effective farming breakthrough as a means of creating opportunities and gradually adapting to changes.

STATEMENT OF THE PROBLEM

The purpose of this study is to manage and control environmental growth parameters through via hydroponics. To meet hydroponics' energy requirements, it is prudent to explore solar energy generation. By comparing the device's effectiveness, efficiency, and regulation of environmental elements most conducive to plant development to traditional soil culture, the research intended to address the following questions:

1. What factors and conditions affect the growth of a plant?
2. Does using water as a planting medium have an effect on the growth of plants in comparison to the traditional method of planting?
3. In terms of production, does hydroponics promote crop quantity and quality?
4. Will the ability to control and regulate environmental factors result in the establishment of suitable living conditions for plants capable of producing high-quality crops?

THEORETICAL FRAMEWORK

This study is anchored on the following theories of hydroponics and plant’s living conditions with regards to environmental variables, effects: Szczepanski (2015) brief theory of hydroponics; Good (1931), theory of plant distribution; Etterson & Mazer (2016), How climate change affects plants' sex lives.

Szczepanski (2015), from a brief theory of hydroponics asserts that water is used to make nutrients in the soil soluble and to deliver oxygen to the plant's roots when growing plants in soil. However, in hydroponics, the nutrients are made available directly in the water. A hydroponics system requires a nutrient-rich water supply, a method of oxygenating the water supply, and a method of transporting the water to the plants in the most general sense. Because fertilizers can be costly, most hydroponics systems are recirculating, which means that the runoff from conveying water to the plants returns to the original water source. Good (1931), theory of plant distribution states that the distribution of plants is mostly determined by the distribution of various weather conditions. This principle is exemplified by the general global correlation between the weather and the vegetation and it is especially noticeable in the parallel between the main temperature and floral temperature zonations of the planet, as well as in the division of plant life distinct temperature zones based on the dispersion of rainstorm. It is exemplified by the vegetation's altitudinal zonation in high-altitude areas, as well as the dispersion of crop and garden plants also exemplifies it. Etterson & Mazer (2016), How climate change affects plants' sex lives states that climate change affects wild plant species across their geographical ranges, revealing upslope expansion, low-elevation range contraction, and, in some cases, a lack of geographic response to climate change. Species in the core of their ranges are subject to climate-driven natural selection that promotes adaptation to a warmer world.

CONCEPTUAL FRAMEWORK

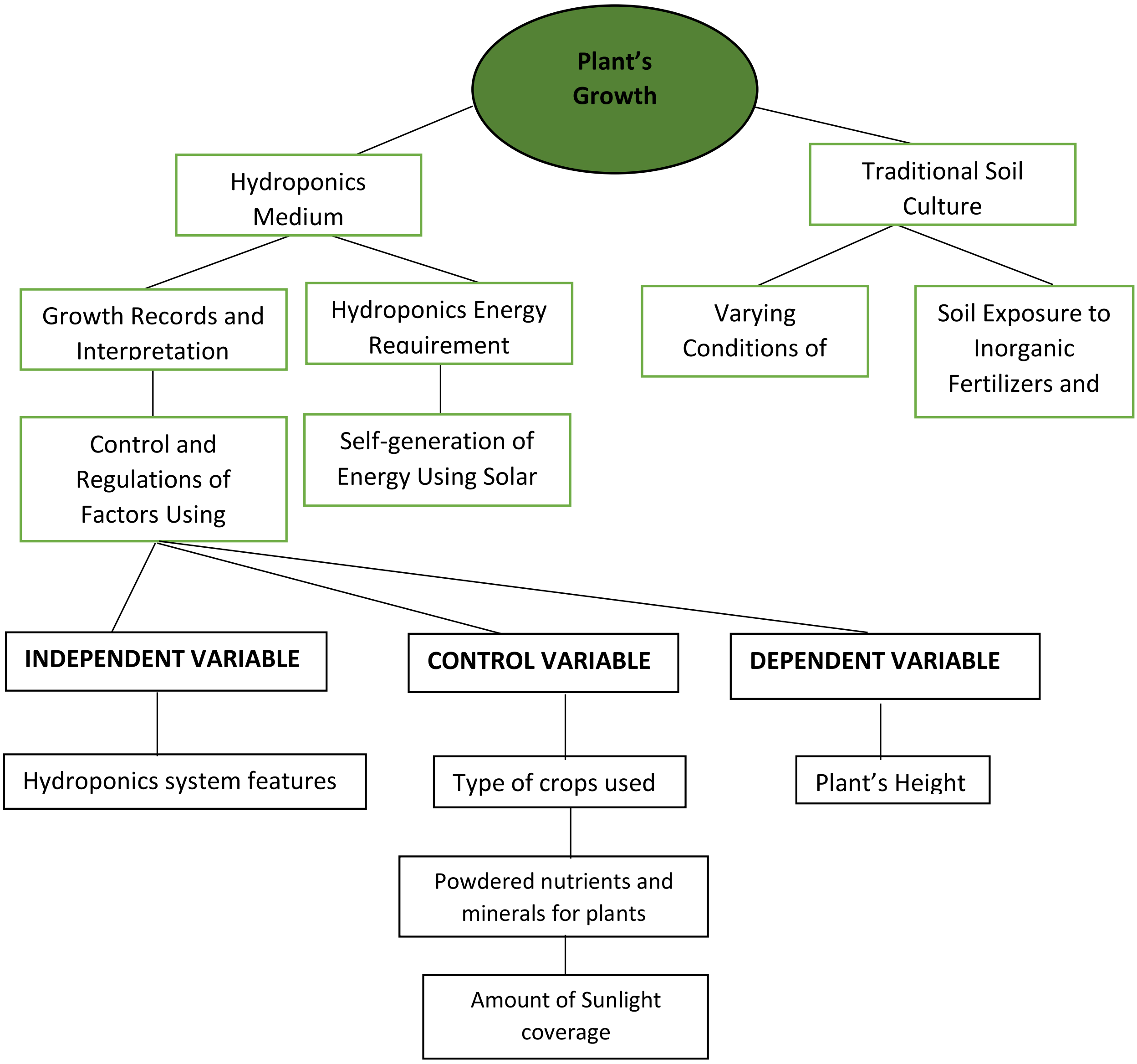

Figure 1. Plant's Growth

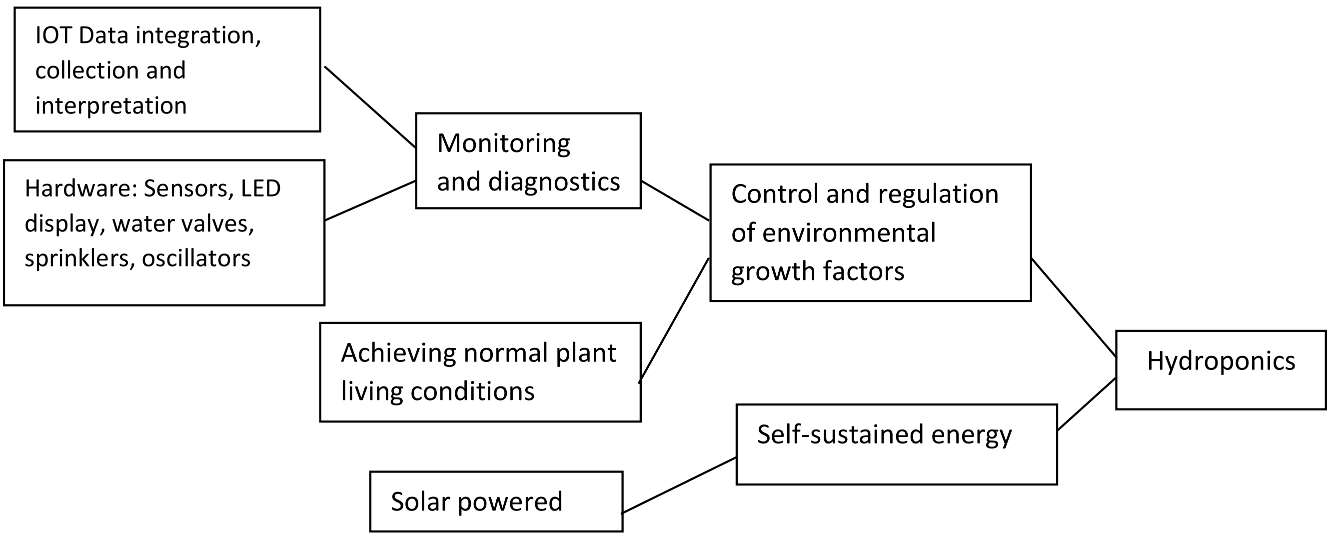

Figure 2. Schema of the Study

SIGNIFICANCE OF THE STUDY

Agriculture in the Philippines has great potential because of the country's topography and geographic position, where fauna and plants thrive. Since agriculture has evolved over time, the country's population and food requirements have grown, resulting in more farmland being occupied and more food being produced. Farm productivity is being limited by factors such as unmechanized planting stations that relied on manual labor, inadequate irrigation, and squandered financial support as a result of industrialization taking over most farming areas. When it comes to food production and the continuation of agriculture in our country, our research is critical via inception of propagating ideas to promote hydroponic culture.

Farmers. Crop production relies heavily on land, pesticides and water, as well as labor and considerable amount of fertilizer which totals the amount that overweighs the cost. This study can help counterbalance these expenditures. Along with its ability to make optimum use of available space, hydroponics may be an attractive option for farmers with limited land holdings. Hydroponics can be used in a variety of ways, including as a novel medium for growing plants. These involves not being dependent to the soil and its external & internal conditions in various weather circumstances. Less effort is needed compared to conventional way of planting which make use of work animals and machines to till the soil, by utilizing water as a medium for nutrient transmission it roughly reduces the extra workload caused by soil farming. Plants health is extremely pertinent to hydroponics since it separates the plant from diseases while ensuring growth via nutrients uptake. Regarding sunlight absorption, farmers may take it easy with the plants having less or excessive sunshine exposure because the oscillator makes sure to supply the plants the average normal demands.

Consumers. Developing countries prominent characteristic includes the blowing population that requires daily food resources. With the increase of inhabitants, plans to sustain food production falls unto import goods for its affordability in comparison to local products which creates triviality towards its prices and production. The study can help produce quality crops with good market value in contrast to import goods which can help recede the amount of imports taken into the country. Availability is present to most cities as the equipment requires enough space to construct, transforming an area to an agricultural site for food production. With the supply found nearby, delivery costs is reduced and results to lower prices of products.

Environment. Agricultural lands necessitate machineries which produces carbon dioxide in the air aggravating the pollution in the atmosphere. The use of fertilizers and pesticides is needed to keep the plants healthy and free from disease and pests, but these products also contain chemicals that causes algal bloom to local ponds and rivers that restrict water flow. Other cases present itself to bodies of water causing red tide and water pollution that causes poisoning of marine animals. This study presents use of isolated water conduit as a medium for plant's nutrients which avoids the elimination of contaminated liquid to bodies of water and preserving the conditions of the soil. The mentioned device is energy efficient and environment friendly because it uses solar energy to run, thus releasing less carbon dioxide compared to machineries used in farm fields.

SCOPE AND DELIMITATION OF THE STUDY

The study is limited to comparison of plant's growth using hydroponics and soil culture. The study focuses on controlling and regulating plants growth factors while interconnecting the device with the internet via IOT. Energy generation using solar panels and oscillation of plot is affixed to establish energy sustenance during blackouts which takes care of the disadvantages of hydroponics. The plants used for comparison and growing are limited to plants that doesn't need plenty of soil like tubers. Environmental growth factors to be controlled and regulated are limited to soil moisture, soil temperature, nutrients, moisture, and humidity. Comparisons of crops growth are to be experimented on soil culture and hydroponics. Effects of optimized sunlight hours of plants are to be studied upon in order to achieve coherent growth observations.

DEFINITION OF TERMS

The following terms are operationally defined to ensure that the research is better and clearly understood.

- **Hydroponics**. production method where the plants are grown in a nutrient solution rather than in soil. The work of delivering nutrients to the plant roots. In order to grow, plants need water, sunlight, carbon dioxide (usually from air circulation), and nutrients.
- **Skeletal Frame**. a framed structure often used for the construction of multi-storey buildings. It incorporates a network, or system, of columns and connecting beams which support the building's interior floors and exterior walls and carries all loads to the foundations.

- **Environmental Factors**. eco factor is any factor, abiotic or biotic, that influences living organisms. Abiotic factors include ambient temperature, amount of sunlight, and pH of the water soil in which an organism lives. Biotic factors would include the availability of food organisms and the presence of biological specificity, competitors, predators, and parasites.
- **Oscillating**. means "to kiss" and is usually used humorously or ironically to add an unnecessary level of clinical detail to an otherwise casual action. Oscillate means "to move back and forth," and it can be used to describe something physically moving or figuratively switching between two points
- **Water Reservoir**. A reservoir is an artificial lake where water is stored. Most reservoirs are formed by constructing dams across rivers. A reservoir can also be formed from a natural lake whose outlet has been dammed to control the water level.
- **Plant medium**. the term ‘growing medium’ is used to describe the material used in a container to grow a plant. Often also referred to as “substrate” or “potting soil”, a growing medium is a material, other than soil on the spot, in which plants are grown. As an important supplier to the modern horticultural industry, the peat and growing media sector is an important contributor to its sustainability.
- **Drip systems**. drip irrigation is a method of crop irrigation that involves a controlled delivery of water to plants through system of pipes, valves, tubing and emitters. Water drips constantly onto plants to keep them well watered. Drip irrigation is also called trickle irrigation.

- **Aeroponics**. is the process of growing plants in an air or mist environment without the use of soil or an aggregate medium. It is sometimes considered a type of hydroponics, since water is used in aeroponics to transmit nutrients.
- **Deepwater culture**. hydroponic method of plant production by means of suspending the plant roots in a solution of nutrient-rich, oxygenated water. ... Typically, DWC is used to grow short-term, non-fruiting crops such as leafy greens and herbs.
- **Horticulture**. the science and art of the development, sustainable production, marketing and use of high-value, intensively cultivated food and ornamental plants. Horticultural crops are diverse, including: Annual and perennial species, Fruits and vegetables, Decorative indoor plants
- **Soil culture**. defined as "any method of growing plants without the use of soil as a rooting medium, in which the inorganic nutrients absorbed by the roots are supplied via the irrigation water"

CHAPTER II

REVIEW OF RELATED LITERATURE

Issues regarding about agriculture in Philippines are countless as a result to the country's expansion which is the foundation of agriculture resulting to less production of crops and materials. To address this issue various sources are thoroughly explored and examined to determine which solutions are needed for the development of the agriculture. (Espiritu, 2019)

The primary aim of this study is to utilize a different system in cultivating crops which is with the use of hydroponic system which is water-based. It works by filtering and transporting the minerals and nutrients required by plants solely through water, this allows for pest control because the entire production area is isolated. Furthermore, environmental factors such as humidity, sunlight, and moisture are monitored and controlled in accordance with climate and weather influences by the use of sensors. (Espiritu, 2019)

The modern reference of hydroponics was by William Frederick Gericke when he proposed the idea that instead of soil, plants could be grown in a solution of nutrients. Despite the fact that his proposal was initially doubted, he provided evidence that prompted more research into the topic, which revealed the benefits of soilless agriculture. Further discoveries of using hydroponics lead to water conservation, oxygenated water reservoirs, and the most important finding of hydroponics is total control over its environment, which means pests and diseases are controlled as a result of the area being isolated. (Espiritu, 2019)

Hydroponics is the art of gardening without the use of soil. Crops are grown in inert growing media with nutrient-rich solutions, oxygen, and water. This approach fosters rapid growth, higher yields, and higher quality because the root system of a plant is directly exposed to water and nutrition, the plant does not have to exert any energy in sustaining itself. The energy the roots would have expended acquiring food and water can be redirected into the plant's maturation. (Woodard, 2019)

Hydroponic systems function by allowing precise control of environmental parameters such as temperature and pH balance, as well as increased nutrient and water exposure. Hydroponics works on the basis of a fairly simple principle: supply what is required for cultivation. Hydroponics administer nutrient solutions that are specifically matched to the demands of the plant being cultivated. With this regulated environment, the system can control the amount of sunlight that reaches the crops, as well as the pH levels. Plant development is accelerated. (Woodard, 2019)

Hydroponic s is a technology for growing plants in nutrient solutions (water containing fertilizers) with or without the use of an artificial medium (sand, gravel, vermiculite, rock wool, perlite, peat moss, coir, or sawdust) to provide mechanical support. Liquid hydroponic systems have no other supporting medium for the plant roots; aggregate systems have a solid medium of support. Hydroponic systems are further categorized as open (i.e., once the nutrient solution is delivered to the plant roots, it is not reused) or closed (i.e., surplus solution is recovered, replenished, and recycled).In combination with greenhouses, it is high-technology and capital-intensive. It is also highly productive, conservative of water and land, and protective of the environment. Yet for most of its employees, hydroponic culture requires only basic agriculture skiUs. Since regulating the aerial and root environment is a major concern in such agricultural systems, production takes place inside enclosures designed to control air and root temperatures, light, water, plant nutrition, and adverse climate. (Hydroponics, 1997)

The development of hydroponics has not been rapid. Although the first use of CEA was the growing of off-season cucumbers under "transparent stone"(mica) for the Roman Emperor Tiberius during the lst century, the technology is believed to have been used little, if at all, for the following 1500 years.

Greenhouses (and experimental hydroponics) appeared in France and England during the 17th century; Woodward grew mint plants without soil in England in the year 1699. The basic laboratory techniques of nutrient solution culture were developed independently by Sachs and Knap in Germany about 1860 (Hoagland and Am on, 1938).

In the United States, interest began to develop in the possible use of complete nutrient solutions for large scale crop production about 1925. Greenhouse soils had to be replaced at frequent intervals or else be maintained in good condition from year to year by adding large quantities of commercial fertilizers. As a result of these difficulties, research workers in certain U.S. agricultural experiment stations turned to nutrient solution culture method s as a mean s of replacing the natural soil system with either an aerated nutrient solution or an artificial soil composed of chemically inert aggregates moistened with nutrient solutions (Withrow and Withrow, 1948).

The study of crop nutrition began thousands of years ago. According to the ancient history, various experiments were undertaken by Theophrastus (372-287 B.C.) while several writings of Dioscorides on botany dated from the first century A.D. are still in existence (Douglas & James, 1975). The classic work on growing terrestrial plants without soil was published by Sir Francis Bacon in 1627, the book named ‘Sylva Sylvarum’. After Bacon’s work, water culture became a popular research technique. In 1699, John Woodward published his water culture experiments with spearmint. He observed that plants grew better in less pure water sources than plants in distilled water.

Experiments of German botanists, Julius von Sachs and Wilhelm Knop (1859-65) resulted in a development of the technique of soilless cultivation. It was Professor William Frederick Gericke (1937), who finally introduced the term hydroponics and wrote the book named ‘Complete Guide to Soilless Gardening’. Two other plant nutritionists, Dennis R. Hoagland and Daniel I. Arnon, at the University of California wrote a classic in 1938 in agricultural bulletin, The Water Culture Method for Growing Plants without Soil. These two researchers developed several formulas for mineral nutrient solutions, known as Hoagland solutions. Modified Hoagland solutions are still used today.

The biggest drawback of using hydroponics is its high electrical consumption however, this can be mitigated by the use of a solar panel, which is a trusted and efficient alternative energy source

Straten, G. (2014) A mobile electricity generator having a telescoping boom, a first retractable support leg, and a base. The telescoping boom contains a first end and a second end. A wind turbine is linked to the second end of the telescoping boom and the wind turbine can translate wind into power. The first end of the telescopic boom and the first retractable support leg are fastened to the base. The energy generator comprises a moveable solar panel assembly that may be stowed in the base and deployed to a usage position and a pair of doors each equipped with a solar panel swing having solar panels. The mobile electricity generator can further incorporate a battery in electric communication with the solar panels for storing the electricity.

Hydroponics medium

Debangshi, U. (2021), Soil-based agriculture is currently confronted with significant challenges because of urbanization, industrialization, and environmental degradation, among other factors. Among numerous issues, the most serious is the decline in land availability per capita. With a population of 6 billion, per capita land availability is currently 0.25 hectares and will decrease to 0.16 hectares by 2050. Climate change, in conjunction with urbanization and industrialization, amplify these negative consequences. To combat these threats, hydroponics has emerged as a viable option that is gaining popularity globally due to its resource-efficient management. Hydroponic farms are a viable option for more sustainable food production, as they avoid hazardous chemicals due to their controlled environments and stringent certification requirements. Hydroponic farming is far from a pipe dream; it is already being integrated into sustainable agriculture to meet growing global food demand.

Plant's growth records and interpretation

Olas, et al. (2019), Plant growth is a highly complex biological process that involves an infinite number of biochemical and signaling pathways that are all interrelated. Numerous methodologies have been developed to quantify growth, disentangle the multiple mechanisms involved in plant growth, and comprehend how a complex interaction between genotype and environment dictates the growth phenotype. Despite this complication, researchers frequently simplify the term "growth"; depending on the quantification method used, growth is defined as an increase in plant or organ size, a change in cell architecture, or an increase in structural biomass. In summary, the cellular and molecular principles behind plant growth in this review, present state-of-the-art imaging, and non-imaging-based methodologies for quantifying growth, including their advantages and disadvantages, and propose a vocabulary for growth rates based on the technique utilized.

Self-generation of Energy Using Solar Panels

Straten, G. (2014), A mobile electricity generator having a telescoping boom, a first retractable support leg, and a base. The telescoping boom contains a first end and a second end. A wind turbine is linked to the second end of the telescoping boom and the wind turbine can translate wind into power. The first end of the telescopic boom and the first retractable support leg are fastened to the base. The energy generator comprises a moveable solar panel assembly that may be stowed in the base and deployed to a usage position and a pair of doors each equipped with a solar panel swing having solar panels. The mobile electricity generator can further incorporate a battery in electric communication with the solar panels for storing the electricity.

Traditional soil culture

Passioura, J. (2002), Plants can respond to soil conditions in ways that are difficult to explain in terms of their roots' capacity to absorb water and nutrients. Roots may detect tough soil conditions and transmit inhibitory signals to the shoots, hardening the plants against the effects of a deteriorating or limiting environment, particularly if the plants' water supply is threatened. In general, this behavior might be viewed as feed forward responses to the soil becoming too dry or too hard, or to the available soil volume being extremely tiny, as with bonsai plants, or to pathogen infection of the roots. However, excessively soft soil or roots forced to develop in extremely big pores might also generate substantial conservative responses, the relevance of which is unknown. Stomata conductance, cell expansion, cell division, and the rate of leaf development may all be affected by inhibitory signals. Their nature is still debated, and the discussion is becoming more complex, which suggests that a network of hormonal and other reactions is involved in adjusting a plant's growth and development to its environment.

Varying Conditions of Soil due to Climate Change

Yadav, et al. (2020), Agriculture output is influenced by climatic and weather conditions, but increasing temperatures, precipitation, and CO_2 concentrations have a direct effect on crop productivity these days. CO_2 concentrations are increasing at a rate of 1.5 to 1.8 parts per million each year. In India, a decline in rainfall of 0.7 percent and 3.0 percent in 2050, 5.0 percent and 7.6 percent in 2100, and an increase in temperature of 3-4 degrees Celsius by the end of the twenty-first century, should be noticed. Temperature increases of 10 degrees Celsius diminish wheat output by 4% to 5%. After harvesting the crop, crop residue is burned in the field, which should assist increase CO_2 levels and destroy the field's microorganisms. Climate change can also have a direct or indirect effect on an ecosystem. Climate change will have an effect on the recharging of groundwater, the water cycle, soil moisture, livestock, and aquatic species. Climate change increases the incidence of pests and diseases, resulting in a massive loss of food productivity. Climate change should be identified as a factor in soil fertility degradation, increased salinity, resistance to several insecticides and herbicides, and deterioration of irrigation water quality.

Soil Exposure to Inorganic Fertilizers and chemicals

Basak, et al. (2017), this is the third consecutive issue devoted to the importance of soil biological health for long-term productivity. Emphasized the importance of missing links in our research agenda, the need for studies on microbial diversity, aided by molecular biology, over soil physical and chemical properties, owing to the former's rapid detectable changes in comparison to the latter two as a result of physical, chemical, or climatic aberrations, and thus urging for the development of new indicators in the field of soil biology to index soil quality. Soil health is not a simple nomenclature but a 'concept' that qualifies agricultural and environmental sustainability, advocating for renewed efforts to rethink the entire domain and simultaneously reinvent the methodology and parameters. In recent years, there has been a strong push in many quarters to focus on organic composting, utilizing not only agricultural residues but also urban and industrial waste, avoiding environmental contamination of rivers, soil, and atmosphere, and minimizing greenhouse gas production, thereby attempting to return to the soil over 90% of the organic materials currently considered trash. It will contribute to CO emission reductions by sequestering carbon and altering agronomic methods that favours such emissions, both of which are critical measures in combating the phenomenon of climate change. Other critical points include, in addition to enhancing plant nutritional aspects through favourable soil physical conditions, the development of processes and methodologies for studying the ecotoxicological effects of all types of residues, regardless of origin, thus establishing a link to human health. Compost may even inhibit the spread of soil-borne plant diseases that cause major harm to globally vital food crops, although the results are inconsistent thus far. Without a doubt, public health is dependent on nutritious food, which is directly related to soil health, which is frequently referred to as soil wealth. Composting organic material results in the breakdown of big complex molecules in a sequence of phases. The result is a simple, stable molecule that forms the humus-like matrix of nutrients and organic waste that we refer to as compost. The addition of organic waste enhances and stimulates microbial communities in the soil, particularly due to the presence of easily available nutrients and C compounds. Numerous microbial activities and biochemical properties serve as crucial indications of organic composting's impact on soil. Additionally, these are qualitatively and quantitatively related with the presence of extracellular hydrolytic enzymes that are involved in the degradation and mineralization of organic matte

CHAPTER III

METHODOLOGY

This chapter covers the different scientific methods and procedures in conducting the study.

RESEARCH DESIGN

This study used a descriptive research design.

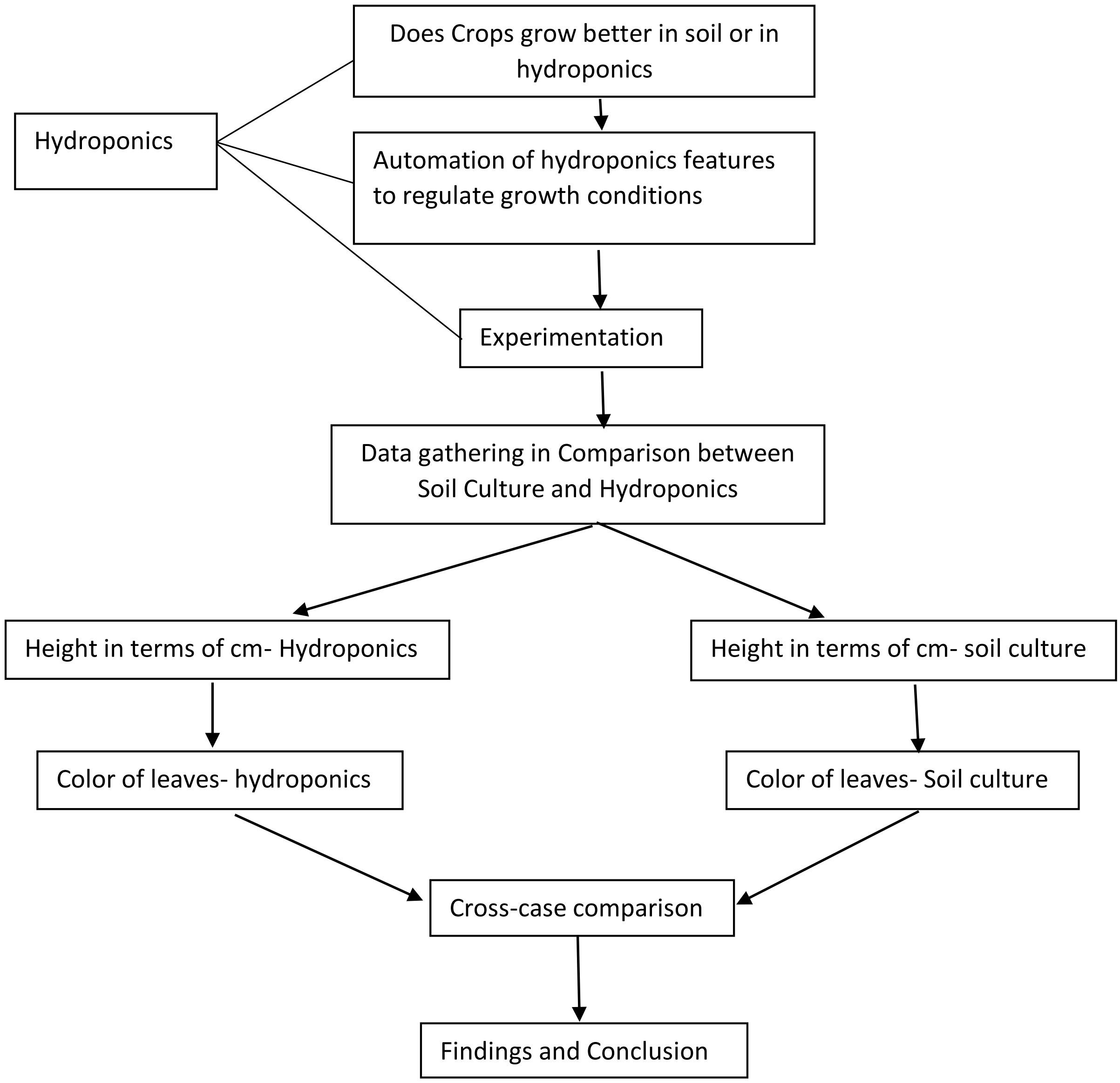

Figure 1. Methodology Chart

RESEARCH ENVIRONMENT

This study would be undertaken on the grounds of Iligan City East National High School or in the homes of students to observe the device's effect on the plants. It is more successful in gardens, farmlands, and agri-farms where plant-related elements may be easily detected and identified using the necessary equipment.

PARTICIPANTS OF THE STUDY

The participants of the study are the researchers conducting the experiment between the effects of hydroponics and soil culture to plants. In device testing, participants include agribusiness men and farmers in areas with extreme weather conditions and unhealthy soil that has difficulty retaining plant growth.

RESEARCH INSTRUMENT

The researchers used a researcher-made survey questionnaires in gathering data, suggestions, and etc. from the participants that includes agri-business men, farmers, people who have interests in plants, and etc.. The use of researcher-made surveys are used to scope certain conditions perceive by people engaged in farming and also the interest of people rearing towards gardening in their backyards.

DATA GATHERING PROCEDURE

To gather data for analysis, tests can be conducted to compare the device's use and benefits to the traditional method of planting. Independent and dependent variables have to be collected and compared between soil and hydroponics in terms of plant growth results. Moisture, humidity, nutrients, solar coverage, and water are all parameters considered by the gadget. The same sort of crop is to be planted and employed on both the apparatus and its soil counterpart, and its growth is to be monitored and documented daily up to a specified time period. Physical evaluation of the plants' characteristics should also be considered when comparing the success of isolated studies. The plants are to be exposed to specific environmental conditions prevalent in today's global phenomenon while yet ensuring the crop's survival. The internet of things will also be incorporated into the data collection process, as will the data given by the sensors linked to the gadget to track growth. Following the time period specified, the data acquired, both qualitative and quantitative, are to be examined statistically using statistical tools and procedures.

STATISTICAL TREATMENT

This study would be using the Mean and T-test as its statistical treatment. The researchers would calculate, evaluate, and find the mean of the results of the conducted surveys, and questionnaires.

CHAPTER IV

RESULTS AND DISCUSSIONS

Cucumber Height Growth in One Month Experiment (weekly record)	
Traditional Method of Planting	**Hydroponics System**
62 mm	58 mm
65.3 mm	67.15 mm
68.7 mm	77.55 mm
72.2 mm	87.95 mm

Table 1. Cucumber Height Growth

Cucumber Weight Growth in One Month Experiment (weekly record) $g/3m^2/week$	
Traditional Method of Planting	**Hydroponics System**
121.13 g	213.82 g
245.31 g	429.96 g
369.92 g	644.46 g
494.59 g	857.86 g

Table 2. Cucumber Weight Growth

As shown in the table 1 and table 2, there are significant differences in the comparison of two same types of crops cultivated utilizing two different cultivation methods. The data shows that crops cultivated in a hydroponics system yield better quality than those cultivated in traditional soil cultivation. According to the findings, the advanced planting method had a significant impact on the crop's height and weight. The difference in the rate of growth of the seedlings after germination was visible in the height and weight changes of the crops. However, because the experiment only took one month to complete and only tested a few crops, it is unclear whether the sensors used can guarantee long-term use, as one of the factors that affects its service is sensor quality, and the sensor that the researchers used is low quality and not suitable for long-term uses. Therefore, the researchers decided to go with a sensor with better quality. This also answered the following research questions from the statement of the problem numbers 2 and 3 about the quality of hydroponics system device that was being consider to come up with the data.

CHAPTER V

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

FINDINGS

Based on the results and discussions gathered from this study, the following findings are drawn.

1. When the researchers were testing the device, the researchers observed that the device starts functioning when it met the conditions made by the researchers.
2. When using the device, the data was successfully stored in the website called adafruit.io.
3. Even though the power supply is off or not plugged it still functions by connecting the Arduino to the laptop. So, the data will still be shown in the LCD display.

CONCLUSIONS

Based on the findings gathered from this study, the following conclusion are drawn.

1. Hydroponics system is efficient in providing acceptable living conditions for plants as well as improving their quality and quantity and with the utilization of water-based system precludes the prospect of being embedded by soil diseases.
2. Utilization of Hydroponics system has more advantages when comparing to the utilization of soil cultivation.

3. With its closed systematic setup, it is guaranteed that the rate of occurrence will decline. In addition to its advantage, the prospect of having diseases is lessened.

RECOMMENDATIONS

Following the completion of the study and consideration of its flaws, it was decided to perform additional research and seek out knowledge that could aid and fully integrate the process, allowing for a better development of the study and the best possible improvement that could increase the study's performance.

These are the following recommendations that the researchers made:

1. The study should be performed in a long-term period of time.
2. It is better if different kinds of plants are being compared in testing the hydroponics.
3. To add another sensors and battery that has much more volts that can produce sufficient power for the enhancement of the device.
4. To add shade using *thermochromic spray paint* for covering the plants inside to avoid much heat and water exposure.

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APPENDICES

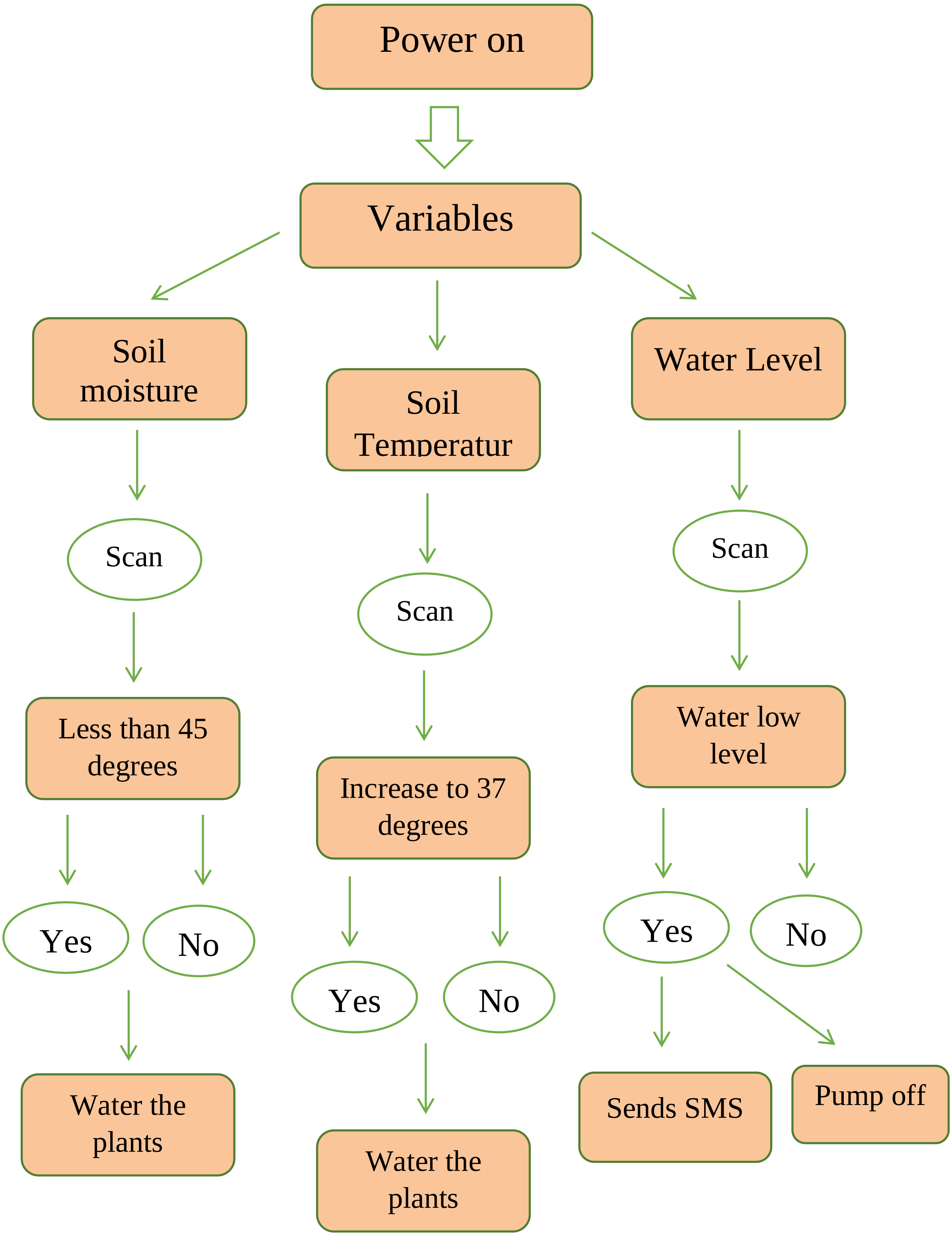
APPENDIX A

This shows the estimated costs of the materials used for constructing and developing the device which are listed below:

Components	Quantity	Price	Total Price
Arduino Mega 2560	1	Php.645.00	Php. 645.00
ESP8266	1	ESP8266	Php.300.00
Mini Submersible Pump 3-5V	2	Php.56.00	Php.112.00
2-Channel Relay	1	Php.114.00	Php.114.00
6-24V to 5V 3A USB DC-DC Buck Step-Down Converter	2	Php.72.00	Php.144.00
Male Header	1	Php.143.00	Php.143.00
Prototyping Board	4	Php.70.00	Php.280.00
Motor controller	1	Php.83.00	Php.83.00
Waterproof Temperature Sensor	2	Php.105.00	Php.210.00
Weatherproof Plastic Enclosure 240x160x90mm	1	Php.650	Php.650
Standoff Kit	1	Php.163.00	Php.163.00
Switch	1	Php.30.00	Php.30.00
SRB- 12V 9.0Ah	1	Php. 999.75	Php. 999.75
Solar panel	1	Php.834	Php.834
Male-Female Jumper Wires	1	Php.75.00	Php.75.00
5pcs Bracket for the Enclosure	1	Php.300.00	Php.300.00
DC 12V Power Supply	1	Php.471.00	Php.471.00
1-meter Transparent Tube	3	Php.10.00	Php.30.00
FC-12 Soil Moisture	4	Php.159.00	Php.636.00
			Total Price = Php.6,318.75

APPENDIX B

Flow chart of how the device works



APPENDIX C

Codes of Arduino

```
#include <LiquidCrystal_I2C.h>

#include <ArduinoJson.h>

#include <SoftwareSerial.h>

#include <OneWire.h>

#include <DallasTemperature.h>

#include "max6675.h"

#include "DHT.h"



//Soil Temperature Sensors

#define ONE_WIRE_BUS 7

#define ONE_WIRE_BUS1 6



//Soil Moisture Sensor Connections

const int soil_sensor1 = A15;

const int soil_sensor2 = A14;

const int soil_sensor3 = A13;

const int soil_sensor4 = A12;
```

```
//Water Pump Pins

const int relayPin1 = 4;

const int relayPin2 = 3;



//Temperature and Humidity Surrounding

#define DHTPIN 5

#define DHTTYPE DHT11

DHT dht(DHTPIN,DHTTYPE);



// LCD

LiquidCrystal_I2C lcd(0x27, 20, 4);



StaticJsonDocument<200> jsonBuffer;

DynamicJsonDocument root(1024);



OneWire oneWire(ONE_WIRE_BUS);

OneWire oneWire1(ONE_WIRE_BUS1);



DallasTemperature sensors(&oneWire);

DallasTemperature sensors1(&oneWire1);
```

```
void setup() {
  pinMode(relayPin1, OUTPUT);
  pinMode(relayPin2, OUTPUT);

  sensors.begin();
  sensors1.begin();
  dht.begin();

  Serial1.begin(115200);

  lcd.begin();
  lcd.backlight();
  lcd.setCursor(3, 0);
  lcd.print("Soil Monitoring");
}

void loop() {

  // Getting the Soil Moisture Sensor Values
```

```
int soil_moisture_value1 = analogRead(soil_sensor1);

int soil_moisture_value2 = analogRead(soil_sensor2);

int soil_moisture_value3 = analogRead(soil_sensor3);

int soil_moisture_value4 = analogRead(soil_sensor4);

float averageMoist = ((soil_moisture_value1 + soil_moisture_value2 +
soil_moisture_value3 + soil_moisture_value4) / 4);

int moisture_level = map(averageMoist, 0, 1023, 100, 0);


float h = dht.readHumidity();

float t = dht.readTemperature();


lcd.setCursor(0, 1);

lcd.print("Soil Temp: ");

lcd.print(getTemperature());

lcd.print((char)223);

lcd.print("C");

lcd.setCursor(0,2);

lcd.print("Soil Moisture: ");

lcd.print(moisture_level);

lcd.print(" %");
```

```
lcd.setCursor(0, 3);
lcd.print("Humidity: ");
lcd.print(h);
lcd.print(" %");

digitalWrite(relayPin1, HIGH);
digitalWrite(relayPin2, HIGH);
if (moisture_level < 45 || getTemperature() > 37) {
  digitalWrite(relayPin1, LOW);
  digitalWrite(relayPin2, LOW);
  delay(2000);
  digitalWrite(relayPin1, HIGH);
  digitalWrite(relayPin2, HIGH);
}

Serial1.print("{\"moist\":");
Serial1.print(moisture_level);
Serial1.print(",");
Serial1.print("\"soil_temp\":");
Serial1.print(getTemperature());
```

```
  Serial1.print(",");

  Serial1.print("\"humid\":");

  Serial1.print(h);

  Serial1.print(",");

  Serial1.print("\"temp\":");

  Serial1.print(t);

  Serial1.print("}");

  Serial1.println();

}



float getTemperature() {

  sensors.requestTemperatures();

  float temp1 = sensors.getTempCByIndex(0);

  sensors1.requestTemperatures();

  float temp2 = sensors1.getTempCByIndex(0);

  float averageTemp = temp1;

  return averageTemp;
```

RESEARCHER'S PROFILE

Name: Leon V. Orong III

Address: Purok 14-A Dalipuga, Iligan City

Cell number: 0963 136 0755

Email Address: L.lll20200214@gmail.com

PERSONAL INFORMATION

Age: 17 years old

Birthday: March 22, 2004

Height: 163 cm

Weight: 58 kg

Gender: Male

School: Iligan City East National High School

Grade: 12

Religion: Roman Catholic

Name of Mother: Socoro V. Orong

Name of Father: Leon D. Orong III

Name/s of Sibling(s): Sheira, Cyril, Zyra

Civil Status: Single

Motto in Life: Live a little

Name: Ericca Jane J. Paylaga

Address: Purok 1 Luinab, Iligan City

Cell number: 0917 150 0686

Email Address: aegaemi123@gmail.com

PERSONAL INFORMATION

Age: 18 years old

Birthday: October 12, 2003

Height: 5’3

Weight: 72 kg

Gender: Female

School: Iligan City East National High School

Grade: 12

Religion: Roman Catholic

Name of Mother: Annie J. Paylaga

Name of Father: Glorito Z. Paylaga

Name/s of Sibling(s): Giovanni Paylaga, Kathrina Paylaga, Queenie Paylaga, Hannah Blanca Paylaga, Jon Paolo Paylaga, Mary Glory Ann Paylaga, Chrysanthe Mae Paylaga

Civil Status: Single

Motto in Life: Take it easy

Name: Erreana Lei C. Mariquit

Address: 0018 Purok 12 Tibanga, Iligan City

Cell number: 0915 284 8893

Email Address: erreanalei24@gmail.com

PERSONAL INFORMATION

Age: 18 years old

Birthday: April 24, 2003

Height: 148 cm

Weight: 40 kg

Gender: Female

School: Iligan City East National High School

Grade: 12

Religion: Roman Catholic

Name of Mother: Melissa C. Mariquit

Name of Father: Roderick V. Mariquit

Name/s of Sibling(s): Ericka Lisse C. Mariquit and Enrico Louisse C. Mariquit

Civil Status: Single

Motto in Life: Make people aware of what they don’t know.