AUTOMATIC WI-FI CONTROLLED GUMBO SEEDER USING RASPBERRY PI

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ABSTRACT

Being in the twentieth century, it is undeniable that technology is playing a vital role in the lives of everyone. As time passes by, technology continues to grow and flourish as more studies are being done. The proponents took hold of that concept and applied it in the field of agriculture, thus producing another method of planting. Automatic seeder is basically the application of technology to the seeder activities done manually. This paper presented an automated seeder system using python programming, both were implemented in Raspbian Operating System. A Raspberry Pi 3 was used for the hardware part as a control mechanism. Code processing was done by the use of terminal panel in Raspbian to control the motion of the seeder. A stepper belt system was implemented to run the stepper motor which was controlled by the Raspberry Pi. Series of tests were conducted to test the functionality of the system. Results showed that the system was quite accurate with about 80 % of recognition rate, with roughly 21 cycles per hour.

Keywords: *Raspberry Pi; Python Programming, Terminal Panel; Secure Shell, Wi-Fi*

INTRODUCTION

In the Philippines, agriculture plays an important role to Filipinos. Based on Philippine Statistics Authority (PSA), agriculture has been recovered to a high 5.28 percent growth from 2016.[1] Roaming around in rural places shows a great evidence of agriculture. Hectares of land are being planted by different types of vegetables and rice fields that are being imported on urban communities and in some international countries.

Due to rich soils and land spaces, some Filipinos choose to plant vegetables by themselves to save money and get a healthy and fresh food after some time of watering, fertilizing, and watching the crops grow. With the use of proper equipment such as shovels, pickaxe some sticks, straws, the seeds, proper water, sunlight and patience. It is possible to have a rich green and healthy vegetables.

Filipinos are one of the most aggressive in the field of agriculture. Almost every Filipino household knows how to plant and care each vegetable known. The most common method that was used is the usual method – the process of digging and fining the soil of a rectangular or square shaped garden. After fining and digging, the seeds are ready to plant in each grid one by one, 14 inches away from each other to gather up some space.[2] For example, a Pechay (Brassica rapa) seed needs to be watered twice a day, with an ample amount of water and fair shade of sunlight. A lot of attention is needed as the vegetables grow and mature by 4 to 6 weeks depending on the maturity of the plant.[3]

The proponents chose this topic to develop an autonomous seeder system using a Raspberry Pi 3 with network connectivity to make control via android application that is connected to a server. The project was equipped with a number of DC motors, belts that were attached to an aluminum body. Putty was also used as it can help the proponents to send and receive inputs from the Raspberry Pi to the android phone.

Objectives of the Study

The general objective of this study was to develop a WiFi controlled system that automatically plant seeds using Raspberry Pi. Specifically, this study aimed to control the system across multiple platforms, to test the functionality of the system, to set a fix seeder injection rate, and to perform a series of tests if the system is performing its proper functionalities.

Significance of the Study

Planting seeds draws a lot of attention. Each of the vegetables has its own characteristics on the way of how it is planted. Planting own vegetables assures Filipinos that the food they are eating are safe.

Furthermore, this study aimed to assist Filipino households in planting vegetables every day. The importance of the system is to lessen the labor spent in seeding process that requires time and causes delay of tasks. The usage of Raspberry Pi was maximized because the modules, the input, and the output pins were active. In addition, Raspberry Pi was connected to the WIFI and interacted with a server compared to other microcontrollers around that needed to be connected first to a laptop before connecting to the WIFI or an Internet connection.

The system was created through a continuous based algorithm. The seeder planted 8 different distance position per cycle. Therefore, the system performed sufficiently in terms of time consumption.

Moreover, the automated seeder system would help to avoid the possible spillage of excessive amount of seeds needed. The use of a Raspberry Pi helped the system bigtime as the microcontroller was used for Internet controlling applications that was suitable for the system compared to other microcontrollers around. The system was indeed an eco-friendly system as it used only 12v power supply to run compared to the gas-powered machineries. In terms of budget, the whole system only cost less than PHP12,000. This kind of system is rather timely in agriculture sector as our country is adapting to different Smart Farming systems. The mantle of the system is not applying only for Filipino household, but also a fragmentary help for the agriculture as whole.

Scope and Limitations

The purpose of development of this system was to help farmers and home owners of farm for proper seed planting process, since they only use their own method.

In terms of software and hardware, it was considered in the design of the system. The use of a motors helped the movement of the system. It controlled the movement in x, y, and z axis. Also, android application, IOS, and windows were used in controlling the system automatically and manually.

The Automated Legume Seeder system using Raspberry Pi is a system that provides automated seeder and irrigation system. The scope and limitations of the study also comprised the following:

- Connection to the local host server;
- Constant supply of power;
- Fixed garden space;
- Limited only to Gumbo seeds; and
- Speed of planting.

REVIEW OF RELATED LITERATURE

A study, entitled Growth performance of Pechay (Brassica rapa) in household derived composts, states that planting in household areas is possible. The Pechay seeds must be planted on a fair shaded area, watered two times a day (morning and afternoon). To get the best results, the soil must be composed of organic fertilizers to make the leaves grow larger versus a soil that has no fertilizers at all. Pechay plants are used to grow within 4 to 6 weeks. [4] While an article at FarmOn.ph indicates that Philippine vegetables will grow best in a well-drained soil mixed with plenty of compost. This article enlightens the proponents in how the soil conditions will be best for planting vegetables. In addition, seeds must sow 1/5-inch-deep with enough seedlings and spaces 14 inches between rows. [5] According to the proponents of the research study entitled GPS based navigation design for a bio inspired precision airdrop system, the design for this navigation module is for precision airdrop system. The system will be air dropping the seeds in midair and maple seed will be there test subject in dropping the seeds. In navigating in air, GPS based navigation module will help in controlling the flight and targeting the location of air drop, the proponents will be using a LabVIEW software interface to control the servo motors.[6] Another study in India, Krishi Ville – Android based solution for Indian agriculture, states that a mobile based application for farmers has been provided by the researchers to help them for farming activities. The mobile application will update agricultural commodities, weather forecast, and agriculture news update.[7] In a research study from Serbia entitled Proposal of the irrigation system using low-cost

Arduino system as part of a smart home, the proponents have designed an automated control and remote management irrigation system by the use of a low-cost Arduino and an android application to gain access to the system. The system is also consisting of 3 divided modules: control part, regulatory part, and server part.[8] Based on the research study entitled Gram Sandesh Transmission a web based information system for farmers, the proponents develop a system that allows the farmers to automatically monitor the flow of information in the agriculture farm. Gram Sandesh Transmission is a web based system that allows farmers to have an access to the farm, by means of iOS application, android application, messaging server, and GSM based led board.[9] In another android research entitled An Automatic Irrigation System using self-made soil moisture sensors and android app, the researchers of this study provided an android application that is based on an automatic irrigation system and made a capacitive sensor that will allow the smart phone to be connected to the raspberry pi microcontroller.[10] According to another research paper which is about A higher precision seeder control system, the system uses SCI serial port to communicate to the host computer through photoelectric encoder to measure the mechanical walking position and feedback to the DSP2407 controller. The feedback of the results will adjust the PWM signal frequency control motor speed. [11]

Synthesis

Based on the gathered 20 literatures of the researchers and arranged reviews as shown in Table 1, the researchers found that this project was viable. Methodology of this previous studies have used Raspberry Pi as the main server that controlled and monitored the main system and it served as the passageway for agriculture seeding system to other devices that were connected via internet or local host area. The use of android application allowed the user to gain access to the main system. The proponents provided an application that is connected to the PHP Server that communicates to the Raspberry Pi. It allowed the user to remotely and automatically control the agriculture seeding system. Applying WIFI router allowed limited access to its system. In developing the system, several techniques and tools can be acquired to improve the farming system that was discussed and it can impact its overall performance. To improve and increase the functionality of the farming system, an intelligence in counting the seed system can be added and installed to the system. This will allow the system to plant the seeds automatically and manually with various number of seeds needed, with the use of Raspberry Pi. Recommendations from the past studies were considered, thus the researchers of this study were urging to do an Automated Legume Seeder using Raspberry Pi.

Conceptual Framework

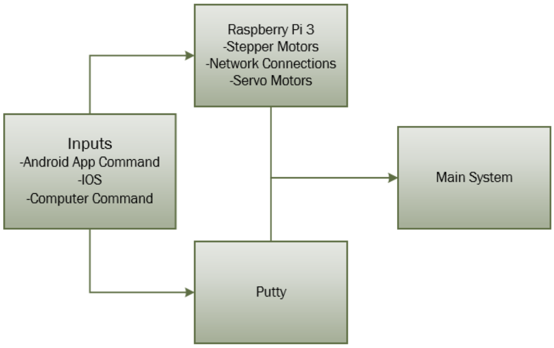

Figure 1. Conceptual Framework of the System

The figure above shows the methodology of the system. The hardware part used several modules compatible with the Raspberry Pi 3 that was being the main controller of this system. For the inputs, the system had to consider the commands done by the Android Application, IOS, computer command and the Putty. The android application, IOS, and computer command were responsible in sending commands to the Raspberry Pi 3 to plant the seeds.

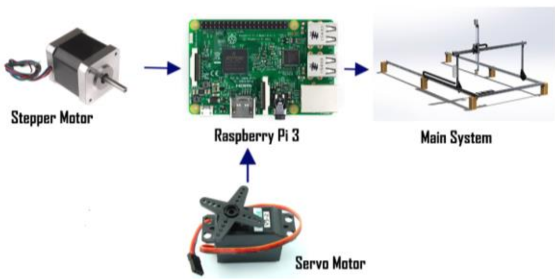

Figure 2. Internal Components of the System

Figure 2 shows that all motors were connected to the microcontroller that helped the mechanism part to move in the platform.

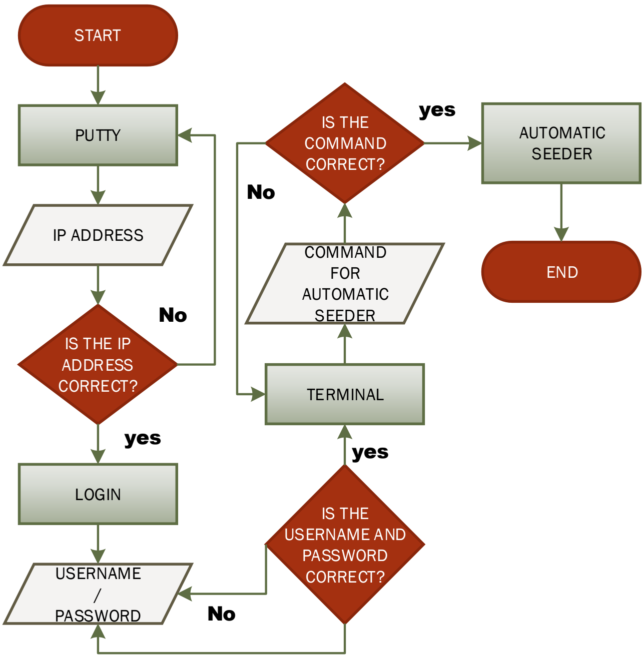

Figure 3. System Flowchart for Android, IOS, and Computer command

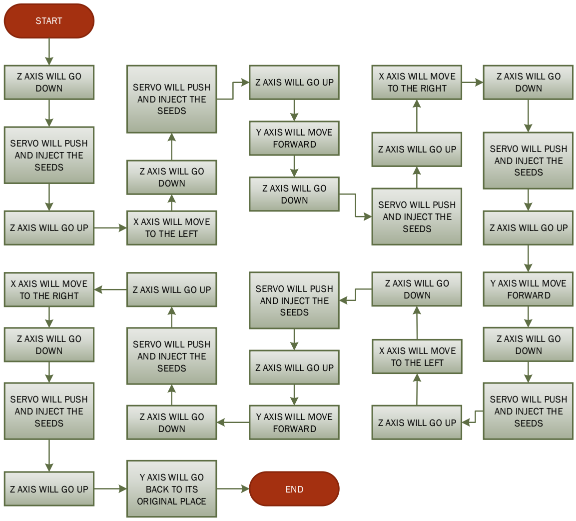

Figure 4. System Flowchart for Automatic Seeder System

Figure 2 and 4 show the system flowchart for the automated seeder system, for the autonomous seeder, the Raspberry Pi automatically planted seeds in eight (8) different locations of seed per one (1) cycle.

The process of the inputs was done using the Raspberry Pi 3. The stepper motors were used in the system to provide a precise positioning in a form of grid (in sq. ft.). Servo motor was used to push the seeds outside the container and injected it downward to the soil to be planted. Putty was used as a bridge between the android application and the Raspberry Pi 3; thus, controlling the system in distant was feasible, Visual representations of the conceptual framework of the system were present in figures 2 and 3. In this study, the proponents used a 4x2 sq. ft. soil compost to test the system.

A counting algorithm was applied to the program of the system to set the needed seeds to be injected and to be planted it. Since, the needed seeds for an Okra is 4, the program was set to inject three (3) to four (4) seeds. The whole system must be connected to a local host to get the best results.

Proposed Design

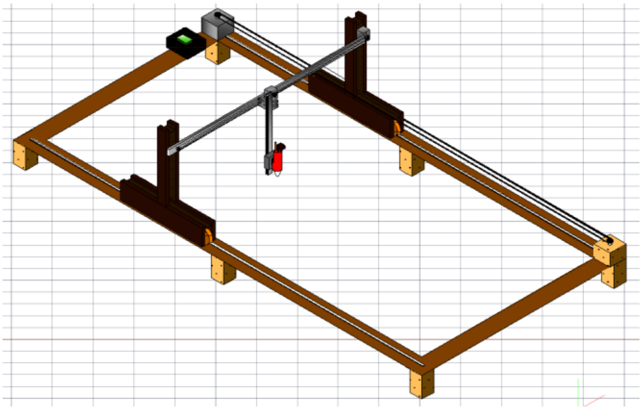

Figure 5. Proposed Design of the System

The figure above shows the proposed design of the system. The Raspberry Pi 3 and its wirings were attached to the side panel of the system. Servo motors and stepper motor were attached to the main arm of the prototype. This was designed to make it look as normal as possible with etch of advanced technology.

RESULTS AND DISCUSSION

Speed Test			
Trial no.	Time consumed per cycle of seeding the seeds per sec		
1	171		
2	171		
3	171		
4	172		
5	171		
6	171		
7	171		
8	172		
9	171		
10	171		
Total	1712		
Average	171.2		
Output per minute	0.350467	Total & Average	Error %
Speed Score	100%	0.350467	0.581395349

Table 1. Arranged results of Speed Test

Table 1 shows the results of the multiple speed testing performed by the proponents.

SEEDS PER SQUARE												
Trial No.	1st	2nd	3rd	4th	5th	6th	7th	8th	Total	Average		
1	4	4	4	4	4	4	4	4	32	4		
2	4	4	4	4	4	4	4	4	32	4		
3	4	4	4	4	4	4	4	4	32	4		
4	4	4	4	4	3	4	3	4	30	3.75		
5	4	4	4	4	4	4	4	4	32	4		
6	4	4	4	4	4	4	4	4	32	4		
7	4	4	4	4	4	4	4	4	32	4		
8	4	4	4	4	5	4	4	4	33	4.125		
9	4	5	4	4	4	4	4	4	33	4.125		
10	4	4	4	4	4	4	4	4	32	4	Error%	3.030303

Table 2. Number of seeds per square results

Table 2 shows the results of the number of seeds per square results of the system performed by the proponents.

CONCLUSION

The researchers were able to accomplish the specified objectives and multiple trials to show the overall performance of the system. With that, the objectives were accomplished because the system was able to the main task to plant okra seeds with their respective distance and positioned; multiple trials and testing of its functionality shows the accuracy of the system, and the speed in planting the seeds in a 2 by 4 feet area takes up to 2 mins and 51 seconds as shown in previous chapter; the proponents proved that the system was working and doing what it was intended to do; okra seeds were planted deep enough to the soil; and by the use of computer based system, the proponents were able to control automatically the movement of the seeder system.

With that, the researchers conclude that the project was a success with some minor errors. Of course, further research can improve and enhance the capabilities of the system.

RECOMMENDATIONS

After the development of the system and completing the study, the researchers suggested to enhance the system. Since the system was only a prototype, it is very likely prone to flaws and error. For further enhancement of the system, the future researchers may look at the following areas:

- Using chains instead of belts in helping the movement of the system;
- Using of counting algorithms to attest the needed seeds in the system;
- Seeding of other vegetables seeds rather than the okra seeds;
- Stabling the movement of Y axis mechanism in the system;
- Using equipment's for the durability of the system; and
- Adding wheels to the legs of the system, for better movement of the overall system.

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