Solar Powered Rice Black Bug Light Trap

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Abstract**—** Bugs epidemic is a widespread outbreak in the rice field in a severe form in the region. Every year, thirty seven percent (37%) is the estimated average of farmer's rice crops that suffer due to diseases and bugs species outbreak. Invasive species such as Rice Black Bug (RBB) infest rice plants at all growth stages from maximum tilling to ripening stage. Government stated that the practice of inorganic pesticide to RBB would also destroy its natural enemies. For this reason, farmers are advised to avoid spraying inorganic pesticides to control bugs. As a substitute of utilizing pesticides, the government has to support other ways to prevent insect pests. A previous the study shown that these sap-sucking bugs are strongly attracted to high intensity light. The study aimed to design and develop Solar-powered Rice Black Bug Light Trap that will help in the rapid production of rice in the industry using Arduino- Microcontroller Unit and C++ Programming Language. The study used questionnaires answered by the respondents, which is divided into five (5) categories; these are the Efficiency, Functionality, Maintainability, Reliability, Usability and Cost-effectiveness of the materials. Experts assessed the prototype which is resulted to 3.7 overall weighted mean where expert's response is "Highly Acceptable".

Keywords**—** Rice Black Bug, Bug, Light Trap, Solar Powered

I. Introduction

Rice serves as the staple food of all the people around the world . If rice was not include on the meal specially on the Filipino family's table , the satisfaction of them were not complete. Rice is definitely a significant need of us. In a wide agricultural land of our country , particularly in Luzon allotted in the rice production. It is commonly cultivated on wet land.

Most farmers engaged in planting rice as one of their agricultural product because when they have already such rice harvest these can support the basic needs of their family as the foremost food everyday.

However , there are encountered problems when it comes to the production of rice , this is particularly the fact that rice plant is subject to attack by more than 100 species of insects that resulted to the damage a good palay harvest thus the economic growth in the aspect of rice production affected too. Leafhoppers and plant hoppers are commonly pest that damage the good rice harvest. It suck the nutrients in palay that burden its enough growth. [1]. Most farmers need to think of the appropriate solution to trap the multiplied numbers of pest so that they can have the good rice harvest.

SLSU Lucena, Philippines

II. Background Of The Study

Lucena City particularly Barangay Ibabang Dupay Red V has a wide area for planting rice and mostly family's resided around the area engaged in farming and commonly cultivate for rice production. For previous years of engaging in this kind of agricultural activity , farmers commonly encountered problem on the pest known as rice black bugs which was never been solved yet . It lay eggs in decaying outermost leaf sheaths of the rice plant and this case trap the enough growth of this.

However , In the Philippines, one of most important invasive pests is the rice black bug , locally known as "Itim na Atangya" (Scotinophara coarctata (Fabricius)). These bugs attack the rice crop at a numerous growth stages from seedling to maturity. It damages plants by sucking its sap. The area around a feeding hole turns brown with dark-brown margins, resembling a blast lesion. Heavy damage is usually seen after heading or maturing, especially when irrigation is stopped during the maturation period. Rice Black Bugs are moisture loving and become dormant in dry weather or when the temperature is cool or hot. In favorable conditions, adults migrate to rice fields and feed on the leaves or leaf sheaths of young plants [2].

The development of the solar powered rice black trap can help to eliminate these pest for the objective of eliminating rice black bug so that farmers can have the good rice harvest.

III. Significance of the Study

The Solar Powered Rice Black Bug Light Trap is a project designed to attract and trap the rice black bug using LED light and exhaust fan. It will be very useful in protecting the crops in the rice field. This device is designed appropriately in agriculture especially in the rice field for reducing the loss of crops made by rice black bug and to decrease the uses of pesticide in the crops.

The proposed study would benefit the academe by its great contribution in the field of agriculture that based in the modern technology. It will serve as a guide for other researchers who wants to improve the modern technology in agriculture, to produce and develop more quality devices using microcontroller based project.

For Academe, this will be of great help in all educational institutions especially to those who are undergoing research in the advancement of technology.

For Community, this study would be useful to the community especially to those who are involved in agricultural business particularly in rice fields.

For Educators, this study would serve as an idea on how the micro controller be applied to the community and agriculture.

For End-users, this proposed project would also a great help to end – users for its advantages than the manual supervising of the rice black bug.

Researchers, this would serve as reference to help them become more innovative and be critical in developing new ideas and apply the knowledge they have learned to develop and enhance their awareness in the innovation brought by modern technology.

Objectives of the Study

The main objective of the research and development project is to design and develop a Solar Powered Rice Black Bug Light Trap that will help to reduce rice black bug infestation.

Specifically, it will seek answers to the following specific objectives:

1. To identify the requirements of Solar Powered Rice Black Bug Light Trap using Microcontroller.
2. To design a Solar Trap using Gizduino ATMega328 and identified requirements to be used by the end-users assigned in rice field areas.
3. To develop a prototype Solar Powered Rice Black Bug Light Trap using C++ Programming Language that will develop a tool for assigning the operation of the device.
4. To evaluate the level of acceptability of the prototype in terms of:
   4.1 Functionality
   4.2 Adaptability
   4.3 Cost-effectiveness of the materials
   4.4 Originality

IV. CONCEPTUAL FRAMEWORK

This section of the study discusses the extraordinary advancement of Solar Powered Rice Black Bug Light Trap that could make through the use of C++ Programming Language as platforms, Arduino ATMega328 and Solar Power as development tool and its electronic components[3].

The development of this project can be effective to trap insects through the use of ultraviolet LED bulbs as its light source. Its solar cells used in changing solar energy that trap the pest in farmland particularly in the area of rice field where rice black bug often attacks. It is made up of the steel that is appropriate in agricultural fields to use with 150 centimeters height install on top of insect pest trap with the 20 watts solar cells panel, size where its base is made up of steel plates . For trapping the insects there is clear acrylic square box function as letting the LED light out of the box . Its one side a wire mesh of electronic mosquito trap where 150 LED size 7x7 mm , 5 rows of 30 LED can be seen inside each box. There are other stuffs with 5 ampere battery charger, 12V 14Ah Sealed Lead Acid battery, light sensor switch circuit, and high voltage circuit of mosquito trap are set in steel box to prevent from any damages [4].

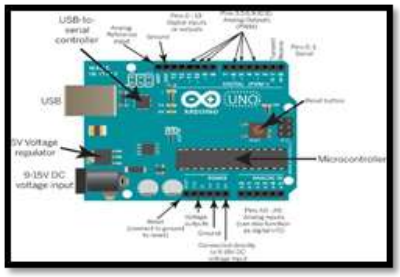

Fig 1 Arduino UNO
(https://www.arduino.cc/en/Main/ArduinoBoardUno)

Figure 1 shows that Arduino UNO has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started [5].

Fig *2* DC Brushless Exhaust Fan
(http://www.dhgate.com)

Figure 2 presents that DC Brushless Fan does not draw constant currents. The choice of the power source along with the addition of other peripheral devices will be affected by the type and number of DC fans and their motor current characteristics. Throughout the rotational cycle and particularly at commutation, the currents will fluctuate from minimum to maximum [6][7].

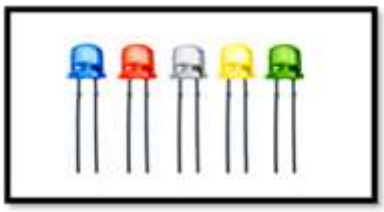

Fig. 3 **LED (Light Emitting Diode)**

Figure 3 shows that inside of the big round bulbs there is a bulb with filaments with warm light source which are really familiar to us. Through its LED bulbs with different shapes, colors and materials help to produce brighter and cooler tones in vast spectrum. These oriented the users for its efficiency as environmental choice because it don't have parts that can harm [8].

Fig 4 **DS1307 Real-Time Clock (RTC)**
(http://www.amazon.in/Silicon-Technolabs-DS1307-Arduino-raspberry)

Figure 4 shows that this is a great battery-backed real time clock (RTC) which function is to see how the microcontroller project allows that time to keep track though it was reprogrammed even the its power lost which is equally important as for data logging clock building , time stamping , timers and alarms. It is definitely the most popular real-time clock working its best with 5V chips [9].

Fig 5 Rice Black Bug (RBB) Scotinophara coarctata
(http://knowledgebank.irri.org:pest-managemen /rice-black-bug)

Figure 5 shows that Rice Black Bug damages rice by sucking out the contents of developing grains from pre-flowering spike lets to soft dough stage, therefore causing unfilled or empty grains and discoloration. Immature and adult rice black bugs both feed on rice grains [10].

Fig 6 **Solar Panel**
(https://www.solaronline.com:solar-panel)

Figure 6 Solar Panel shows that the BP Solar (Solarex) SX320J, previously known as the SX20U, is a 12V 20W solar panel that uses standard polycrystalline solar cells to provide cost-effective photovoltaic power for DC loads with many energy requirements. With 36 polycrystalline solar cells in series, they charge batteries efficiently in virtually any climate. Typical commercial applications of these modules include remote telemetry, instrumentation systems, security sensors, and land-based navigation aids. They are also well-suited to providing subsistence power to homes in remote areas [11].

Fig 7 **Rice**
(http://www.shutterstock.com)

Figure 7 shows that it is the seed of the grass species *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice). As a cereal grain, it is the most widely consumed staple food for a large part of the world's human population, especially in Asia. It is the agricultural commodity with the third-highest worldwide production, after sugarcane and maize [12][13].

Research Paradigm

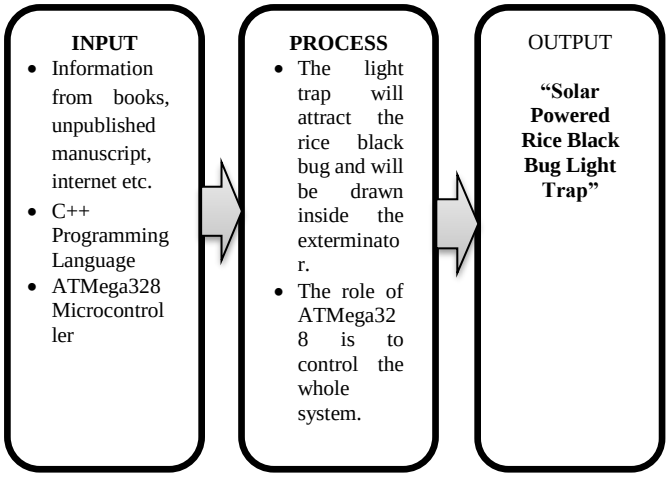

Fig 8 Research Paradigm of the prototype device

Figure 8 Input, Process and Output shows how the researcher came up to develop a device that will eliminate rice black bugs in an easiest way. Input contains the materials used in developing the device. Books, unpublished manuscript, internet and other references were used by the researcher in gathering data in order to construct the system. C++ Programming Language is the language that will be used in the system.

Process is the way used in the device. Components needed on the device were purchased from various electronic shops. The ATMega328 is the controller of the whole system where the program is burned.

Output is the result combining the input and the process. The project "Solar Powered Rice Black Bug Light Trap" is designed to attract and trap the rice black bug using the source of light in LED light and exhaust fan. The finished device will be evaluated by the experts from Agricultural Department, and the comprising engineers and technicians. It will be used by farmers which have problems in rice black bugs.

Research Design

The researcher used the developmental research in the study in assessing the changes of the proposed system over an extended period of time. This study concerned in developing, designing, and then evaluating the enhanced device.

The purpose of developmental research is to optimize and gain a sound basis for development activities. It is a problem oriented and interdisciplinary research methodology that can be used in case study, experiments and action research or evaluation studies.

Project Development

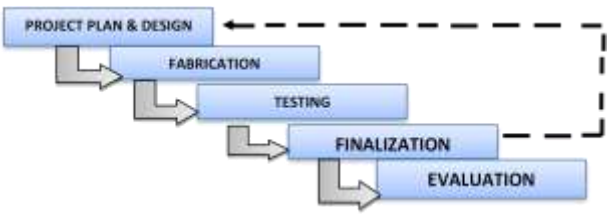

Fig 9 Project Development

Figure 9 Stages of Development of the Device. It shows the stages of development of the machine. It started with the project and design. This stage consists of a review of the areas immediately associated with the proposed system. It produces a broad definition of the system requirements in terms of the functions the system supports. The researcher includes an outline system area model of the area under study, a definition of the systems scope, and a cost justification for the new system. They also created a plan for the corresponding design of a Solar Powered Rice Black Bug Light Trap, and build the system. After planning and conceptualizing the design, the device was fabricated. The researcher is consulting of some experts and technical advisers to make the design of the device. Their opinions to improve the device and planning for more developmental process for the device were given. They analyze the concept, starting to put programs in the device, assembling and designing the whole circuit. The researcher debugs or modifies the error in the programs, check the wire connections of the device. A test will conduct to find out whether the machines are performing well base on the design. The series of testing of the fabricated device have been done to determine its performance. Adjustment and some corrections were taken before finalizing and fixing the device. After all the corrections, the device was finalized. The proposed device has been evaluated in order to determine the acceptability of Solar Powered Rice Black Bug Light

Fig 10 The researcher used observation as a technique to gather data and how the device functions and progress all throughout the given time

Instrument and Technique Used

This project was a developmental research. This research focused on the accessibility of the Solar Powered Rice Black Bug Light Trap for the workers of rice farms. Questionnaires were given to the experts and respondents to evaluate the device and determine the acceptability of the device.

Data Gathering Process

The letter has been formulated, noted by the adviser, and approved by the Campus Director. A mock survey was conducted to establish the validity of the instrument. After which the questionnaire has been submitted back to the panel for further reviews and recommendations. The actual survey was made to the respondents gathered, computed and tabulated.

Evaluation Criteria

Evaluation is a means to determine the acceptability of the project design in order to assess the Solar Powered Rice Black Bug Light Trap, thirty (30) randomly selected individuals were asked to rate the performance of the device. The respondents of the study was composed of 10 from the field of agriculture, electrical, programmer, technicians, engineering and 20 ordinary users particularly workers of a rice farms. Prior to the actual demonstration the function of the device and its specification has been explained. When the evaluation was completed, the result was tabulated and computed. The evaluation instrument uses a four-point Likert Scale in which the highest is 4 and 1 as the lowest.

Statistical Treatment

The data analysis contains the information to be gathered through the research instrument (questionnaire). Data Analysis is defined as the process extracting, compiling, and modeling raw data or purposes of obtaining constructive information that can be applied to formulating conclusions, predicting outcomes or supporting decisions in business, scientific and social science settings.

In the statistical treatment the researchers used the Average Weighted Mean Formula. Weighted mean is a measure of central tendency. It represents the average of a given data.

$$AWM = \frac{\sum fx}{N}$$

Where: AWM = Average Weighted Mean
$\sum$ = summation
fx = function
N = Number of Items

Table I Summary of Results

Results	**Weighted Mean (WM)**	**Descriptive Ratings**
1. Functionality	3.88	Highly Acceptable
2. Adaptability	3.7	Highly Acceptable
3. Cost-effectiveness	3.3	Acceptable
4. Originality	3.85	Highly Acceptable
Average Weighted Mean	**3.68**	**Highly Acceptable**

Legend:

Scale	Range Interval	Code	Descriptive Ratings
4	3.25 - 4.00	HA	Highly Acceptable
3	2.5 – 3.24	A	Acceptable
2	1.75 – 2.49	UA	Unacceptable
1	1.0 – 1.74	HUA	Highly Unacceptable

Table 1 depicts the summary of result or the general acceptability of the device. It obtained an average general weighted mean of 3.68 equivalents to highly acceptable descriptive rating.

V. CONCLUSION

Based on the findings, it is drawn that the device was easy to operate and the end-users has the ability to control the device since assembling the device only requires plugging the two wires in the battery below the exterminator. The device can be turns on using the switch at 6:01am in the morning to perform the charging process during daytime and starts to trap the rice black bugs at 6:00pm in the evening for the extermination process. However, cost-effectiveness is the only category

which did not appear constant in terms of the device is economical in terms of system hardware services since some of its parts can only be found at Manila.

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