

sativa L.). In the operational test, several observations were carried out, including moisture, grow light, pump, and seedling yield conditions for 4 days.

1) *Soil moisture sensor testing*: Based on the readings of soil moisture sensors and moisture meters as calibration samples in Table I, the reading values of soil moisture sensors and moisture meter analyzers have a high sensor error rate. The high rate of sensor errors that occur is caused by the uncalibrated sensor used in the tool that has been made. After calibrating the soil moisture sensor reading, the sensor value is obtained. Soil moisture sensor calibration aims to determine the correctness of the conversion of the reading value of the soil moisture sensor. Calibration is carried out regularly to maintain accuracy on the sensor [49]. The results of *moisture* meter and moisture sensor reading data are connected by linear equations with the help of Microsoft Excel application. The read value of the moisture sensor is the x axis and the moisture read value as the y axis. Based on the readings of the moisture sensor and moisture meter, a liner graph is obtained as shown in Figure 6, so that the linear equation formula is $y=0.758x+13.534$ applied to the sensor program. Based on the results of taking error rate data after calibration of the moisture sensor, the error rate reading in Table II is low moisture after calibration on the sensor, which is an average error rate of 2.9%. The smaller the sensor error rate, the difference between sensor readings and standard measuring instruments will be smaller. The smaller the tolerance value of the sensor, the greater the percentage value of accuracy it has [50].

2) *Pump*: Based on the readings of the on and off pumps in Table III, data was obtained that the pump was on 2 times, namely the first pump on at a moisture level of 55% and off at 66%, both pumps on at a moisture level of 59% and off at 62%. On 55% moisture level data, the pump *on* experienced a delay. Pump delay occurs because the slow relay gives commands to the pump so that the moisture reading on the LCD is slow [51].

3) *Operational Testing*: Based on seedling yield growth data in Table IV, the highest moisture value of 71% was obtained and the lowest value was obtained as 66%. The highest moisture value occurs in the afternoon due to the beginning of seeding while the lowest value occurs on the third night the rockwool moisture in the seedling box has a moisture below 60% so that the pump *on* and pump *off* above 60% moisture. The moisture of rockwool is affected by the temperature level present in the tool.

Moisture control is one activity that must be carried out in the process of seeding hydroponic plants, both in open and closed systems. This control must be carried out periodically. The moisture in the device is maintained, inversely proportional to the temperature / temperature. The higher the temperature, the lower the moisture value and vice versa. The influence of soil moisture on plants is almost the same as temperature because plants really need water [52]. If soil moisture conditions are not suitable, it will adversely affect the growth, production, and quality of fruits. This is closely related as a basic material to be used in the process of photosynthesis which is a plant physiological process for the formation of carbohydrates. To meet water needs and

maintain soil moisture can be done through the watering process [15].

Based on the results of tests that have been carried out, the automatic seedling tool is equipped with grow light (LED lights / *Grow light*) as a substitute for sunlight. The grow light used in the seedling tool is automatically connected to the RTC. RTC serves as a timer and date. Grow light has been set by coding LED / Grow light on 06.00 and LED / Grow light off 18.00. In the seeding process for 4 days the grow light on the tool is lit according to the regulated coding.

Grow light on the tool has several colors light. The blue and red light produces the purple color. Red light and blue light have different effects on plants. Not all colors of light can be absorbed by plants. The color of light absorbed by plants is red and blue light, where red and blue light is good for plant growth, because chlorophyll absorbs red and blue light so photosynthesis can run optimally. The implementation of technology with the addition of LED lighting/*Grow light* with an aeroponic cultivation system on lettuce plants can increase the growth and yield of lettuce plants [53].

Based on the results of growth on lettuce plants for 4 days in Table V obtained plants tested as many as 21 live *rockwool*, having two leaves, small and tall stems. In Table V, the highest stem height value was obtained by 4 cm and the lowest value was obtained by 1.7 cm. small and tall stems are caused by the lack of light obtained. The growth of the playing process is affected by treatment. Another factor that can determine the success of hydroponics is plant care. To ensure the circulation of water and nutrients goes well, treatment must be carried out. The results of automatic seedling device sealing on lettuce seeds experience etiolation due to the lack of light obtained during the seeding process. The light greatly affects plant growth. LED lamps/*Grow light* can emit light colors that can accelerate the process of photosynthesis [54]. Blue color for the vegetative phase and red color for the generative phase.

E. Product Revisions

The development of microcontroller-based automatic seedling tools in hydroponic systems works well, the tool is able to detect the moisture level in *rockwool* well, but the tool still needs to be made some improvements such as naming the moisture sensor material on each shelf, grow light and fans on the tool so that plants do not lack light and can grow well.

IV. CONCLUSION

Microcontroller-based automatic seedling tools are able to monitor moisture and LED / *glow light* in the seeding process consisting of two stages. The first stage, mechanical components include the manufacture of seedling boxes and control boxes. The second stage, the control system component includes the creation of circuits, installation of components and input of program languages in the control system.

Lettuce seeding equipment is able to monitor moisture when the moisture is below 60% then the pump will be on and when the moisture is above 60% the pump will be off, and the light produced with LED / *Grow light* will turn on at 06.00 to 18.00 pm every day. Sorting using an automatic seedling

device on lettuce seeds is etiolated due to the lack of light obtained during the seeding process.

Based on research conducted, researchers suggest adding moisture on each shelf, LED sensor lights / grow lights and fans in future studies. As a consideration and reference material regarding the latest science on the manufacture and performance test of seedling tools that are able to monitor moisture and light automatically. Adding the latest insights and knowledge about making and testing the performance of seedling tools that are able to monitor moisture and light automatically. This researcher is expected to be an industry reference in seeding.

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