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Education on Automatic Sprinkle Device based on Humidity Sensors at SMA 2 Slawi, Tegal District

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Abstract

Watering plants is one type of plant care that can be said to be monotonous if done conventionally. The conventional watering process sometimes consumes more water and if watering is done too late it can cause the plants to dry out and wilt first. The purpose of this activity is to educate about the automatic plant watering system based on humidity sensors. The methods used in this activity are lectures, demonstrations, direct practice, and mentoring. The results obtained from this activity are increased knowledge of the automatic watering system based on humidity sensors consisting of soil moisture sensors, and water level sensors, microcontrollers, and actuators in the form of solenoids and pumps. The sustainability of the program after this activity is carried out is science and technology in the form of learning media for automatic plant watering automation systems based on humidity sensors that can be used as learning media (extracurricular or crafts), school icons, and attracting students' interest in continuing their education in the field of engineering.

Keywords: *Education; training; automation; environment; humidity*

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A. INTRODUCTION

SMA N 2 Slawi is located on JL. RA. KARTINI POBOX 22 SLAWI, Tegal Regency. The school was founded on March 11, 1979. During its journey, SMA PEMDA SLAWI was inaugurated as a senior high school by the Department of Education and Culture of the Republic of Indonesia on December 31, 1981 by the Head of the Regional Office of the Department of Education and Culture of Central Java Province. SMA N 2 Slawi has a Vision: (1) Practicing the values of religious teachings according to each person's beliefs, (2) Increasing activities celebrating religious holidays, (3) Strengthening behavior and attitudes of good character and morals, (4) Developing attitudes and cultures of responsibility, discipline, and mutual cooperation, (5) Increasing concern for all creatures of God Almighty, (6) Increasing the quality of the learning process through meaningful learning. (7) Increasing the quality of human resources through literacy activities and competency development. (8) Increasing the culture of competition and collaboration in achieving achievements. (9) Increasing love for local, regional, and national culture, (10) Increasing creativity, independence, and entrepreneurship through various academic and non-academic activities

(curricular and co-curricular), (11) Increasing clean and healthy lifestyles. (12) Increasing concern for the environment.

Semarang State University has a Vision, namely to Become a World-Reputable University and a Pioneer of Brilliant Education with a Conservation Insight. UNNES has a mission: (1) Organizing brilliant and world-renowned education; (2) Carrying out research in developing science and technology; (3) Carrying out community service to solve problems, empower, and improve the welfare of the community; (4) implementing good governance and being able to adapt and synergize with the environment in a sustainable manner; and (5) Carrying out cooperation in building a reputation.

In line with the vision and mission of UNNES, SMA N 2 Slawi has a common vision to increase concern for the environment. Currently, environmental problems including increasing global temperatures are increasing due to exhaust emissions, and other environmental problems such as waste management that becomes waste (Riyanto, 2017; Sarkawi, 2011). Climate change causes an increase in average temperatures worldwide, changes in rainfall patterns, and changes in extreme weather (Nugroho & Habiballoh, 2023).

Figure 1. SMA N 2 Slawi

SMA N 2 Slawi is located near the Pantura road which is passed by many vehicles. So that the presence of exhaust emissions can be detrimental to health. The increasing rate of urban development and the increasing population have caused various urban activities to also increase, such as factory activities and motorized vehicles that emit CO_2 gas, which is one of the greenhouse gases that contributes the most to global warming. In addition, SMA N 2 Slawi also carries out extracurricular activities where students learn technology and natural sciences as the material. The conditions at SMA N 2 Slawi also have many plants that need to be maintained and cared for environmental sustainability. In line with the development of science and technology, every human being is encouraged to compete in making various innovations (Barri et al., 2023). However, there are still several areas that are considered less effective and efficient in their work systems, such as plant care due to the lack of new technological innovations developed in this field (Yudhistira et al., 2022). To overcome this problem, one of them is planting trees. The existing trees need to be maintained and watered so that they can grow and develop, thereby reducing emissions. The need for technology is also increasing so that it is necessary to improve the skills of teachers and students in making automatic watering devices based on humidity sensors.

Watering plants is a type of plant care that can be said to be monotonous if done conventionally (Nisa & Astuti, 2023). The conventional watering process sometimes consumes more water and if watering is done too late it can cause the plants to dry out and wilt first (Mujahid et al., 2023). The main point of watering plants lies in the level of plant needs for sufficient water intake (Septyanto & Chandra, 2023). Water is a very important element for plant growth and development because it plays a role as a solvent for nutrients, photosynthesis components, plant temperature regulation, and affects soil moisture (Pasciana et al., 2023).

Based on the request of SMA N 2 Slawi partners, the need for the development of sprinklers currently focuses on automatic systems. The current watering system still uses a conventional system. So it is considered less efficient and takes a lot of time. Based on the problems faced by SMA N 2 Slawi partners, one of the efforts made to overcome obstacles in the watering process is to increase automation competency through training and implementation of automatic watering tools based on humidity sensors. The use of an automatic system will certainly be very helpful considering that daily activities no longer need to be done conventionally (Rozzi et al., 2023; Kaikatui, et al., 2023).

This automatic watering tool uses a microcontroller, humidity sensor, relay, with an LCD display (Jupita et al., 2021; Lubis, 2021; Fuadi & Candra, 2020). This automatic plant watering tool works by using a sensor to measure soil moisture levels. This information is sent to the microcontroller which functions as a tool controller. The motor is used to channel water to the watering container. The creation and testing of the automatic plant watering sensor was carried out using Arduino IDE software by entering programming by connecting a computer/laptop device with a microcontroller. The results of testing this software are in the form of humidity sensor values that have been changed to percentage values. Before making an automatic plant watering circuit, the first thing to do is to make a circuit and determine what components are needed in the automatic plant watering tool. The components needed include an Arduino Uno ATmega328 microcontroller that functions as a tool controller, a relay to conduct electricity to the motor, and this tool is equipped with a soil moisture sensor to measure soil moisture levels, the results of which will be displayed on a 16x2 LCD screen as in **Figure 2**.

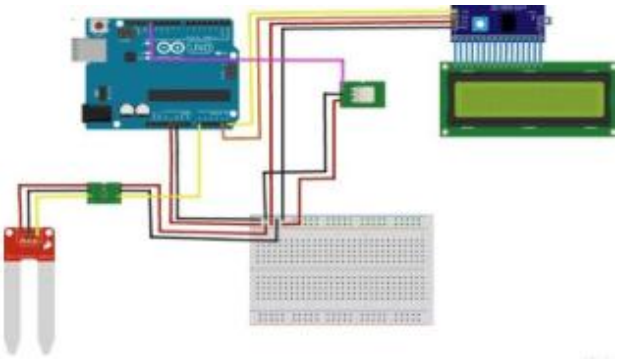

Figure 2. Configuration scheme of a watering system based on a humidity sensor.

After the automatic plant watering circuit assembly process is complete, the steps that should be taken are that the hardware needs to be tested to ensure that the tool is actually functioning properly. After the hardware manufacturing and testing process is complete, the automatic plant watering tool is thoroughly tested. This testing involves the use of an ATmega328 microcontroller and an

Arduino Uno soil moisture sensor. Watering uses the properties of water to fill empty and always flat spaces, so that water can be evenly watered from one area to another.

Table 1. Problems and solutions

No	Aspect	Solution	Target
1	Knowledge	Enhancement and empowerment of automation systems	Increased knowledge of automation and IoT systems
2	Skills	Skills enhancement through automation system creation training	Automatic plant watering tool based on humidity sensor
3	Environmental	Implementation of a plant watering automation system based on humidity sensors	Automatic plant watering tool based on humidity sensor

B. METHOD

The implementation of this community service program is carried out using various methods so that the expected output targets can be achieved effectively and efficiently. Some of the methods that are to be applied include lectures, demonstrations, direct practice, and mentoring (Ichwani et al., 2024). The choice of method is adjusted to the material and objectives to be achieved.

Informational or theoretical material is delivered through lectures or socialization. However, practical material, for example how to make an Arduino circuit, is carried out through demonstrations, direct practice and mentoring to partners.

Lecture

Lecture activities are carried out to provide theory in the form of knowledge about control systems, sensors, and automation. Theoretical materials include the components and mechanisms of automatic sprinklers.

Demonstration

In this activity, the implementing team demonstrated how to assemble an automatic sensor-based plant watering device.

Hands-on Practice

In this activity, partners, teachers and students practice directly in making automatic sprinklers.

Mentoring

The mentoring method is implemented with the target as a work partner or subject. The implementing team as a companion, with the intention that the main actor is the partner so that there is no dependence on the implementing team.

To determine the extent of the success of the community service program, an evaluation is carried out. The evaluation is carried out in three stages, namely before, during, and after the activity. The evaluation before the activity is used as

a comparison, which describes the initial conditions of the activity partners, such as their knowledge, skills, and responses. The evaluation during the activity aims to determine the extent of the motivation and intensity of the involvement of the target audience in this activity. The evaluation at the end of the activity is carried out to determine the extent to which the objectives of the activity that have been set have been achieved. The evaluation is used to measure the ability of the knowledge aspect of automatic sprinklers.

Sustainability of the program

After the implementation of this activity, science and technology in the form of learning media for automatic plant watering systems based on humidity sensors can be used as learning media (extracurricular/crafts), school icons, and attract students' interest in continuing their education in the field of engineering.

C. RESULT AND DISCUSSION

This community service activity has been successfully implemented. In the initial activity, the team built an automatic watering system based on a humidity sensor. This tool works to water plants automatically so that plants grow well and watering is carried out effectively and efficiently. The initial activity of the team was to design an automatic watering system based on a humidity sensor as shown in **Figure 3**.

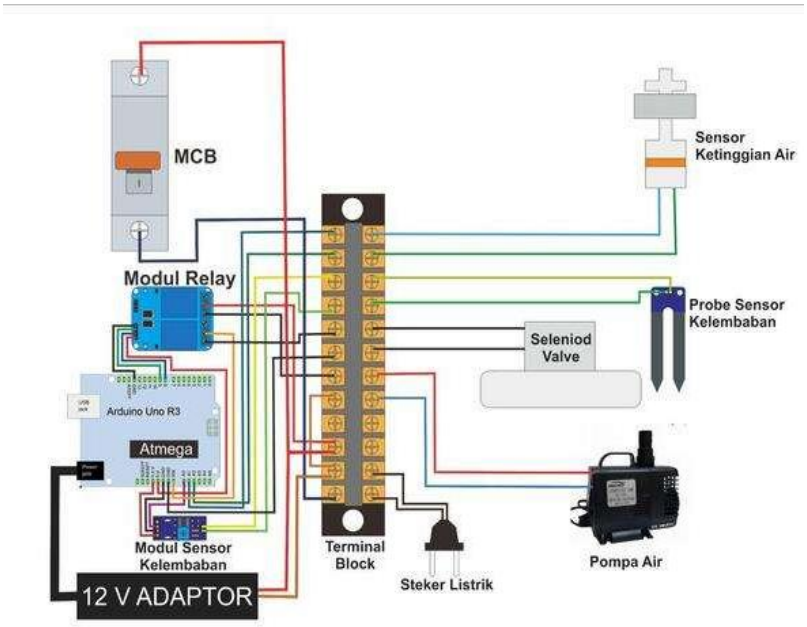

Figure 3. Design of an automatic plant watering system.

Based on **Figure 3**, the tool consists of two sensor inputs, namely humidity sensor and water level sensor. The controller uses Arduino Uno R3, and the actuator uses a relay that drives two actuators, namely a pump and a solenoid valve whose work is regulated by Arduino via a relay. Technically, the specifications of the components used are described as follows.

Table 2. Controller specifications

Types of Microcontrollers	Atmega328P
Operating Voltage	5 Volt

Recommended Voltage	7-12 Volt
Voltage Limit	6-20 Volt
Digital Input Output Pins	14
PWM Pins Provided	6
Analog Input Pins	6
Maximum Current per Pin	20 mA
Maximum Current That Can Be Drawn by the 3.3 V pin	50 mA
Flash Memory	32 kB
SRAM	2 kB
EEPROM	1 kB
Clock Speed	16 MHz
Port USB	Type A to Type B (exactly same as USB Printer)

Table 3. Soil Moisture Sensor Specifications

Operating voltage	3.3 V ~ 5 V
Panel PCB Dimension	3 cm x 1.5 cm
Soil Probe Dimension	6 cm x 2 cm
Pin VCC	3.3 V - 5 V
Pin GND	GND
Pin D0	Digital output interface (0 and 1)
Pin A0	analog output interface

Table 4. Water Level Sensor Specifications

Maximum degree of communication	10 - 50 Watts
Maximum switching voltage	100 - 220 VDC
Maximum switching current	0.5 - 1.5 A
Maximum breakdown voltage	220 VDC - 300 VDC
Load Current	1.0 A - 3.0 A
Maximum contact resistance	100 mΩ
Temperature rating	-10 ~ +85 °C
Float ball material	P.P
Flat body material	P.P

Table 5. Water Pump Specifications

Type	WP-106
Voltage	220-240 V 50 Hz
Watt	85 Watts
Capacity	4000 Liter per hour
Maximum Head	4 Meters

Table 6. Solenoid Valve Specifications

Operating Voltage	DC 12V
Inlet/outlet valve socket	3/4" / 25mm
Operation mode	N/C-Normally Closed
Water pressure	0.02-0.8 MPa

The automatic watering system based on humidity sensor is an automatic plant watering tool based on an Arduino microcontroller and sensor. This tool consists of a plant medium with an automatic watering can and a fish farming box. The automatic watering can be activated based on the humidity sensor indicator that detects soil moisture in the plant medium. This tool is equipped with a water pump to flow water to the plants, a humidity sensor to detect humidity in the water, a water level sensor to maintain the water volume in the fish farming box, and a microcontroller as a system controller on this tool. This automatic watering system is also equipped with a wiring diagram and a series of electronic components that can be observed as a learning tool.

The next stage of activity after designing an automatic watering system based on a humidity sensor is the process of making the tool. The activity of making this automatic storage tool is shown in **Figure 4**.

Figure 4. The process of making the frame and preparing the automatic broadcasting tool based on humidity sensors.

In the automatic plant watering system, there is a main component that functions as the core of the system that works to run all automation systems on this tool, namely Arduino Uno. Arduino Uno has a very important function in the automatic watering system. In order to work, Arduino needs to be programmed using the C programming language where the IDE/Software used is Arduino IDE. The following is a program for the automatic plant watering system.

Community service activities were carried out on Saturday, April 13, 2024 at SMAN 2 Slawi, Tegal Regency. This implementation began with a lecture related to the function of each component of the tool. Continued assembly of the automatic watering system based on humidity sensors. Documentation of implementation activities is shown in **Figure 5**.

Figure 5. The process of making a watering tool based on a humidity sensor by the community service team with SMAN 2 Slawi.

Figure 6. Deepening the material on the watering system based on humidity sensors

Figure 7. Implementation of community service activities

D. CONCLUSION

The community service activity successfully designed and implemented an automatic plant watering system using a humidity sensor and Arduino Uno microcontroller. The system, equipped with components like a water pump, solenoid valve, and sensors, effectively automates plant watering, ensuring efficient water usage. The project not only provided a practical solution for maintaining plant health but also served as an educational tool, teaching participants about electronics, programming, and sustainable technology. The implementation at SMAN 2 Slawi, Tegal Regency, included hands-on assembly and educational sessions, fostering innovation and practical skills among students. This activity highlighted the potential of simple, cost-effective technology to address real-world challenges, such as water management in agriculture, while promoting sustainable development and technological literacy..

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