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TRAINING OF TEMPERATURE MONITORING SYSTEM WITH LM35 SENSOR BASED ON RESBEERY PI

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Abstract. This community service activity aims to train the community on developing and implementing a temperature monitoring system using the LM35 sensor integrated with Raspberry Pi. This training was carried out to improve people's understanding and skills, especially in utilizing microcontroller-based technology and IoT (Internet of Things) in daily life, especially in the field of room temperature or environmental monitoring. This activity involves targets, for example, teachers, students, and technicians, at SMA AL-IRSYAD TEGAL, with training methods that include basic theories about temperature sensors, introduction to Raspberry Pi, and hands-on practice in assembling and programming temperature monitoring systems. The results of this training showed that participants could understand the basic concepts of temperature monitoring systems and could apply the knowledge gained in making simple devices that can measure and display temperature in real-time. The activity evaluation showed that most of the participants felt helped by this training and showed high interest in further developing the system that had been studied. In the future, it is hoped that similar activities can continue to be carried out to empower the community to utilize technology for daily needs.

Keywords: Community service technology, temperature monitoring system, LM35, Raspberry Pi

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INTRODUCTION

The rapid development of information and communication technology has brought many changes, including in environmental control and monitoring. One of its applications is temperature monitoring systems, which are important for various purposes, such as in industries, hospitals, laboratories, and even households. With this technology, temperature monitoring can be done in real-time and automatically, making it more efficient and accurate (Mirza, 2018) (Hidayaturohmat *et al*., 2016).

The LM35 temperature sensor and Raspberry Pi microcontroller are the ideal combination to build a simple yet effective temperature monitoring system. The LM35 sensor has advantages in temperature measurement accuracy and linearity, while the Raspberry Pi offers a flexible and powerful platform to process sensor data and display it visually (Putra and Sari, 2022), (Perkasa, 2014) and (Sutabri, 2012).

However, not all people understand and utilize this technology adequately. Therefore, training is needed to introduce and teach the public how to work with and apply a Raspberry Pi-based temperature monitoring system. This training is expected to increase the capacity of the community to utilize technology for daily needs (Anjasmara *et al*., 2019), (Mustamin *et al*., 2017) and (Wiyatmo and Budi, 2012).

Objectives: The objectives of this training activity are:

1. Improve participants' understanding of the basic principles of LM35 and Raspberry Pi temperature sensors.
2. Train participants in assembling and programming a simple temperature monitoring system.
3. Encouraging the application of technology in daily life, especially in environmental monitoring.
4. Raising awareness of the importance of temperature monitoring in va i usf applications.

Benefits: This training activity is expected to provide several benefits, including:

1. Increasing participants' knowledge and skills in IoT-based temperature monitoring technology for Al-Irsyad High School teachers and students.
2. Practical application of the learned technology for work, school, or home needs.
3. Increasing people's adaptability to digital technology and automation development.

Community empowerment through mastery of technology that is relevant to local needs.

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IMPLEMENTATION METHOD

Time and Place

This Community Service activity was carried out offline on Monday, August 12, 2024 at Al Irsyad High School, Tegal city.

Goal

The target of this community service is the teachers and students of Tegal City High School, which totals 2 and 14 people.

Activity Method

The temperature monitoring system training using the Raspberry Pi-based LM35 sensor is carried out through several stages to ensure that participants understand the basic theory, practice what they have learned, and apply the technology in daily life. This implementation method includes theoretical, practical, and evaluative approaches tailored to participants' needs. The stages of the implementation of this training are as follows:

Stage 1: Introduction

At this stage, preparations are made, including procuring the necessary hardware and software. In addition, participants will be introduced to primary material which provides for:

- Introduction to the LM35 Sensor: An explanation of the function, characteristics, and how the LM35 sensor measures temperature.
- Introduction to Raspberry Pi: A basic introduction to Raspberry Pi, including the components, operating system, and programming language used (e.g., Python).
- Introduction to IoT (Internet of Things): This section explains the IoT concept and its relevance to temperature monitoring systems.

Stage 2: Discussion

This session focused on theoretical delivery, including:

- LM35 Sensor Working Principle: An explanation of how the LM35 sensor measures temperature and converts it into an electrical signal that the Raspberry Pi can read.

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- Raspberry Pi Interface with LM35 Sensor: This section discusses how to connect the LM35 sensor to the Raspberry Pi, including an explanation of the pin input/output used.
- **Basic Programming**: An introduction to Python programming for the Raspberry Pi, focusing on retrieving data from the sensor and its appearance.

Interactive discussions were conducted to answer participants' questions and deepen their understanding of the concepts.

Stage 3: Assembly

This stage is the core of the training, where participants are allowed to practice the material learned directly. Steps in this practice include:

- System Assembly:
  - Connecting the LM35 sensor with the Raspberry Pi via breadboard and jumper cables.
  - Ensures the proper connection between the sensor and the Raspberry Pi.
- Programming and Testing:
  - Write Python code to read the temperature data from the LM35 sensor.
  - Run code on a Raspberry Pi and observe the real-time temperature measurement results.
  - Correct and improve the program if there are errors.
- Data Visualization:
  - Displays measured temperature data in graphs or tables on the screen.
  - Saves temperature data for further analysis.

Stage 4: Case Studies and Applications

Once participants understand and can practice the primary material, this session is used to apply the technology learned in real scenarios. Some of the case studies that may be discussed include:

- Room Temperature Monitoring: A system is applied to monitor the room temperature and display the data continuously.
- Abnormal Temperature Alert: Create a system that can provide notifications if the detected temperature exceeds or falls below a specific limit.

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Participants were also invited to share ideas on how this system can be applied in their respective environments.

Stage 5: Evaluation

The evaluation was carried out to measure the success of the training and the participant's understanding of the material presented. Evaluation methods include:

- Comprehension Test: Participants will take a short test related to the theory and practice they have learned.
- Independent Practice: Participants are asked to develop and present the temperature monitoring system they have assembled and programmed independently.
- Participant Feedback: Participants provide input on implementing the training, difficulties faced, and suggestions for future improvements.

RESULTS AND DISCUSSION

The temperature monitoring system training using the Raspberry Pi-based LM35 sensor has been carried out smoothly according to the plan. The following are the results obtained from the implementation of this training:

Stage 1: Increasing Participant Understanding

Most of the participants showed a significant increase in their understanding of the basic concepts of the LM35 and Raspberry Pi temperature sensors. This is reflected in their ability to explain the working principles of the sensor, identify Raspberry Pi components, and understand the basics of Python programming used in the project.

Stage 2: Material Submission

The delivery of material was carried out after practice. Materials include programming and assembling. The resource person provided training and assistance in preparing temperature monitoring for participants.

Speaker 1 : Aziz Yulianto Pratama, S.T, M.T.

Material: Program Creation

Speaker 2.3: Ir. Fahmy Ferdian D, M.T., IPP, Doni Setiawan , SPd., MPd.

Material: Practice of Assembling and Presenting Materials

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Figure 1. Practicum Socialisation

Stage 3: Q&A

The question-and-answer stage was carried out after the presentation of the training material. Participants were asked additional questions about the LM35 Temperature Monitoring Training using Resbeery. In this step, the resource person received and answered 3 questions from the participants.

Figure 2. Questions and answers

Stage 4: Workshop

The workshop stages are carried out by providing training in the preparation of assembly training to teachers, using the steps for preparing the assessment. Resource persons provide direct assistance to teachers/participants. The resource person provided direction and assistance in preparing the LM35 sensor.

Stage 5: Stage 5: Evaluation

Based on the evaluation results and feedback, the majority of participants were satisfied with the material presented and the overall implementation of the training. They stated that this

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training was very useful and relevant to their needs, especially in understanding and utilizing IoT technology for temperature monitoring. The results of *the post-test assessment* that have been carried out are presented in Table 2.

Table 2. *Post-Test Results* of PkM Participants

No.	Participant No	Correct Amount	Score
1	01	8	80,00
2	02	9	90,00
3	03	8	80,00
4	04	10	100,00
5	05	8	80,00
6	06	10	100,00
7	07	9	90,00
8	08	9	90,00
9	09	10	100,00
10	10	10	100,00
11	11	8	100,00
12	12	9	80,00
13	13	8	80,00
Average			93,10

CONCLUSION

The temperature monitoring system training using the Raspberry Pi-based LM35 sensor has been successfully carried out with satisfactory results. Based on the results of the training, several important points can be concluded as follows:

1. **Improved Technology Understanding**: Trainees successfully understood the basic concepts of the LM35 and Raspberry Pi sensors and how they work and integrate in forming a temperature monitoring system. This training has improved the knowledge and skills of participants in IoT technology, especially in temperature measurement and monitoring.
2. **Success in Practice**: All participants were able to assemble and program the temperature monitoring system independently. They also read and displayed temperature data in real-time using a Raspberry Pi, which showed that they could apply the theory they learned in practice.
3. **Applications in Daily Life**: Participants can apply the systems they create to real-world scenarios, such as monitoring room temperature or specific environments. This shows that this training provides technical knowledge and practical relevance in everyday life.

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4. **Enthusiasm and Interest for Further Development**: Participants were enthusiastic about developing this temperature monitoring system, such as adding new features or integrating it with other systems. This reflects the success of the training in arousing participants' interest in technology and innovation.

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