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Introduction of Artificial Intelligence to Students Using AIOT kit Based on Thing Speak

Suryasatriya*, Hanna Arini Perhusip , Bambang Suranto , Adi Setiawan, Didit Budi Nugroho, Johannes Dian Kurniawan
Master of Data Science Departement, Universitas Kristen Satya Wacana, Salatiga, Indonesia
*Corresponding Author: suryasatriya@uksw.edu

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ABSTRACT

Background: Schools struggle to engage students in science and technology, highlighting the need for innovative, tech-driven teaching methods to meet 21st-century educational demands.
Contribution: An AIOT kit was developed to introduce middle school students to Artificial Intelligence (AI) and the Internet of Things (IoT). The kit measures environmental factors like temperature, humidity, pressure, and light, providing real-time data.
Method: Students received training in mathematical and coding fundamentals, programmed the AIOT kit to collect data, and displayed it on the ThingSpeak dashboard. They also designed and assembled the kit, fostering peer-to-peer learning in future activities.
Results: Students visualized data effectively and successfully connected the AIOT kit to the dashboard, confirming its functionality.
Conclusion: The project enhanced students' understanding of AI and IoT, providing hands-on learning and boosting engagement in science and technology.

1. Introduction

Education today faces challenges in the use of technology, especially artificial intelligence (AI) technology and various related platforms [1] [2] . With AI technology such as Chat GPT, students can access various necessary information without the presence of a teacher [3]. Moreover, in completing school assignments, it is possible for students to complete with AI

[4]. Teachers who are incompetent and not meticulous in evaluating assignments to students, can cause students' competencies not to be explored as they should be in the traditional teaching period where AI is not recognized [5]. Therefore, the combination of the two in mathematics learning can be a middle ground, namely: students can use ChatGPT as a source of information, but students must also know how to have understanding.

Despite the return to face-to-face learning in 2023, significant advancements in digital learning materials remain necessary to ensure accessibility for all students. Additionally, there is an urgent need to address the inadequacies of educational tools, particularly those related to science and technology[6]. Preparing students for the future workforce, which will demand expertise in the latest information technologies, requires early exposure to coding and the introduction of artificial intelligence (AI) to both students and teachers. These initiatives are essential to ensure students can access higher education with the technological skills needed in today's rapidly evolving world. Research has been conducted on the importance of introducing coding to students and teachers through robotics activities in secondary schools [7][8].

In order to improve students' and teachers' 21st century learning skills, which include mastering science and math, innovative digital learning is required [9][10]. In a similar vein, coding has become a significant component of educational activities in schools where pupils find it enjoyable [11]. Furthermore, both teachers and students need to be introduced to the growth of artificial intelligence as a new educational innovation [12][13]. Consequently, in order to apply AI technology, it is also necessary to teach basic coding, arithmetic, and statistics [14] [15]. Likewise, a key technology associated with the Internet of Things (IoT) as an intelligent tool [16] that has also been assessed for its advantages [17] [18].

However, for students and teachers who have never integrated things, the introduction of artificial intelligence and the internet of things that are related to the studied topic, such mathematics and statistics, is difficult [19][20]. In a similar vein, without a direct product that students can grasp, it will undoubtedly be very difficult to understand how it can be done. Consequently, this article will demonstrate how AI and IoT-related technologies are integrated into a gadget that can serve as an illustration for students to understand the relationship between the products created are known as AIOT kit since the science being investigated is mathematics and statistics with the newest technologies, specifically AI and IoT. This AIOT kit product is regarded as a straightforward form that students can follow in learning AI where in previous studies more complex devices have been made called AI-Mining as a device that also functions in monitoring air quality with various measured features [21][22].
Connecting any physical device to the Internet or a local network in order to gather and exchange data and carry out certain physical activities based on the data that is available is known as creating an Internet of Things product [23][24]. The equipment created becomes more pertinent to needs when artificial intelligence is incorporated into decision-making. AIOT kits are designed to be so basic that both students and teachers may learn how to create them and determine the worth of the products on their own. Thus, the problem in the

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community service activity is that schools need a new approach to attract students' interest in learning science and technology. In addition, innovative teaching that uses technology is needed to fit the demands of 21st century education. For this reason, the findings of lecturer research are used in the educational community to empower teachers and students in data science-related science and technology.

2. Method

2.1. Tools and materials

The tools and materials used are as follows :

1. nodeMCU ESP 8266
2. sensors: Soil Moisture for capacity, DHT11, LDR for light
3. Diodes in 4205,
4. T0 wires,
5. Jumper Wires,
6. small PCBs,
7. Pralon,
8. Cement,
9. Adapters,
10. Oled.

This material was chosen so that the material is affordable and can be given in learning with teacher assistance. The activities are done in August -October 2023, in SMP Kristen Wonosobo with students in the age range of 12-14 years old.
The research protocols are shown in the following steps:

1. Provide mathematical training that becomes the basis for understanding the data generated by the AIOT kit. These include presenting data into tables, graphs, pie charts, and other data visualizations. We use Excel such that students can use easily and use statistics descriptive in this step. The community here are students in the middle school called SMP Kristen Wonosobo, Central Java with 18 students for each activity.
2. Making AIOT kit as devices to become coding learning media for students. This will allow students to learn coding [25] and introduction to science and technology through the use of AIOT kit devices, such as measuring ambient temperature and humidity with sensors attached. The programs introduced are C programs, Arduino and Micropython .
3. Involve training for teachers and students for the theory that forms the background of AIOT kit in the learning process.

The application of AIOT kit in the school environment in order to be a sustainable process in the transfer of technology and knowledge.

2.2. The flow activities

The following is a list of flows in the flow chart as an AIOT kit, based on the list of tools and activity steps that exist in the AIOT kit, the flow activites can seen in Figure 1.

1. Survey & Needs

   Activity: Identify the needs of schools and students related to science and technology learning aids.

   Objective: Determine the gaps in the necessary learning tools, especially related to the introduction of AI and IoT.

2. AIOT Kit Design & Development

   Activity: Designing an AIOT kit that serves as a miniature device to monitor environmental data such as temperature, humidity, and light.

3. Basic Mathematics & Coding Training

   Activities: Provide basic mathematics and coding training using C, Arduino, and Micropython languages.

   Objective: To introduce the basics of statistics and programming so that students understand the data generated by the AIOT kit.

   Output: Students are able to use Excel to visualize data.

4. AIOT Kit Assembly & Installation

   Activity: Students assemble the AIOT kit with teacher guidance and perform the installation of the AIOT kit in the school to collect real-time data.

5. Data Collection & Visualization

   Activity: Collect data from sensors (temperature, humidity, light) and display that data on the ThingSpeak dashboard.

   Objective: Students learn to read, process, and display data obtained from the AIOT kit.

6. Mentoring & Knowledge Sharing

   Activities: Train some selected students to become mentors for their peers, sharing knowledge about the use of AIOT kits.

   Objective: To ensure continuous knowledge transfer in schools.

7. System Evaluation & Feedback

   Activity: Evaluate the performance of the AIOT kit based on the data generated and the use of the dashboard by the students.

   Objective: To measure the improvement of students' data literacy and technical skills in using the AIOT kit.

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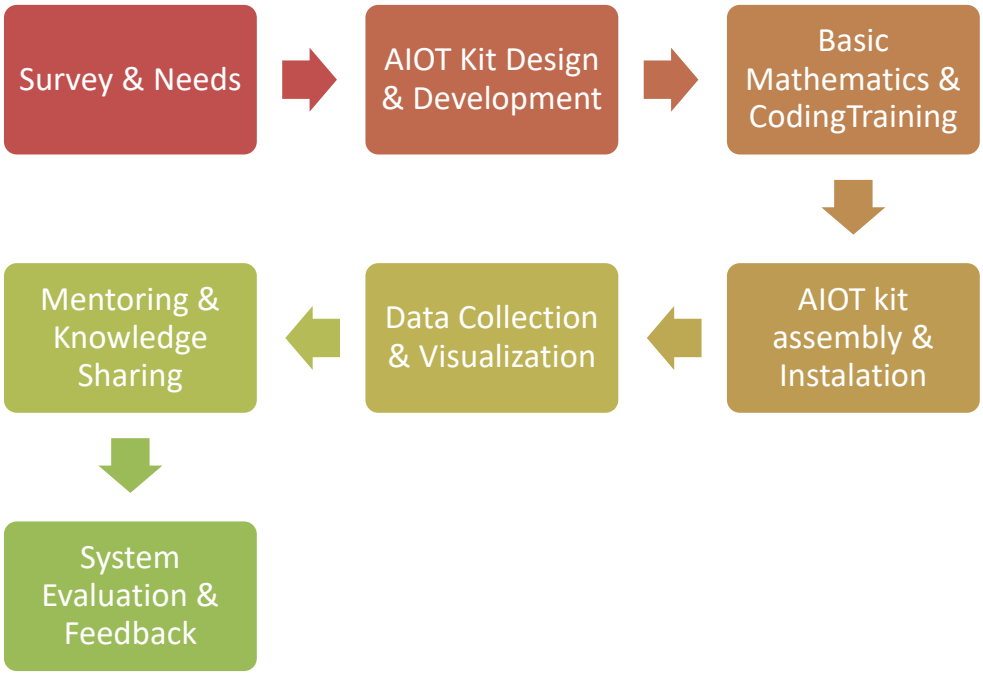

Figure 1. The flow activities in community service done in a middle School , Wonosobo, Central Jaya Salatiga

3. Results and Discussion

The assembly of the AIOT kit, based on the pre-designed plan, involves installing basic components and sensors that will serve as learning tools. The assembled AIOT kit functions as a miniature environment equipped with simple sensors such as humidity and light sensors. By using basic applications sourced from platforms like Google, students can learn how to measure and analyze data collected from these sensors. The results of this study will enable community service activities to produce AIOT kit designs that can be used for teaching science and technology. Additionally, assembling the AIOT kit will serve as an introductory learning medium. This approach is expected to improve students' understanding of scientific and technological concepts through a practical and interactive method. While the AIOT kit functions as a learning tool, its current capability is limited to measuring humidity and light using a simple application sourced from Google as part of the initial learning phase.The AIOT kit device is shown in Figure 2. Then the AIOT kit prototype as the first tool for this activity was tested using the ThingSpeak dashboard. Now, we present the results that related to the learning outcomes.

3.1. Learning Outcomes

3.1.1. Basic Mathematics and Data Literacy

On August 4, 2023, community service activities were conducted by providing basic mathematics training to help students understand the data output generated by the AIOT kit on the dashboard. This training was delivered in English, offering the added benefit of allowing students to simultaneously practice both mathematics and English. Figures 2-3 depict the activities during the session. Additionally, the AIOT kit underwent initial testing using the DHT11 sensor, with data recorded via the ThingSpeak platform, as shown in Figure 3.

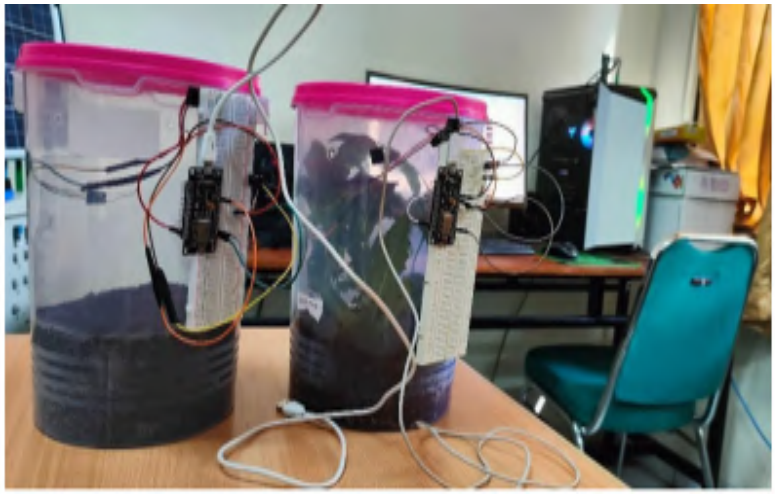

Figure 2. AIOT kit for learning in acquiring data at sample scale (tool created in 2022 as prototype)

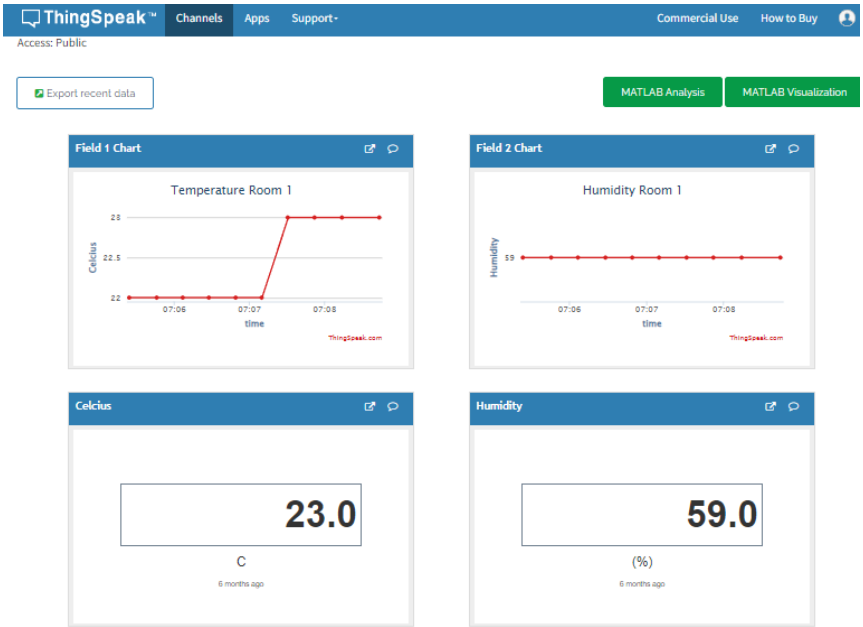

Figure 3. Phase 1 test results for AIOT kit prototypes that read the results using ThingSpeak

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Figure 4. Mathematics training activities underlying AIOT kit by Dr. Suryasatriya Trihandaru, S.Si, MSc.nat (August 4, 2023)
Youtube activity : https://www.youtube.com/watch?v=_l5NMxrGnfU

3.1.2. Coding and IoT Assembly Skills

On September 1-2, 2023, community service activities were conducted to introduce AIOT kits to students at Wonosobo Christian Junior High School. Four students were selected from the school, accompanied by one mathematics teacher, with the goal of preparing the students to become mentors for their peers in the future. This will be particularly important as the development and utilization of the AIOT kits progress, helping introduce Artificial Intelligence to other students. The selected students learned coding and developed data literacy skills using Excel to visualize data gathered from the AIOT kit, which was displayed on the ThingSpeak dashboard, making it easier for other students to follow.The AIOT kit was installed in Wonosobo on September 3, 2023. The conditions in Wonosobo differ from those in Salatiga, particularly due to the colder weather. The dashboard showed a significant decrease in temperature in real time, as depicted in Figure 5.

Figure 5. Representatives of SMP Kristen Wonosobo in studying the Thin Speak dashboard for the AIOT kit display.

Figure 6. Students learn to assemble their own AIOT kits that will be installed at Wonosobo Christian Junior High School

3.1.3. Mentorship and Peer Collaboration

Selected students received specialized training to become peer mentors, helping to create a collaborative learning environment and encourage continued knowledge-sharing (Figure 7). This mentorship model allowed students to build leadership skills and take ownership of their learning by supporting their peers in AI and IoT concepts.

Figure 7. Students received mentoring from Dr. Suryasatriya Trihandaru, S.Si MSc.nat in assembling AIOT kit.

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Figure 8. Students receive assistance in conducting statistical data literacy by Prof.Dr. Adi Setiawan ,MSc.

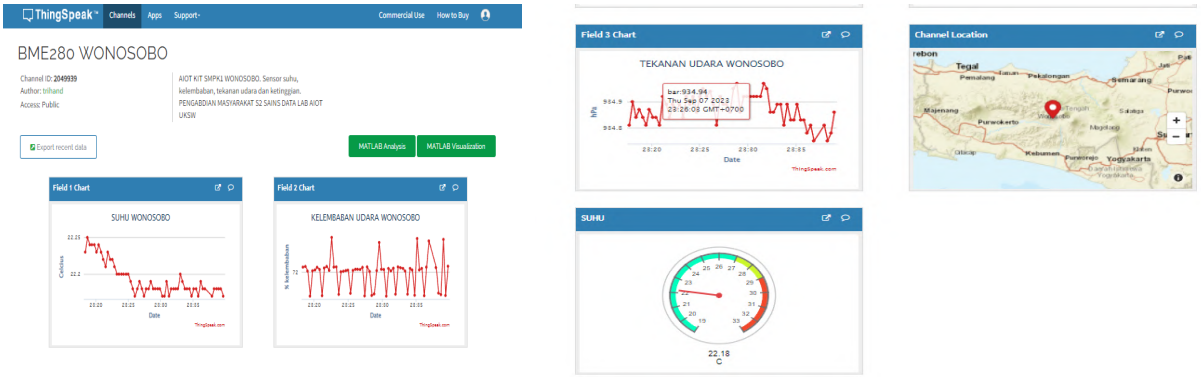

Figure 9. AIOT kit dashboard as a result of the output of AIOT kit placed in Wonosobo . AIOT kit results on dashboard with ThingSpeak : https://thingspeak.com/channels/2049939

3.1.4. Introduction to AI Tools

Students were also introduced to emerging AI platforms like ChatGPT, where they explored its use in coding support and data learning. This experience demonstrated the role of AI in information access and digital problem-solving, further enhancing their technical understanding and data acquisition skills. They received brief training on how ChatGPT can be utilized to obtain information for various purposes, including learning to code. This step demonstrates how students and teachers engaged in coding related to Artificial Intelligence (AI) and the Internet of Things (IoT) through the AIOT kit devices. Both students and teachers remain actively involved, where AI plays a role in the digital acquisition of data. Other researchers have explored how various AI competencies were introduced to school students

in South Korea [26]. However, in this article, the focus has not yet shifted to the introduction of broader AI competencies for educational purposes.

3.1.5. Broader Educational Implications

The broader implications of using AIOT kits in education are substantial. AIOT kits can be adapted as accessible tools for teaching data science, coding, and AI concepts in a wide range of educational settings. By offering students hands-on experience with AI and IoT, the kits promote data literacy and computational thinking skills that are vital in the digital age. This initiative could be scaled to other schools by establishing similar partnerships with educational institutions, providing teacher training on AIOT kit assembly and coding, and integrating AI and IoT into the curriculum. Furthermore, the use of AI platforms like ChatGPT in conjunction with the AIOT kits could support self-guided learning, allowing students to access information and enhance problem-solving skills independently.

3.1.6. Students respond to the AIOT-kit and specific improvements their understanding of AI, IoT, or coding

Students responded enthusiastically to the AIOT kit, engaging deeply with hands-on data collection and real-time analysis. They improved coding skills using Arduino and Micropython, gaining a clearer understanding of IoT applications. AI tools like ChatGPT supported their coding tasks, enhancing data literacy and problem-solving skills. The mentorship model boosted their confidence and leadership, fostering collaborative learning and a sustained interest in AI and IoT.

Studies show that AI and IoT enhance education by personalizing learning and providing real-time feedback, aligning with the AIOT kit findings. AI analyzes student data to adapt content and assessments to individual needs, while IoT devices facilitate interactive, real-time monitoring, echoing the AIOT kit's hands-on data analysis. Similar initiatives also highlight adaptive, collaborative learning, where AI-driven support and IoT enable remote, accessible learning—beneficial for students in diverse settings. Ethical implementation remains essential to ensure equal access and responsible tech use [27] [28].

3.1.7. The Key Findings

The AIOT kit project introduced middle school students to AI and IoT by engaging them in hands-on assembly of sensor-based kits that measure humidity and light, with data displayed on the ThingSpeak dashboard. Students gained coding and data literacy skills, supported by basic math and visualization training. Peer mentoring encouraged collaborative learning, and AI tools like ChatGPT helped enhance coding skills. This project demonstrated that AIOT kits are effective, scalable tools for teaching complex tech concepts, fostering digital literacy, and preparing students for STEM careers.

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3.1.8. Future Implications

The success of this project demonstrates that AIOT kits can be scalable and adaptable educational tools, especially for introducing complex technological concepts in an accessible format. Integrating these kits into the curriculum offers an engaging entry point into data science, coding, and AI concepts, equipping students with essential skills for the digital age. The mentoring approach could also create sustainable learning cycles within schools, allowing for the continuous development of data literacy and computational thinking skills. This initiative could be extended to other schools and adapted to include more advanced AI applications, supporting a broader goal of nurturing digital literacy and STEM engagement at a young age.

Through this project, students gain data literacy by learning to collect, interpret, and visualize data, which strengthens their foundation in data science. Their programming abilities have also improved the use of the Arduino and Micropython languages, which provide essential basic skills for IoT applications and problem-solving. In addition, students who are selected as peer mentors help create a collaborative learning environment and strengthen leadership skills within the school

4. Conclusion

The community service project successfully introduced middle school students to the concepts of Artificial Intelligence (AI) and the Internet of Things (IoT) through the assembly and use of AIOT kits. These kits allowed students to engage in hands-on learning by collecting and analyzing environmental data such as temperature and humidity, which was then displayed on a dashboard using ThingSpeak. The project not only enhanced students' coding and data literacy skills but also promoted a deeper understanding of science and technology concepts through a practical, interactive approach. By integrating both AI and IoT into learning, the students gained valuable experience in assembling the kits and understanding the relevance of AI in everyday applications. The involvement of teachers and the mentoring approach ensured that the knowledge could be shared and sustained within the school, further empowering students to become peer mentors. Overall, the project demonstrated that AIOT kits could effectively serve as an educational tool for introducing complex technological concepts in an accessible and engaging manner.

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