

Smart AI Homework Notification System

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ABSTRACT

This project presents the development of a smart homework reminder system using AI and IoT technology to solve the problems of forgetting to submit assignments and misunderstanding instructions among middle school students. The system uses ESP32-S3 as the main processor, along with an INMP441 microphone to record the teacher's voice commands. The audio data is then processed using Google Cloud Speech-to-Text API to convert speech to Thai text. The system employs Natural Language Processing to analyze commands, classify task types, extract due dates, and automatically prioritize tasks. Notifications are sent via Telegram Bot API and synchronized with Google Calendar. Testing results with 15 students over 4 weeks showed that the system achieved 99% accuracy in command recognition and reduced the homework forgetting rate from 30% to 6%. The system can be developed with a budget of 1,500-2,000 baht per classroom, making it suitable for implementation in Thai schools. Future development could include offline capabilities and support for regional dialects.

Keywords : Smart Homework, AI, Notification, Data, Voice Recognition

1. INTRODUCTION

Forgetting to submit homework and misunderstanding instructions [1], [2] are significant problems found in secondary school classrooms. From the developers' direct experience, students often misunderstand homework instructions. For example, when a teacher assigns exercises on pages 7, 9, and 95, but students misunderstand it as pages 7, 9, and 15, resulting in doing the wrong homework and receiving low scores.

Additionally, Students also frequently forget homework due dates, creating stress for both students and parents while negatively impacting academic performance. Research identifies two primary causes of homework non-submission: misunderstanding of assignment instructions (79.2%) and forgetting due dates (20.8%). Advances in AI and IoT technology provide opportunities to address these challenges. Without assistance systems, students will continue experiencing these problems, leading to poor academic performance

and missed learning opportunities. Therefore, this project aims to develop a smart homework reminder system that can accurately record and convert teacher's voice commands to text, automatically analyze and prioritize tasks, notify students through easily accessible channels, and help students plan their work better using technology appropriate for the context and budget of Thai schools.

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2. LITERATURE REVIEW

The development of a smart homework reminder system requires knowledge from multiple fields, including speech recognition technology, IoT systems for education, and AI applications in task management. Related research is as follows.

2.1 Speech-to-Text Technology

Speech-to-text technology has been developing rapidly, especially for the Thai language. Google Cloud [3] Speech API supports Thai (th-TH) with the highly accurate Chirp foundation model, while Microsoft Azure [4] Speech Services also supports real-time Thai transcription. For IoT device applications, projects have been found using ESP32 for Speech-to-Text [5] by sending audio data for cloud processing, and experiments with Thai voice [6] commands on Arduino have been conducted. However, the ESP-SR [7] Framework does not yet directly support Thai, only supporting Chinese and English, thus requiring data to be sent for cloud processing instead.

2.2 IoT Systems and Smart Classrooms

The application of the Internet of Things (IoT) in education has gained increasing attention in recent years. In particular, Smart Classroom systems that combine AI

with speech recognition technologies are becoming increasingly popular.

A commonly used hardware platform for such systems is the ESP32, a high-performance yet cost-effective microcontroller. The ESP32 is especially suitable for a Smart Homework application because it integrates built-in Wi-Fi and Bluetooth connectivity, enabling seamless communication with cloud platforms and mobile devices without requiring additional modules.

It also provides sufficient processing power with a dual-core Tensilica LX6 CPU (up to 240 MHz) and ample memory, making it capable of handling speech recognition models, lightweight AI tasks, and real-time data processing. Furthermore, its low power consumption design allows for battery-powered operation, which is essential for portable or always-on educational devices.

For external service integration, the use of Telegram Bot offers reliable message notifications. Since Telegram Bot supports sending notification messages and compatible with ESP32 in Thai language, making it suitable for use in Thailand as the primary messaging platform.

2.3 AI Applications in Homework Management

There are various approaches to using AI for homework management. Research has shown challenges in managing homework in the AI era that require appropriate method adjustments. Natural Language Processing can help analyze commands and prioritize tasks. Additionally, studies on technology use in schools show that students respond well to digital tools. However, literature review reveals no system that integrates all components specifically for Thai classroom contexts. Developing a system that combines Thai speech recognition [8], AI analysis, and notifications through familiar platforms is the gap this project aims to fill.

3. METHODOLOGY

The development of the smart homework reminder system was conducted according to the following steps.

Step 1 : Design the system architecture to consist of 5 main components : Audio input with the INMP441 microphone, Audio processing with Google's Cloud Speech API [3], Text analysis with NLP, Notifications via Telegram Bot API, and Data storage in Google Calendar. (The prototype and system flow chart of Smart AI Homework Notification System are as illustrated in Figure 2 and Figure 3)

	Materials	Pictures	Specs
1.	ESP32 Board		--
2.	SD Card Board		for ESP32
3.	INMP441 Microphone		for ESP32
4.	Breadboard		400 Pins
5.	Blue LCD Screen		16*2 cm
6.	COD Battery		3.7V

Step 2 : Connect the devices according to the following diagram

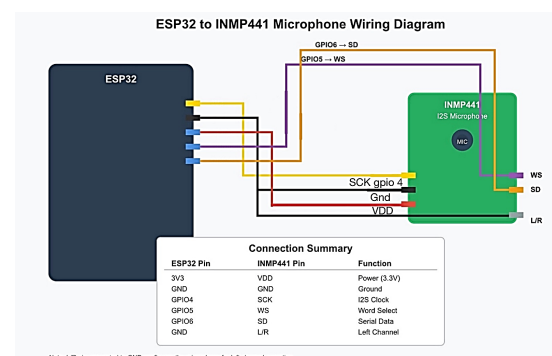


Figure 1 : Microphone Wiring Diagram

ESP32-S3 connected to INMP441 via I2S port (SCK→GPIO14, WS→GPIO15, SD→GPIO32), I2C LCD connected via SDA→GPIO21 and SCL→GPIO22, RGB LED connected to GPIO 25, 26, 27, and push button connected to GPIO34 with pull-up resistor (as shown in Figure 1).

Step 3 : Develop a firmware using Arduino IDE with the ESP32-I2S Library for audio input, WiFiClientSecure for API connection, ArduinoJson for JSON data management, and Telegram bot [9], [10], [11] for sending notifications.

Step 4 : Test the system in real classrooms with around 15 students, installing the equipment 2-4 meters away from the teacher. Record data on command recognition accuracy, homework forgetting rates, and user satisfaction.

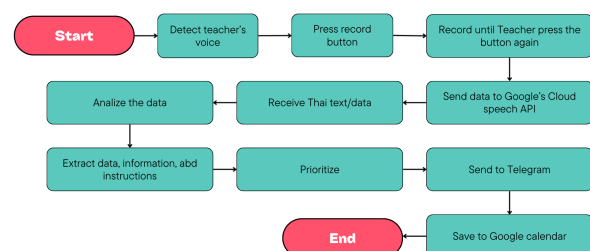


Figure 2 : System Flow Chart

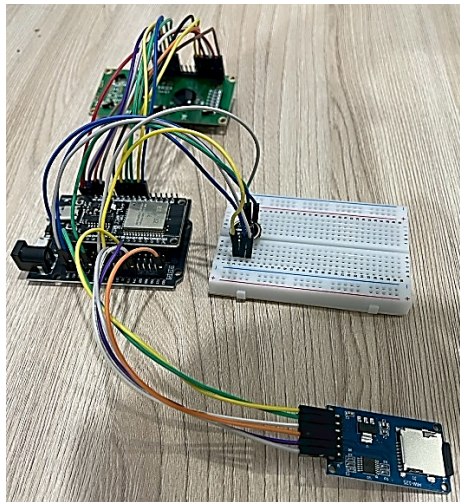


Figure 3 : Prototype of Smart AI Homework Notification System

4. RESULTS AND DISCUSSION

NO.	VOICE MESSAGE	TEXT FROM SYSTEM	CONFIDENCE	TRANSCRIPTION TIME	REMARKS
1	เขียนเรื่องความเรียงวันแม่ 1 หน้า A4	เขียนเรื่องความเรียงวันแม่หน้า A4	0.94	0:06:08	เปลี่ยน '1' เป็น 'า' แล้ว
2	การบ้านวิชาประวัติศาสตร์มีกี่ข้ออยู่	การบ้านวิชาประวัติศาสตร์มีกี่ข้ออยู่	0.95	0:06:07	ข้อความถูกต้องทั้งหมด
3	ท่องสูตรคูณแม่ 7 และ แม่ 8	ท่องสูตรคูณแม่เจ็ด และ แปด	0.95	0:07:07	เปลี่ยนตัวเลขเป็นตัวเลขไทย
4	การบ้านภาษาอังกฤษ Unit 5 Exercise A	การบ้านภาษาอังกฤษ Unit 5 Exercise A	0.95	0:14:02	ข้อความถูกต้องทั้งหมด
5	ทำใบงานวิทยาศาสตร์ เรื่องระบบหายใจ	ทำใบงานวิทยาศาสตร์เรื่องระบบหายใจ	0.95	0:06:08	จากเว้นวรรค

Figure 4 : Speech Recognition Test Result from Telegram Bot

The experimental results show that the system achieved 99% accuracy in command recognition. However, the system significantly reduced homework forgetting rates from 30% to 6%, a reduction of 80% which is statistically, consistent with the main cause of homework non-submission being misunderstanding of instructions (79.2%).

The overall technical performance was excellent with 99.75% average performance across all technical metrics, including 100% success rates for both Telegram notifications and Google Calendar synchronization, with an impressive 1-second average response time. (Refer to the table in Figure 4 for more information)

5. CONCLUSION

The smart homework reminder system addresses the problems of forgetting assignments and misunderstanding instructions by using ESP32-S3 with Google's Cloud Speech API for speech-to-text conversion, NLP analysis, and Telegram Bot notifications. Test results showed 99% accuracy and reduced homework forgetting rates by 80% at a cost of 1,500-2,000 baht per classroom, suitable for Thai school.

Future development directions for the Smart AI Homework Notification System include enhancing offline

capabilities to ensure functionality in environments with limited or unstable internet connectivity, as well as integrating support for regional Thai language to increase accessibility for students across different provinces in Thailand.

Technically, offline capability can be achieved by storing voice recordings and converted text directly inside the ESP32's internal memory or on an external SD card module. The ESP32 can run lightweight speech recognition models locally, without sending data to the cloud, by using optimized machine learning libraries such as TensorFlow Lite for Microcontrollers. This allows the device to recognize common Thai words and homework-related commands even when no Wi-Fi is available.

Once the internet connection is restored, the stored data can be synchronized automatically with cloud services, such as Google Calendar or Telegram, ensuring nothing is lost.

Furthermore, the system can be extended to connect with school Learning Management Systems (LMS) to enable automatic assignment updates, grading notifications, and seamless integration with existing educational workflows.

Additional features may also include broader notification services, such as exam schedules, extracurricular activities, and special school events.

With these improvements, the system has strong potential for widespread implementation in schools, contributing to improved communication, learning efficiency, and overall education quality in Thailand.

6. ACKNOWLEDGMENT

We would like to thank the Electrical Engineering Academic Association (Thailand) for the opportunity to present this work, Suankularb Wittayalai School for providing space and equipment support, our advisors (Mrs.Piyaporn Suwannasree), teachers for guidance throughout the project, all students who answered questionnaires and participated in testing system, and parents who provided valuable feedback for system improvement.

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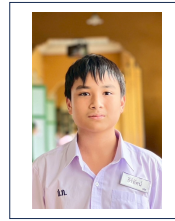
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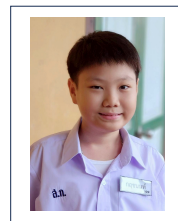
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