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| **KONERU LAKSHMAIAH EDUCATION FOUNDATION**  **AZIZ NAGAR, HYDERABAD**  **DEPARTMENT OF ECE**  **Project Proposal** | | | |
| **1.0** | **Details of Candidates:** | (i) S.MD.Awaiz (2310040038)  (ii) D.Rahul (2310040040)  (iii) K.harshavardhan reddy(2310040042)  (iv) Dharma teja (2310040134) | |
| **Course of Study:** | B. TECH/ECE | |
| **Year:** | II | |
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| **2.0** | **Course Details:** | |  |  | | --- | --- | |  | 23SDEC02A |   EMBEDDED SYSTEM AUTOMATION | |
| **3.0** | **Name of Supervisor:** | Mrs. Kosaraju Madhavi | |
| **4.0** | **Proposed Title:** | Prototype Of Moisture Content Meter in Grain Using Esp32 in serial monitor | |

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* 1. **Introduction**

Grain moisture content is crucial for storage and quality control in agriculture. High moisture can cause spoilage, mold, and financial losses. Traditional moisture measurement methods are costly and time-consuming. This project introduces a **Moisture Content Meter** using an **ESP32** micro controller. The system reads data from a moisture sensor and displays real-time results on a **serial monitor**. The ESP32 processes and transmits the data efficiently. This prototype offers a **low-cost, portable, and user-friendly** solution for farmers and grain storage managers. It helps in **preventing spoilage** and maintaining grain quality. Future upgrades may include wireless monitoring and cloud integration. This innovation improves efficiency in grain moisture monitoring.

* 1. **General Introduction**

Moisture content measurement is essential in various industries, especially in agriculture, food processing, and storage management. The moisture level in grains plays a vital role in determining their quality, shelf life, and market value. Excess moisture can lead to microbial growth, spoilage, and economic losses, while low moisture can cause brittleness and weight reduction.

Traditional methods for measuring moisture content, such as oven drying and electronic moisture meters, are often expensive, time-consuming, and require skilled operation. With advancements in technology, micro controller-based solutions have become a cost-effective and efficient alternative. The **ESP32-based Moisture Content Meter** provides a **real-time, low-cost, and user-friendly** solution for monitoring moisture levels in grains. By utilizing a **moisture sensor and serial monitoring**, this system allows users to make informed decisions regarding grain storage and processing.

This technology has applications in farming, warehouses, and food industries, ensuring better storage management and reducing post-harvest losses. Future improvements may include **wireless connectivity, IoT integration, and cloud-based monitoring** for enhanced automation and remote access.

* 1. **Problem Statement**

Despite rice being a major agricultural product in Indonesia, farmers still rely on manual drying techniques that are inaccurate and dependent on weather conditions. The lack of standardization in measuring moisture content can lead to either over-drying or under-drying of the rice, affecting its quality and market value. Traditional methods are also not equipped to provide real-time or accurate moisture content data. Therefore, an automated solution is necessary to ensure accurate moisture measurement and improve the efficiency of grain drying processes, thus helping farmers and the industry manage rice quality better.

* 1. **Objectives of the study**

The objectives of this study are to develop an accurate moisture content meter for grain using ESP32 and a capacitive sensor, improving the quality of rice through real-time moisture monitoring. It aims to provide farmers with an efficient tool for tracking moisture levels, accessible via serial monitors or spreadsheets. The study also seeks to integrate IoT for data transmission, enhancing agricultural efficiency and reducing human error. Additionally, it evaluates the reliability of the system in real-world conditions. Ultimately, the goal is to improve post-harvest grain quality and yield management.

* 1. **Scope of the Project**

The scope of this project includes designing and developing a moisture content meter for grains using ESP32, a capacitive soil moisture sensor, and an LCD display. The system will monitor the moisture levels of grains, allowing farmers to ensure proper drying and improve grain quality. The project also integrates IoT technology, enabling real-time data transmission to a serial monitor for easy access and monitoring. Additionally, it aims to create a prototype that is cost-effective and suitable for use in agricultural fields to help farmers make informed decisions about grain storage and processing. The focus is on enhancing efficiency, accuracy, and usability.

* 1. **Literature Review**

**Introduction**

The literature on grain moisture content measurement highlights the importance of accurate monitoring in improving agricultural practices, particularly post-harvest handling. Traditional methods of measuring moisture, such as visual inspection, are often unreliable and prone to human error. Recent studies have shown that capacitive soil moisture sensors can provide accurate readings, detecting the dielectric properties of materials. Microcontroller platforms like Arduino and ESP32 are increasingly used to automate data processing and enhance measurement accuracy. Furthermore, the integration of IoT technology enables remote monitoring through cloud-based systems, offering real-time data access. These innovations improve decision-making for grain drying and storage, reducing post-harvest losses and enhancing grain quality. These technological advancements promise to revolutionize agricultural efficiency and sustainability.

**Existing Technologies and Methods**

Existing technologies for measuring grain moisture include traditional and modern methods. The **oven drying method** is highly accurate but time-consuming and labor-intensive. **Handheld moisture meters**, using electrical resistance or capacitance, offer portability but can lack precision. **Capacitive sensors** are increasingly popular for their accuracy and real-time data collection. **Near infrared (NIR) spectroscopy** is accurate but expensive, mostly used in labs or large-scale industries. **Microwave and RF techniques** also offer accuracy but are complex and costly. **IoT-based systems**, like those using ESP32 or Arduino, enable remote monitoring of moisture levels, enhancing decision-making for farmers. These advancements make moisture monitoring more efficient but could still benefit from affordability and accessibility improvements.

**Prior Research and Theoretical Background**

Prior research on moisture content measurement in grains has focused on improving accuracy and efficiency. Methods such as **capacitive** and **resistive sensors** are commonly used for real-time, non-destructive measurements, with capacitive sensors being preferred for their reliability. Microcontroller platforms like **Arduino** and **ESP32** have been implemented to automate the moisture detection process, allowing for easier integration with **IoT** systems for remote monitoring. Studies show that **capacitive sensing** utilizes changes in dielectric constant due to water content, offering a precise measurement. The use of **cloud storage** and **data analysis tools** like Google Sheets has gained attention in agricultural applications. This combination of real-time monitoring and automated data transfer improves efficiency and accuracy in the grain drying process.

**Research Gaps and Project Relevance**

Research gaps in grain moisture measurement include limited affordability and lack of real-time, cloud-based data integration. Traditional methods are inefficient and inconsistent. This project addresses these issues by using ESP32 technology for accurate, affordable moisture measurement, integrated with Google Sheets. It offers real-time feedback, enhancing grain quality management. The solution is cost-effective and user-friendly for farmers.

**Theoretical Implications and Practical Applications**

This project contributes to advancing IoT solutions for agriculture, enabling real-time, cloud-based moisture measurement. It improves grain management efficiency, reducing human error in post-harvest processes. The system provides actionable data to enhance grain quality. Practical applications include better decision-making for farmers and scalability for various agricultural settings. It offers an affordable, accurate solution for moisture monitoring.

**Summary of Literature and Path Forward**

The literature highlights the shift to IoT solutions for grain moisture measurement, with existing methods facing accuracy and cost challenges. Previous research emphasizes the importance of moisture control for grain quality. This project aims to improve the ESP32-based moisture meter for better precision and real-time data integration. Future development will focus on refining sensor accuracy and cloud-based data access. The goal is to create scalable, affordable tools for farmers to improve grain quality and agricultural efficiency.

1. **Abstract:**

This project develops a radar system using the ESP32 microcontroller and OpenCV for real-time object detection and distance measurement. The goal is to create a low-cost solution for applications in automotive safety and industrial automation. By combining radar technology with computer vision, the system enhances object detection capabilities. The integration leverages the ESP32's processing power and OpenCV's advanced algorithms for efficiency. Expected outcomes include a functional prototype for various practical applications.

1. **Methodology**

**7.0 Methodology**  
The methodology for this project follows a structured approach, divided into three key phases: Design, Implementation, and Testing.

**Design Phase**  
In this phase, system requirements are defined, and hardware components such as the ESP32 microcontroller, radar sensor, and camera module are selected. The architecture integrates these components with OpenCV for image processing.

**Implementation Phase**  
Hardware assembly includes connecting the radar sensor and camera to the ESP32. Software development involves programming the ESP32 for radar signal processing, camera integration, and OpenCV for object detection and distance measurement.

**Testing Phase**  
The system undergoes unit, integration, and performance testing to ensure proper functionality. Calibration and validation are performed, and user feedback is incorporated for iterative improvements.

**User Feedback and Iteration**:  
In this phase, feedback is gathered from potential users to assess the system’s usability and effectiveness. Any issues identified by users, such as difficulty in operation, inaccurate detection, or limitations in the system's responsiveness, are documented. Based on this feedback, the system undergoes iterative improvements, including refining the object detection algorithms, enhancing user interfaces, and optimizing performance. Regular iterations ensure that the system becomes more user-friendly and reliable for real-world applications. The goal is to improve the overall experience, making the system practical and adaptable to varying user needs.

1. **Expected Output**

The expected output of the radar system with object detection is the real-time identification and distance measurement of objects in front of the sensor. This will be achieved using the ESP32 microcontroller for processing and OpenCV for analyzing the video feed from the camera module. The system aims to provide accurate and timely distance data, enabling precise object detection. These outputs are essential for applications such as automotive safety, industrial automation, and security systems, improving situational awareness and operational efficiency. The system is expected to be reliable, with performance evaluated under various conditions.

1. **Other Relevant Information**

In addition to the core functionality of object detection and distance measurement, the radar system integrates several key features to enhance its usability and application potential. The ESP32 microcontroller enables wireless connectivity, allowing the system to be easily integrated into IoT networks or remote monitoring systems. The OpenCV library offers flexibility for future upgrades, allowing the integration of advanced machine learning or AI techniques for better detection accuracy and decision-making capabilities. Future work will explore optimizing algorithms to work under varying environmental conditions, such as different lighting or weather scenarios, and refining sensor calibration for increased precision.

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**CANDIDATES**

Name: S.MD.Awaiz, Reg. No. 2310040038

Signature: ……………………… Date: …………

Name: D.Rahul, Reg. No.2310040040

Signature: ……………………… Date: …………

Name: K.Harshavardhan reddy, Reg. No. 2310040042

Signature: ……………………… Date: …………

Name: Dharma teja, Reg. No. 2310040134

Signature: ……………………… Date: …………

**SUPERVISOR**

1. Comments by Supervisor:

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Date: ……............ Name: ……....……….…………..

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