**American International University-Bangladesh (AIUB)**

**Faculty of Engineering**

**Department of CSE, EEE, and CoE**

**EEE4103 MICROPROCESSOR AND EMBEDDED SYSTEM**

**COURSE CAPSTONE PROJECT PROPOSAL FORM**

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| **SEMESTER: FALL 2024-25** |
| **PROJECT TITLE:** SmartFireBot- An IoT Driven Fire Detection and Extinguishing System |
| **SURVEY: Outcomes of the survey.**  **C:\Users\Pritom\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\3CA95318.tmp**  **C:\Users\Pritom\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\3AFDE0E6.tmp**  **C:\Users\Pritom\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\AD585E4.tmp**  **C:\Users\Pritom\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\A90CB992.tmp**  **C:\Users\Pritom\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\E2205F70.tmp**  **C:\Users\Pritom\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\DA44A6FE.tmp**  **C:\Users\Pritom\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\363A952A.tmp**  C:\Users\Pritom\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\4190F6C8.tmp  C:\Users\Pritom\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\553C3016.tmp  C:\Users\Pritom\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\64ED0C94.tmp  **Survey question link:** [SmartFireBot- An IoT Driven Fire Detection and Extinguishing System](https://forms.gle/4mZcrbqALivx1jNB6) |
| **AIMS AND OBJECTIVES OF THE PROJECT:**  **Aims:**   * **Develop a SmartFireBot:** To capable of detecting and extinguishing fires autonomously in residential, commercial, and industrial settings. * **Integrate IoT technologies:** For remote monitoring and control of the fire detection and extinguishing system to enhance real-time response capabilities. * **To optimize the efficiency and safety:** To optimize the efficiency and safety of fire detection and suppression by implementing innovative algorithms and sensors.   **Objectives:**   * **Design:** An autonomous fire detection and extinguishing robot by integrating IoT sensors (smoke, temperature, and flame sensors) and actuators, enabling real-time monitoring, fire source localization, and activation of appropriate extinguishing methods such as water, foam, or CO₂. * **Simulate:** Various fire scenarios using advanced software tools to validate the system's performance, including obstacle navigation, sensor accuracy, and extinguishing effectiveness, ensuring robustness before physical implementation. * **Implement and Test:** The SmartFireBot in a controlled environment by conducting mock fire drills, assessing its response time, mobility, and fire suppression capabilities, while also ensuring reliable communication with cloud-based or remote monitoring platforms. * **Analyze:** Data collected from IoT sensors to refine the fire detection algorithms using machine learning, improving the system’s ability to distinguish between real fire hazards and false alarms, thereby enhancing detection precision and efficiency. * **Evaluate:** The system’s reliability, accuracy, and response time under different environmental conditions, including varying temperatures, smoke levels, and fire intensities, to ensure consistent performance and scalability for diverse applications such as residential, commercial, and industrial spaces. |
| **LITERATURE REVIEW:**   * Research on fire detection and extinguishing systems has been ongoing, with several strategies investigated to improve efficiency and safety. In order to enhance conventional firefighting techniques, Burchan et al. (2019) suggested a system that combines drones, remote sensing technology, and fire-extinguishing balls. Firefighting unmanned aircraft systems (UAS) are used in this system to respond to fires, communication UAS to create channels between devices, and scouting UAS to identify spot fires. However, it is difficult for real-world applications due to the intricacy of managing several drones and the system's general unreliability [1]. * Qin et al. (2018) designed an intelligent smoke alarm system using a wireless sensor network with ZigBee. The system integrates a smoke detection module, a wireless communication module, and data visualization capabilities. While effective in detecting smoke, the system's high cost and complexity limit its widespread adoption [2]. * Izang et al. (2018) developed an SMS-based fire alarm and detection system. The system uses sensors to detect fire or gas, triggers an Arduino to send an SMS via a GSM module, and activates an alarm and a servo motor. Despite its innovative use of GSM technology, the servo motor’s limited 170-degree range reduces its effectiveness compared to pump motors in extinguishing fires [3]. * Similarly, Jinan (2018) implemented a factory security system comprising a smoke sensor, a GSM module, and a sound alarm. When gas leakage is detected, the system sends an SMS alert. However, the absence of a mechanism to stop gas leakage or extinguish fires limits its utility, risking property loss in fire outbreaks [4]. * Poonam et al. (2014) designed an intelligent fire extinguisher system with features such as fire detection, suppression, fire origin location, power control, SMS/email reporting, and efficient water use. However, the use of a gas sensor prone to false alarms impacts its reliability [5]   These studies highlight advancements in fire detection but reveal issues like complexity, cost, and reliability. The SmartFireBot addresses these with a simpler, cost-effective, and automated solution. |
| **EXPERIMENTAL BLOCK DIAGRAM:**    Fig.1 Block diagram of the system design |
| **POSSIBLE OUTCOMES OF THE PROJECT:**  **1. Early Fire Detection and Prevention**   * **Multi-sensor Integration**: By combining flame, smoke , and temperature (DHT11) sensors, the system can cross-verify potential fire hazards, reducing false alarms. * **Threshold-based Alerts**: When sensor readings exceed predefined safety thresholds (temperature or gas concentration), the system triggers warnings or activates extinguishing mechanisms.   **Benefits**:   * Reduces response time, which is critical in fire emergencies. * Protects sensitive environments (labs, data centers) where early intervention is crucial.   **2. Automated Fire Suppression**   * **Water Pump and Sprinkler Control**: Using a relay module, the bot can activate water pumps to spray water directly on the fire. * **Gas-based Suppression**: A solenoid valve can control the release of fire-suppressant gases (like CO2) for sensitive areas where water is not suitable. * **Targeted Suppression**: Servo motors can direct nozzles toward the fire's source, minimizing collateral damage.   **Benefits**:   * Automated suppression reduces reliance on human intervention. * Reduces water damage in scenarios where precision extinguishing is used.   **3. Remote Monitoring and Alerts via IoT**   * **Cloud Connectivity**: Using an ESP32 Wi-Fi module, the system connects to IoT platforms like Blynk or ThingSpeak for remote monitoring. * **Real-time Notifications**: Users receive SMS, email, or app notifications when a fire is detected, even when they are away from the premises. * **Dashboard Display**: A user-friendly interface can show live data such as temperature, smoke levels, and the status of extinguishing mechanisms.   **Benefits**:   * Enables immediate action by notifying owners or emergency services. * Enhances user awareness and control over fire safety systems from anywhere.   **4. Autonomous Navigation for Fire Suppression (Robotic Feature)**   * **Obstacle Avoidance**: Ultrasonic sensors enable the bot to navigate around obstacles while moving toward the fire. * **Path Planning**: The system can follow a pre-programmed path or use AI algorithms for dynamic routing in real-time. * **Precision Targeting**: Servo-controlled nozzles allow the bot to adjust its position and angle for effective fire suppression.   **Benefits**:   * Ideal for large spaces or areas difficult for humans to access safely. * Reduces risks to firefighters in hazardous environments.   **5. Data Logging and Analysis**   * **Sensor Data Storage**: Logs temperature, gas levels, and incident timestamps to a cloud database. * **Fire Risk Assessment**: Analyzing historical data helps identify patterns and areas prone to fire hazards. * **Predictive Maintenance**: Alerts for sensor recalibration or component maintenance based on usage data.   **Benefits**:   * Supports informed decision-making for fire prevention strategies. * Helps improve system reliability and performance over time.   **6. Cost-Effective Solution**   * **Affordable Components**: The use of open-source hardware like Arduino and low-cost sensors makes the system budget-friendly. * **DIY Installation**: Users can build and install the system themselves, reducing installation costs.   **Benefits**:   * Makes fire safety accessible to low-income households or small businesses. * Reduces long-term maintenance costs compared to commercial systems. |
| **PROJECT TIMELINE (GANTT CHART)**    Fig.2 Gantt Chart |
| **REFERENCES:**  [1] Aydin, B., Selvi, E., Tao, J. and Starek, M. J. (2019) Use of Fire-Extinguishing Balls for a Conceptual System of Drone-Assisted Wildfire Fighting, (PP.1 - 15)  [2] Qin, W. Jiashuo, C. and Chuang, Z. (2018) Intelligent Smoke Alarm System with Wireless SensorNetwork Using ZigBee, (  [3] Shehab, J. N. (2018) Design and Implementation of Factory Security System.  [4] Sonsale, p., Gawas, R., Pise, S. and Kaldate, A. (2014). Intelligent Fire Extinguisher System. (pp. 59 - 61)  [5] Izang, A. A., Ajayi, S.W. Onyenwenu, C. B. and Adeniyi. F.(2018) An SMS Based Fire Alarm and Detection System, |

**Instructions:**

1. There is no definite format to write the proposal, but students must follow the mentioned instructions properly.
2. Fill in the form accurately with all necessary information.
3. Make a color print of this form.
4. Figures, tables, charts, circuit diagrams, block diagrams, and wave shapes must be color printed.
5. Survey form link must be provided in the proposal form with the answers.

**FOR FACULTY USE ONLY**

**COMMENTS BY COURSE TEACHER:**

**COURSE TEACHER’S NAME COURSE TEACHER’S SIGNATURE DATE**

**GROUP MEMBERS**

(Maximum 6 students are permitted to carry out a single Project. However, depending on the capability of the students, 4 students may be allowed but not less than that)

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| --- | --- |
| **NAME**: Safkat Khan  **ID #: 22-46392-1**  **PROGRAM:** CSE  **EMAIL: safkatkhan420@gmail.com** | **NAME**: Pritom Das  **ID #: 22-48171-2**  **PROGRAM:** CSE  **EMAIL: pritomdas144@gmail.com** |
| **NAME**: Md. Naimur Rahman Masum  **ID #: 22-46393-1**  **PROGRAM:** CSE  **EMAIL:** | **NAME**:Abu Nayem Md Arman  **ID #: 22-47249-1**  **PROGRAM:** CSE  **EMAIL:** |
| **NAME**:Md. Tanvir Rahman Molla  **ID #: 22-46052-1**  **PROGRAM:** CSE  **EMAIL:** | **NAME**: **S**akib-al Hasan  **ID #: 22-47189-1**  **PROGRAM:** CSE  **EMAIL:** |
| **REMARKS (for OFFICE use only)** | |

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| --- | --- | --- | --- | --- |
| **Course Name:** | | Microprocessor and Embedded System | **Course Code:** | EEE 4103 |
| **Semester:** | | Fall 2024-2025 | **Sec:** | R |
| **Faculty Member:** | | **Niloy Goswami** | | |
|  | |  |  |  |
| **Capstone Project Title:** | | SmartFireBot- An IoT Driven Fire Detection and Extinguishing System | | |
| **Project Group No.** | | 6 | | |
|  | |  |  |  |
| **Sl #** | **Student ID #** | **Student Name** | **Obtained Marks** | |
| **1.** | **22-46392-1** | **SAFKAT KHAN** |  | |
| **2.** | **22-48171-2** | **PRITOM DAS** |  | |
| **3.** | **22-47249-1** | **ABU NAYEM MD ARMAN** |  | |
| **4.** | **22-46052-1** | **MD. TANVIR RAHMAN MOLLA** |  | |
| **5.** | **22-46393-1** | **MD.NAIMUR RAHMAN MASUM** |  | |
| **6.** | **22-47189-1** | **SAKIB-AL HASAN** |  | |

**Assessment Materials and Marks Allocation:**

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| --- | --- | --- | --- |
| **COs** | **Assessment Materials** | **POIs** | **Marks** |
| CO3 | Course Capstone Proposal Form | P.c.2.C6 | 30 |

**Assessment Rubrics:**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| KPIs | Excellent  [2] | Proficient  [1.5] | Good  [1] | Acceptable  [0.5] | Unacceptable  [0] | No Response  [0] | Secured Marks |
| **Project Title** | The title reflects an issue related to complex engineering problems showing targets and methods with possible outcomes. | The title reflects an issue related to complex engineering problems showing targets and methods but some missing issues. | The title reflects an issue related to the course capstone project but there may be some missing issues. | The title reflects an issue related to the course capstone project but is not complete or specific. | The title does not reflect any issues related to the course capstone project. | No Response at all/ copied from others /identical submissions with gross errors/ image file printed |  |
| **Comments** |  | | | | | **Total Marks (2)** |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| KPIs | Excellent  [5] | Proficient  [4] | Good  [3] | Acceptable  [2] | Unacceptable  [1] | No Response  [0] | Secured Marks |
| **Survey** | The survey developed as a process for complex engineering problems considering cultural and societal factors has superior variables, targets, measures, and the implementation process is clear and challenging for future project implementation with several possible outcomes having good impacts. | The survey developed as a process for complex engineering problems considering cultural and societal factors has good variables, targets, measures, and the implementation process is clear and challenging for future project implementation with some possible outcomes with little impact. | The survey developed as a process for complex engineering problems considering cultural and societal factors has moderate variables, targets, measures, and the implementation process is clear and challenging for future project implementation with a few possible outcomes with impacts. | The survey developed as a process for complex engineering problems considering cultural and societal factors has good variables, targets, measures, and the implementation process is somewhat clear for future project implementation with very few possible outcomes with little impact. | The survey developed as a process for complex engineering problems considering cultural and societal factors has poor variables, targets, measures, and the implementation process is very unclear for future project implementation with a few possible outcomes but no impacts. | No Response at all/ copied from others /identical submissions with gross errors/ image file printed |  |
| **Comments** |  | | | | | **Total Marks (5)** |  |
| KPIs | Excellent  [3] | Proficient  [2.5] | Good  [2] | Acceptable  [1] | Unacceptable  [0.5] | No Response  [0] | Secured Marks |
| **Aims and Objectives** | Aims and objectives are written to solve complex engineering problems considering cultural and societal factors with specific targets, measurement, and implementation processes that are clear and challenging and have several possible outcomes having very good impacts. | Aims and objectives are written to solve complex engineering problems considering cultural and societal factors with general targets, measurement, and implementation processes that are not clear and challenging and have some possible outcomes having good impacts. | Aims and objectives are written to solve complex engineering problems considering a few cultural and societal factors with narrow targets; measurement, and implementation processes are clear and challenging and have a few possible outcomes having some impacts. | Aims and objectives are written to solve complex engineering problems considering cultural or societal factors with a very target; measurement and implementation processes are not clear or challenging and have little possible outcome having no impact. | Aims and objectives are written to solve complex engineering problems but do not consider cultural and societal factors with any targets; measurement, and implementation processes are not clear and challenging and no possible outcomes have no impacts. | No Response at all/ copied from others /identical submissions with gross errors/ image file printed |  |
| **Comments** |  | | | | | **Total Marks (3)** |  |

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| KPIs | Excellent  [5] | Proficient  [4] | Good  [3] | Acceptable  [2] | Unacceptable  [1] | No Response  [0] | Secured Marks |
| **Literature Review** | Specific formats are maintained to review and cite the literature with recent publications. Identified and analyzed the problem correctly. | Specific formats are maintained to review and cite the literature with recent publications. Identified and analyzed the problem correctly, but all issues were not addressed with relevant or intended work. | Specific formats are maintained to review and cite the literature with recent and past publications. Identified and analyzed the problem correctly, but all issues were not addressed with relevant or intended work. | Specific formats are maintained to review and cite the literature with recent and past publications. Identified but could not analyze all the problems correctly, and all issues were not addressed with relevant or intended work. | No specific formats are maintained to review and cite the literature with recent publications. Could not identify and analyze all the problems correctly, and all issues are not addressed with relevant or intended work at all. | No Response at all/ copied from others/ identical submissions with gross errors/ image file printed |  |
| **Comments** |  | | | | | **Total Marks (5)** |  |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| KPIs | Excellent  [4] | Proficient  [3] | Good  [2] | Acceptable  [1] | Unacceptable  [0.5] | No Response  [0] | Secured Marks |
| **Experimental Block Diagram** | The block diagram is drawn to show the connections of all the possible components or sub-systems to show their interdependence with all possible flows of signals from inputs to outputs. | The block diagram is drawn to show the connections of all of the possible components or sub-systems to show their interdependence with a few missing flows of signals from inputs to outputs. | The block diagram is drawn to show the connections of most of the possible components or sub-systems to show their interdependence with a few missing flows of signals from inputs to outputs. | The block diagram is drawn to show the connections of a few possible components or sub-systems to show their interdependence with some missing flow of signals from inputs to outputs. | The block diagram is not drawn to show the connections of all possible components or sub-systems to show their interdependence and flow of signals from inputs to outputs. | No Response at all/ copied from others /identical submissions with gross errors/ image file printed |  |
| **Comments** |  | | | | | **Total Marks (4)** |  |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| KPIs | Excellent  [4] | Proficient  [3] | Good  [2] | Acceptable  [1] | Unacceptable  [0.5] | No Response  [0] | Secured Marks |
| **Possible Outcomes** | Outcomes are written to achieve complex engineering problems’ solutions considering cultural and societal factors and showing measurement, and implementation processes to attain the outcomes with all possible impacts. | Outcomes are written to achieve complex engineering problems’ solutions considering cultural and societal factors and showing measurement, and implementation processes to attain the outcomes with some impacts. | Outcomes are written to achieve complex engineering problems’ solutions considering cultural and societal factors and do not show measurement, and implementation processes to attain the outcomes without showing any impacts. | Outcomes are written to achieve complex engineering problems’ solutions but do not consider cultural and societal factors and do not show measurement, and implementation processes to attain the outcomes without showing any impacts. | Outcomes are not written to achieve complex engineering problems’ solutions do not consider cultural and societal factors and do not show measurement, and implementation processes to attain the outcomes without showing any impacts. | No Response at all/ copied from others /identical submissions with gross errors/ image file printed |  |
| **Comments** |  | | | | | **Total Marks (4)** |  |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| KPIs | Excellent  [5] | Proficient  [4] | Good  [3] | Acceptable  [2] | Unacceptable  [1] | No Response  [0] | Secured Marks |
| **Gantt Chart** | Specific formats are maintained to draw the Gantt chart and there is the order of workflow with all work to be done. | Specific formats are maintained to draw the Gantt chart and there is the order of workflow with a few works missing. | Specific formats are maintained to draw the Gantt chart and there is the order of workflow with some works missing. | No specific formats are maintained to draw the Gantt chart and there is little order of workflow with some works missing. | No specific formats are maintained to draw the Gantt chart and there is no order of workflow with the most important works missing. | No Response at all/ copied from others/ identical submissions with gross errors/ image file printed |  |
| **Comments** |  | | | | | **Total Marks (5)** |  |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| KPIs | Excellent  [2] | Proficient  [1.5] | Good  [1] | Acceptable  [0.5] | Unacceptable  [0] | No Response  [0] | Secured Marks |
| **References** | Specific formats are maintained to write the references, and all are recently published journal and conference papers having no missing information. | Specific formats are maintained to write the references, and all are journal and conference papers, but some old papers have missing information. | No specific formats are maintained to write the references, and many are internet sources with several missing information and very old references. | No specific formats are maintained to write the references and most of them are internet sources with missing information. | No specific formats are maintained to write the references, and all are internet sources with missing information. | No Response at all/ copied from others /identical submissions with gross errors/ image file printed |  |
| **Comments** |  | | | | | **Total Marks (2)** |  |