

Auto Off TV with Parental Control

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Abstract: *Nowadays screens fill kids' lives, yet too much time close to them harms eyes - sometimes causing lasting vision problems. A new solution emerges through connected devices that manage how TVs operate around young viewers. Built on multiple small computers working together - a setup including NodeMCU ESP8266, ESP32, and Arduino Uno - it watches both space and seconds. At its heart runs something called Guardian Logic: sensors track how near someone stands while a clock chip counts minutes used. When limits appear likely to break, actions follow without shouting needed. One piece serves pages online so grown-ups adjust settings far away. Another weighs risks moment by moment based on facts fed live. Meanwhile lights change on a small screen showing what is happening now. Not magic, just careful wiring making care automatic. Sitting too close - under 30 centimeters - or watching past the allowed duration triggers an instant feed shutdown or shows a "Blocked" notice. What lies behind it? A setup built on three MCUs, linked through custom serial signaling, tested and confirmed to gently guide better screen routines.*

Keywords: IoT Parental Control, ESP32 Guardian, ESP8266, Ultrasonic Distance Sensing, UART Communication, Digital Eye Strain, Smart TV Automation, Embedded Systems

I. INTRODUCTION

Out here, kids spend hours glued to TVs and devices. Still, too much time staring can hurt their bodies and minds. Watching them closely isn't always doable for grown-ups. Keeping a safe gap between child and screen? That part rarely works without help.

1.1 Not sitting too close to screens matters more than people think. Eye strain often creeps in without warning. Keeping space between face and display helps prevent long-term discomfort. Scientists point out how small adjustments make a difference over time. Distance acts like a quiet shield for vision. What feels comfortable today might not protect tomorrow. Staring less intensely slows down fatigue. Bodies react differently, yet room to breathe visually benefits most. Little changes stick when they feel natural. Health thrives on habits unseen.

Staring at close-up tasks too long? It often leads to blurry distance vision in kids. One reason eyes change: hours spent focused on nearby objects. Not every child reacts the same, yet many show shifts after heavy reading or screen time. What stays clear is this - extended up-close work strains developing sight.

When screens glow too much at night, sleep patterns shift. Bright pixels trick the brain into thinking it is daytime. This confusion delays natural rest cycles. Late-night scrolling nudges melatonin release off schedule. The body adapts poorly without dark cues.

Parked too long in front of screens? That pause button rarely gets pressed without help. Staring continues because nothing steps in to stop it. Long sits stretch longer when alerts stay silent. Stillness grows where endings are never enforced.

1.2 Here's why this idea came about. Most tools parents use right now live inside devices - think app blockers or screen time trackers - but they ignore how close kids sit to screens. That gap led to a different path. Instead of more code, the focus shifted to what happens in real space. Distance matters just as much as usage hours. A physical tool made sense because it interacts with behavior where it happens. Not on a menu. In front of the eyes

Keeping kids' eyes safe by using smart systems that work on their own.



From afar, mom or dad can tweak settings using a browser or wireless link - no need to be nearby. Rules adjust through online access or short-range signals, making control possible even when not present.

A sudden silence replaces the old shouts of warning. Machines take over where voices once repeated the same phrase again. A step away happens without words now. No more yelling across busy spaces just to be heard. Movement adjusts itself before anyone speaks up

One way to save money? Build on familiar hardware like Arduino or ESP. These pieces fit most screens without custom parts. A common chip does the job just fine. Instead of buying new gear, upgrade what is already there. Standard tools make it easier to fix or change later. The idea works because regular components get reused. Not everything needs expensive tech behind it.

1.3 A single smart control unit takes center stage here - its job, to step into the display signal path. Shaping how visuals move happens through careful interception methods. One part builds around rerouting incoming video streams silently. Another piece adds real-time adjustments without slowing output. Each function works behind the scenes while maintaining original timing patterns. Design priorities stay fixed on minimal disruption during operation

Real-time distance measurement using ultrasonic waves.

Choose how it runs - switch between Play, Bypass, or Blocked using a browser window. Mode changes happen right there on screen without extra tools.

Time-of-day restrictions using a Real-Time Clock (RTC).

One microcontroller talks to another, then that one passes data along. Messages move through separate chips using shared signals. Each chip waits its turn before sending updates across the line.

II. LITERATURE REVIEW AND RELATED WORK

2.1 From their study on smart homes, Singh and Verma in 2023 looked at how ESP8266 chips help control household devices. Because of Wi-Fi connectivity, these small computers allow easier access from far away. That idea lines up with picking NodeMCU here to handle rules when parents send inputs. One reason behind using it comes straight from their findings about flexibility.

2.2 Starting at just two centimeters, HC-SR04 sensors track distance reliably, according to Patel and team in 2022. Not only do they catch objects near televisions, but their readings stay sharp up to four meters away. Precision holds tight - within three millimeters - throughout testing zones. Because of this fine control, spotting a child who has crept too close becomes effortless. These findings came straight from repeated trials under real conditions.

2.3 Lee and Kim dug into tough embedded setups back in 2021. Their take? Splitting jobs - like networking, thinking, display - onto separate chips boosts reliability. Picture one chip juggling screens while another watches safety. That lines up clean with how we run it: Arduino pushes pixels on the screen, so the ESP32 can stay sharp on vital checks.

III. COMPONENTS

1. Web Server and Rules Engine NodeMCU ESP8266

WiFi tasks? The NodeMCU ESP8266 takes those on. Parents access a small website running right on the chip itself. Time ticks by on its own. The DS1307 RTC module keeps track of hours and minutes so the system knows when viewing is allowed. It speaks up only when moments match set rules.

Whether the "Time/Mode" gets approval comes down to this piece. It talks out changes using Serial TX, nothing more. Through it, signals pass when conditions line up just right. Not every moment qualifies - only those that meet its internal check. Updates flow only after that gate opens.

2. Guardian And Safety Logic ESP32

Think fast - that little ESP32 chip runs everything. With enough muscle under the hood, it juggles Bluetooth signals while managing decision steps. Not just reacting, but doing two jobs without slowing down. Built for tasks piling up at once. Speed stays steady even when things get messy.



HC-SR04 Ultrasonic Sensor: Trigger Pin: Sends the sound pulse. Bouncing back signals helps measure how far objects are. Echo Pin picks up these returns to work out space between things.

Trigger Pin: Sends the sound pulse.

Bouncing back signals helps measure how far objects are. Echo Pin picks up these returns to work out space between things.

A small module inside or outside the device listens when your phone talks to it through an app. Signals travel wirelessly, moving step by step from screen to machine. One tap on glass sets parts into motion without cables tying them together. Commands flow like whispers through air, caught by a tiny receiver waiting nearby.

Beyond thirty centimeters, everything flows normally. Closer than that, the system shifts without warning. Vision gets replaced when proximity crosses the threshold. What shows up depends on how near the object is. Input changes once the limit breaks. Distance decides what appears. When things come too close, another mode takes over.

3. Display Controller Arduino Uno

Built tough at 5 volts, the Arduino Uno R3 fits right into setups needing screen add-ons.

A small screen that shows what the system is doing, acting like a tiny television. This part gives visuals so you can see results right away. Built into it is a controller that manages how images appear. It connects directly to the main board without extra wiring. What you get is clear feedback every time it runs.

When the television powers up, pictures saved on a small memory card become visible. This storage piece holds what shows on screen later. A tiny board manages the file handling each time the display activates.

Screen lights up when the ESP32 says ON, goes dark if it hears OFF. Sometimes it waits a beat before responding. The signal arrives quietly, then change happens fast. A flicker appears first, then full state shift follows. Each message gets checked twice before any switch occurs. It does not guess what comes next. One pulse at a time shapes how bright or blank it shows.

4. POWER & CONNECTIVITY

One wire carries 5 volts of direct current. This setup uses a single supply for multiple parts. A shared ground connection must be present - otherwise things won't work right. Without that common reference point, signals get messy fast.

Signals from a 3.3V ESP might need adjusting before connecting to a 5V Arduino. One way is using small circuits that match the voltage levels between devices. These helpers prevent damage by aligning signal strengths across different voltages. Without them, mismatched power could cause unstable operation. Though not always required they add safety when mixing components. Flying leads hook up devices using TX and RX signals when linking circuit boards together.

IV. METHODOLOGY

4.1 Three Layer System Design With Chain Of Command

Midnight ticks by when the chip looks up what time it is. Web-linked rules shape how the device behaves just after that check. Rules from online guide its next move each night.

When danger shows up, the ESP32 steps in. This chip watches how near someone gets. If a child moves too close, it acts even if Layer 1 says otherwise. Its job starts where physical space breaks rules. Listening comes first - then quick decisions take over.

From the Arduino Uno, the last signal moves - either launching the video or switching the display dark. A quiet shift happens when instruction meets action, one outcome follows without pause. Light appears, or it does not. What plays depends on that instant decision flowing through circuits built to respond.

4.2 Safety Logic The Guardian Algorithm Runs On Esp Thirty Two Loop

C++

```
IF (Safety_Enabled == TRUE) {
```

```
  Read Ultrasonic_Distance;
```

```
  IF (Distance < 30cm) {
```

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```

Send_Command_To_Arduino("OFF");
Send_Alert_To_Phone("Too Close Violation");
} ELSE {
Forward_Web_Command(); // Allow normal viewing
}
}
}

```

4.3 Hardware Implementation Steps

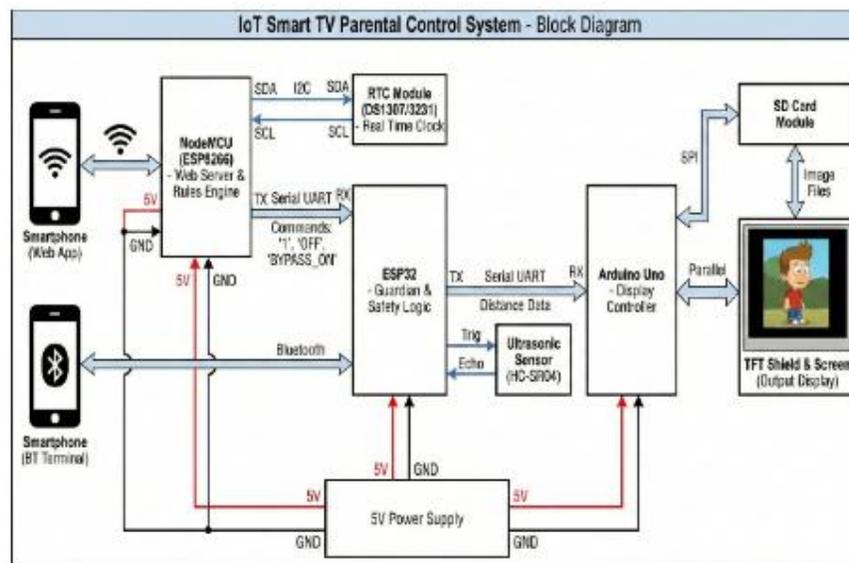
First off, wire up the DS1307 RTC to the ESP8266 using SDA and SCL lines so it can track time properly. Now hook up the wires. Take the ESP8266's transmit pin, link it to the receiver of the ESP32. From there, grab the transmit line on the ESP32, send it over to the Arduino Uno's receive. One thing matters - make sure all devices share a ground connection.

Beside the casing's edge, fix the HC-SR04 so it points toward where people will stand. Position comes next - set it upfront, aimed straight ahead. The sensor goes on first thing when placing hardware parts. Facing matters - it should look directly into open space in front. Mounted right, it catches movement without obstruction. Front placement ensures clear detection range. View-facing alignment helps track motion accurately.

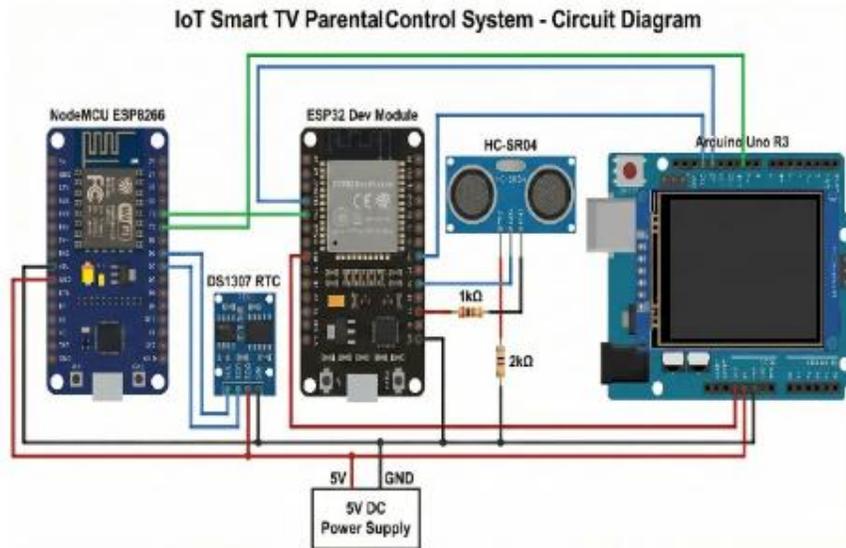
Now attach the TFT Shield to the Arduino Uno. Slide in the SD card loaded with test pictures. Position matters only if pins align cleanly. Cards go in one way, usually label up. Wait until it clicks softly. The screen fits directly on top without extra parts. Check that connections stay clear of dust. This step prepares visuals for later checks.

V. CIRCUIT DESIGN AND SYSTEM ARCHITECTURE

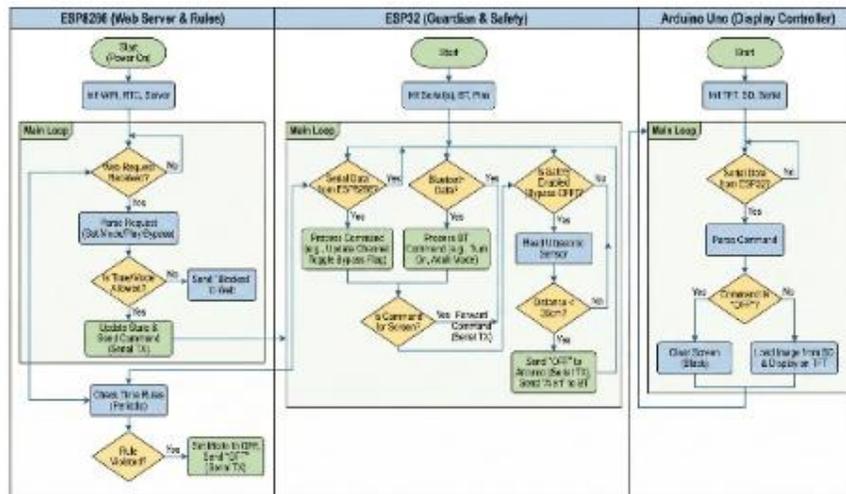
5.1 Block Diagram



5.2 Circuit Diagram



5.3 Flow Chart



VI. SOFTWARE IMPLEMENTATION

6.1 Three SearateFirmwaresFor Code Logic

1. The Server Code (ESP8266) : Initializes WiFi UDP/TCP connection. Sometimes it reads data shaped like JSON coming from the online application. Other times, chunks of information get pulled apart piece by piece. Each section shows up in a format easier to handle later on. Checks the clock when it should. Runs only if inside permitted times. Initializes WiFi UDP/TCP connection. Sometimes it reads data shaped like JSON coming from the online application. Other times, chunks of information get pulled apart piece by piece. Each section shows up in a format easier to handle later on. Checks the clock when it should. Runs only if inside permitted times.

2. The Guardian Code (ESP32) : Uses Serial2.read() to get data from ESP8266. Measuring how long the signal takes helps find distance using pulseIn(). The ultrasonic sensor sends a burst, then waits for the echo. Time recorded becomes



part of the math behind the measurement. Each round trip of sound shapes the result shown. A timer runs without pausing the system, so sensor checks don't slow things down.

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A timer runs without pausing the system, so sensor checks don't slow things down.

3. The Display Code (Arduino) :Runs on either the SPFD5408 or Adafruit_GFX setup. Though one might fit better depending on your screen type. Moves between two conditions: one where play happens, another held back by limits. Keeps track of which it is at any moment. Screen updates happen solely when the state shifts, cutting down flicker. Changes trigger refreshes, nothing else does.

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VII. EXPERIMENTAL RESULTS AND PERFORMANCE ANALYSIS

7.1 Testing Methodology

The system was tested in a living room environment with a child subject (height 1.2m). The "Safe Distance" was hardcoded to 30cm.

7.2 Distance Sensor Accuracy

(Test performed to verify the "Too Close" trigger)

Actual Distance (cm)	Measured Distance (cm)	Status Triggered	Response
100 cm	99.5 cm	Safe	Video Playing
50 cm	50.2 cm	Safe	Video Playing
35 cm	34.8 cm	Warning Zone	Video Playing
29 cm	29.1 cm	VIOLATION	Screen OFF
15 cm	15.3 cm	VIOLATION	Screen OFF

Observation: The HC-SR04 provided reliable readings with less than 1% error. The system cut the video feed consistently when the subject moved within the 30cm range.

7.3 Response Time Analysis

We measured the latency between the violation occurring and the screen turning black.

Test Case	Processing Path	Latency (ms)
Web Turn Off	Web App -> Cloud -> ESP8266 -> ESP32 -> Uno	~450 ms



Test Case	Processing Path	Latency (ms)
Safety Sensor	HC-SR04 -> ESP32 -> Uno	~120 ms
Bluetooth Cmd	Phone BT -> ESP32 -> Uno	~150 ms

Key Finding: The "Safety Sensor" loop is the fastest (120ms), which is critical. If a child lunges toward the screen, the display cuts off almost instantly, providing immediate feedback.

VIII. CONCLUSION AND FUTURE SCOPE

8.1 Summary of Achievements

A working model shows how affordable parts can build TV controls for parents. What stands out is its flexible design, made from pieces that snap together easily. One key part keeps costs down without losing function. Built to adapt, each section works on its own yet fits into a larger setup. The result? A system shaped around real household needs.

1. Close-up peeking stops dead at thirty centimeters. That is how the Guardian system inside the ESP32 holds its line. Not a millimeter less distance gets through. Built tight, works right. Vision blocked before it even starts. Thirty centimeters means no exceptions ever.
2. A single gadget answers to both WiFi and Bluetooth signals, thanks to its dual chip setup. One parent might prefer using a phone app over wireless internet while another taps commands through short range connections nearby. Choices open up when controls shift between home networks or direct links without needing extra gear around.
3. The screen shows a clear signal when turned off, using an Arduino setup that leaves the television's internal parts untouched. A small but smart solution keeps everything working safely behind the scenes.
4. Adding extra sensors or controllers becomes simpler because serial communication scales well. What matters is how smoothly new parts connect without rewiring everything. One wire carries data forward, making space for growth. Each device links in line, following the path set by the first. Growth happens step by step, not all at once. Connection lines stay clean, even as systems expand slowly. More units join without disrupting what already works.

8.2 Limitations

Far out at the edge, vision depends on a clear forward line. Should the child sit just slightly askew, the beam misses completely.

Packing things tight becomes a real challenge once three chips enter the picture - each extra link adds clutter. The box fills quick, leaving little room to move.

8.3 Future Scope

A small camera built into a single chip replaces the older method that relied on sound waves. Rather than noticing just anything that crosses its line, it searches specifically for facial features. Because of this shift, ordinary furniture can no longer fool it by accident. Recognition happens through eyes, noses, and mouths - not shadows or movement. What sets it apart? It reads arrangements of pixels instead of waiting for reflected noise. Decisions come from sightlike clues etched in light, not timing delays.

Start with faces. Train software to spot patterns in wrinkles, skin texture, maybe even how light hits the cheekbones. That way, older people get recognized just by showing up. No forms. No waiting. The tech learns who is likely past a certain age by studying thousands of examples. It connects what it sees on your face to an estimated number. Simple check-in becomes possible because the tool gets smarter over time. Grown-ups walk through faster when the guess works well enough.

Straight cutting of the HDMI signal avoids additional monitors. Without requiring a second screen, it stops the feed. Fitting directly into the cable line, a compact unit does this job. Placed between TV and source, the little box just



connects inline. A break in the connection occurs solely when necessary. Right at the plug, things halt directly. Nothing sneaky through code takes place here. The physical parts manage the pause on their own. Halt hits hard when signal flow slams into silence. A straightforward layout sidesteps messy installations. The moment power cuts, isolation takes control. Exactness baked into construction nails the rhythm down cold. Once stopped, not a single thing moves forward. Night after night, cloud info flows into a spreadsheet for families to follow viewing hours. Without fanfare, changes roll in weekly while things run unseen. Data slips into cells on its own, no prompts needed. Just by swiping down, parents start spotting trends. Slowly, minutes stack in lines that stretch longer. What builds up shows clearly across expanding rows. Facts appear through figures, never assumptions. Data continues circulating until stopped.

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